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9/23/13

Lab 2 – Dual Stack Routing

Purpose

The purpose of this lab was to familiarize ourselves with running IPv4 and IPv6 simultaneously using OSPF, OSPF v3, RIP, and RIPng as routing protocols. Throughout this lab I was required to set up 8 different networks. In order to successfully ping between them, I had to learn how to redistribute different routing protocols in each IPv4 and IPv6.

Background Information on Lab Concepts

OSPF, or Open Short Path First, is a link-state routing protocol that makes use of a unique domain (single autonomous system, or AS) by gathering information from every router and creating a topology. It uses path cost as its metric. OSPF v3 is a simply variation of OSPF that allows routing between IPv6 addresses.

RIP, or Routing Information Protocol, is a distance-vector routing protocol that allows information to be transferred across the network without routing loops. It also uses hop count as its metric, and the maximum number of hops that a packet may travel is 15. Like OSPF v3, RIPng is a variation of RIP that allows routing between IPv6 addresses.

To run all 4 routing protocols simultaneously, I used an IPv6 implementation called Dual Stack. Dual Stack is a concurrent run of IPv4 and IPv6 addresses with their respective routing protocols; it does not need the encapsulation of IPv6 to IPv4, which is also known as tunneling. Dual Stack, although sometimes difficult to implement, is more efficient than tunneling since IPv4 and IPv6 can run together without interference.

Lab Summary

In this lab, I used a Catalyst 6500 Switch in the middle with 6 different Routers. I configured the top 2 routers with RIP and RIPng and the bottom 4 Routers and Switch with OSPF and OSPF v3. The Switch in the middle acted as a branch for redistribution.

To do this, I had to enable IPv6 unicast-routing on each Router/Switch, set up respective IPv4 and IPv6 addresses, and enable the protocols. Setting up IPv6 was relatively simple; I did not need any additional commands besides **ipv6 unicast-routing** (which allows IPv6 to be enabled on a Router/Switch) and

After my initial setup was completed, I set up the routing protocols, OSPF and OSPF v3 on the bottom Routers and Switch, and RIP and RIPng on the top Routers and Switch.

To ensure that communication between networks, including redistribution, was functioning properly for both IPv4 and IPv6, I used the commands **show ipv6 route** and **show ip route.** Initially, some routers did not have any routes marked as either “R” or “O,” so I quickly checked

the absent network portions and troubleshot using the command **show run** and implemented missing commands.

However, as soon as I notice that networks with "O E2" marked next to them were not present, began to troubleshoot for the redistribution commands that were entered. After a considerable amount of time, I realized that the command that needed to be issued was **redistribute ospf 1 metric** command.

Finally, to ensure everything worked properly, I used the **show ip route, show ipv6 route, tracert, and ping** command once again to verify that communication was properly functioning. All the hosts could ping which meant that Dual Stack Routing was enabled successfully.

Lab Commands

To initially enable IPv6, the command *Router (config) # ipv6 unicast-routing* must be issued on every Router and Switch. Since we are enabling Dual Stack Routing, both IPv4 and IPv6 addresses must be entered on every interface. I simply used the command *Router (config-if) # ipv6 address [network::number/64]* to issue an IPv6 address. The Switch configuration commands are the same as those of Routers. Before doing the next steps, set up RIP and OSPF for IPv4 (as well as the router ids).

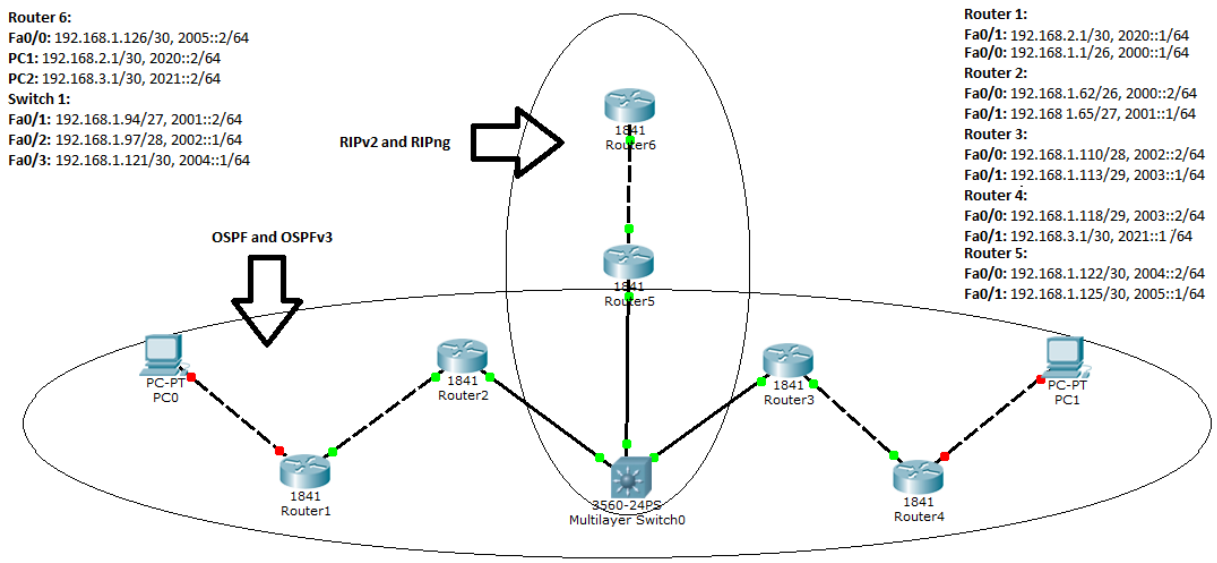
After setting up the IPs, issue the command *Router (config-if) # ipv6 router rip [name]* and on the top two Routers and Switch to enable RIPng. To run dual stack, the RIP for IPv4 must also be configured. Note that RIPng is configured on each interface while RIP is configured on each router (global config mode).

Now we must set up OSPF v3. To do this, issue the command *Router (config) # ipv6 router ospf 1* on the bottom Routers and Switch. This command does not need additional network statements for OSPF v3 to function; the command automatically establishes the network statements. After that, set the router id by issuing the command *Router (config) # router-id [ip address]*.

Finally, we must redistribute routes for RIP and RIPng, and OSPF and RIP to communicate with each other. For IPv4 redistribution, simply type in the commands *Switch (config)# router ospf 1* then *Switch (config-rtr) # redistribute rip subnets.* Then, issue the command *Switch (config) # router rip* then *Switch (config-rtr) # redistribute ospf 1 metric 10.* These two commands will enable redistribution between RIP and OSPF.

For IPv6 (RIPng and OSPF v3), after typing the command Switch (config)# ipv6 router ospf 1, which directs us to *Switch (config-rtr) #*, issue the command *Switch (config-rtr) # redistribute rip cisco metric 10.* Do the same for RIP: after typing *Switch (config) # ipv6 router rip cisco*, issue the command *Switch (config) # redistribute ospf 1 metric 10.* These two commands will allow redistribution between RIPng and OSPF v3.

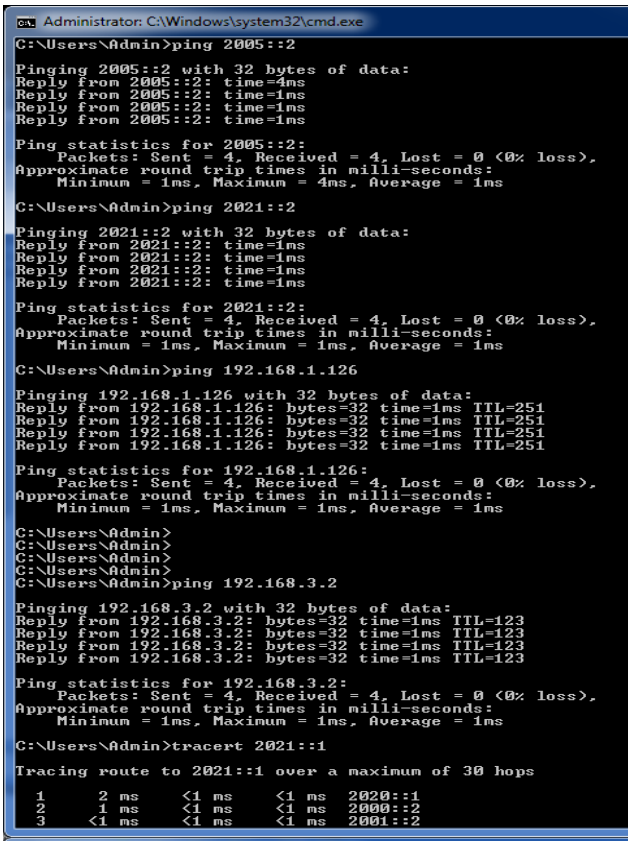
Network Diagram with IP's

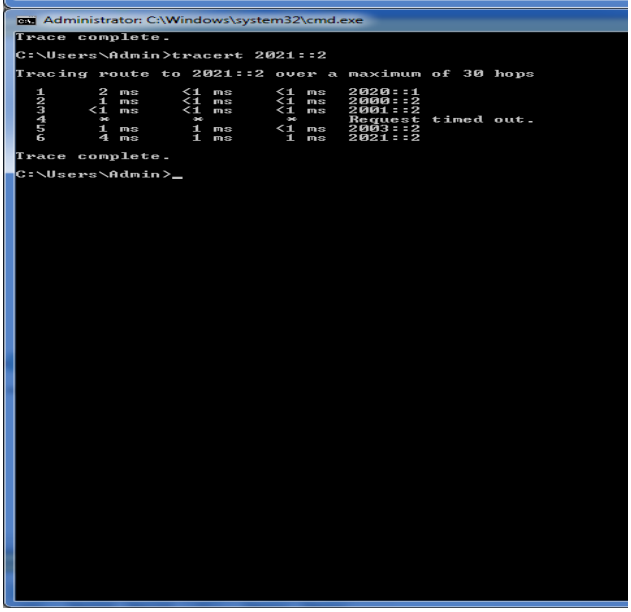


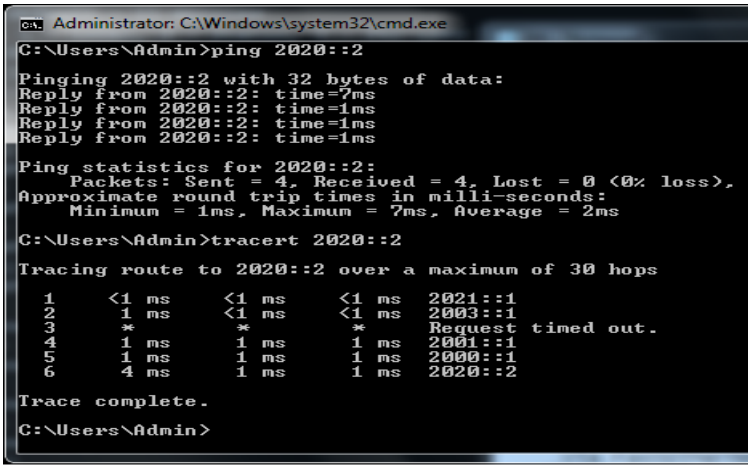
Note: On the Switch, the interfaces were fa4/1, fa4/2, and fa4/3. The area id for OSPF and OSPF v3 is 1.

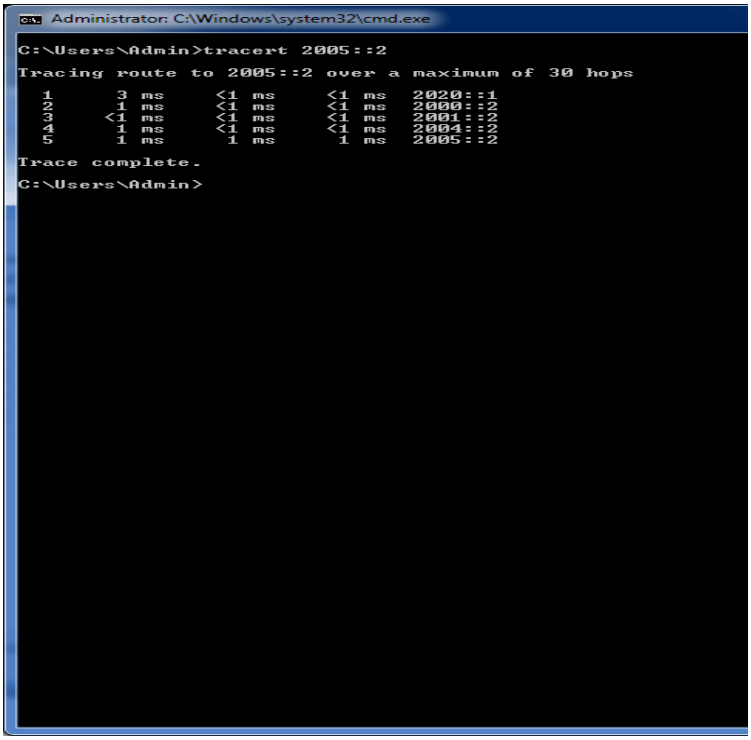
Configurations

Ping and Tracert between both PCs and Router 6









```
Administrator: C:\Windows\system32\cmd.exe
C:\Users\Admin>ping 2020::2

Pinging 2020::2 with 32 bytes of data:
Reply from 2020::2: time=7ms
Reply from 2020::2: time=1ms
Reply from 2020::2: time=1ms
Reply from 2020::2: time=1ms

Ping statistics for 2020::2:
    Packets: Sent = 4, Received = 4, Lost = 0 (
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 7ms, Average = 2ms

C:\Users\Admin>tracert 2020::2

Tracing route to 2020::2 over a maximum of 30 h

  1    <1 ms    <1 ms    <1 ms  2021::1
  2     1 ms    <1 ms    <1 ms  2003::1
  3     *        *        *     Request timed o
  4     1 ms     1 ms     1 ms  2001::1
  5     1 ms     1 ms     1 ms  2000::1
  6     4 ms     1 ms     1 ms  2020::2

Trace complete.

C:\Users\Admin>
```

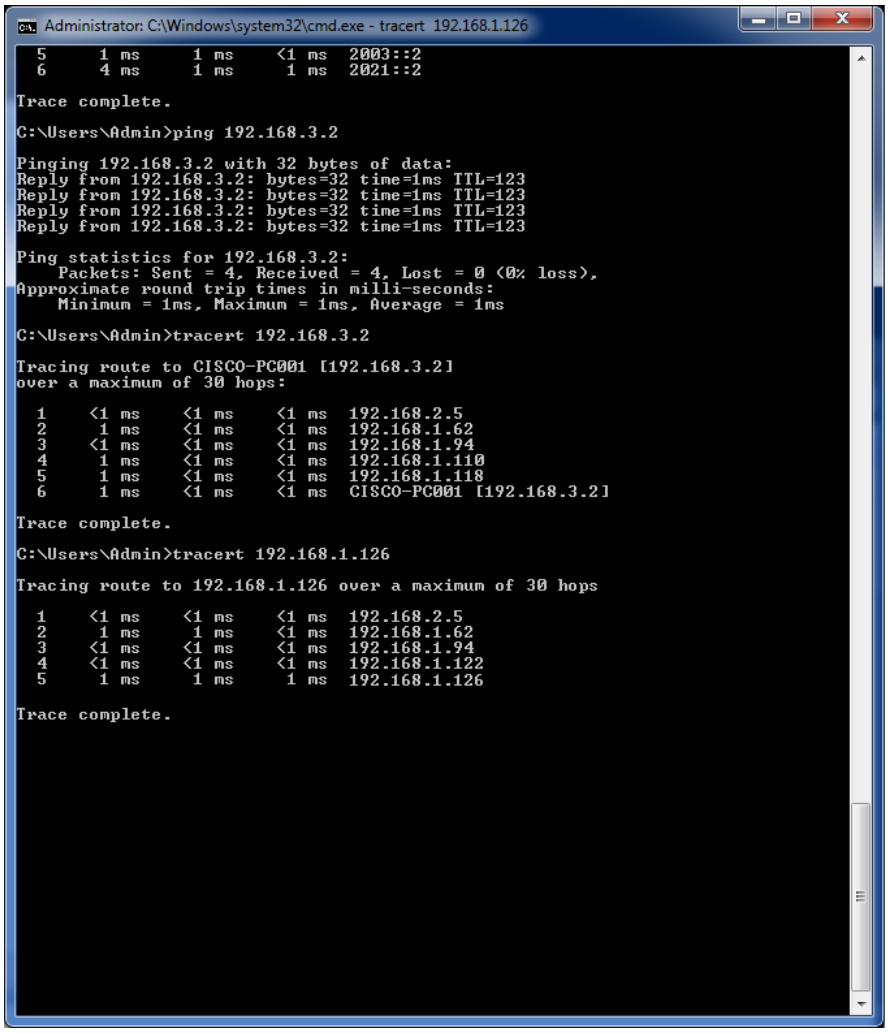
PC1 ipconfig

```
Administrator: C:\Windows\system32\cmd.exe
  5     1 ms     1 ms    <1 ms  2021::1
Trace complete.

C:\Users\Admin>ipconfig

Windows IP Configuration

Ethernet adapter Local Area Connection:

   Connection-specific DNS Suffix  . :
   IPv6 Address. . . . . . . . . . . : 2020::2
   IPv6 Address. . . . . . . . . . . : 2020::7dd8
   Temporary IPv6 Address. . . . . . : 2020::315e
   Link-local IPv6 Address . . . . . : fe80::7dd8
   IPv4 Address. . . . . . . . . . . : 192.168.2.
   Subnet Mask . . . . . . . . . . . : 255.255.25
   Default Gateway . . . . . . . . . : 2020::1
                                       fe80::aef2
                                       192.168.2.

Ethernet adapter VMware Network Adapter VMnet1:

   Connection-specific DNS Suffix  . :
   Link-local IPv6 Address . . . . . : fe80::201c
   IPv4 Address. . . . . . . . . . . : 192.168.11
   Subnet Mask . . . . . . . . . . . : 255.255.25
   Default Gateway . . . . . . . . . :

Ethernet adapter VMware Network Adapter VMnet8:

   Connection-specific DNS Suffix  . :
   Link-local IPv6 Address . . . . . : fe80::517c
   IPv4 Address. . . . . . . . . . . : 192.168.14
   Subnet Mask . . . . . . . . . . . : 255.255.25
   Default Gateway . . . . . . . . . :

Tunnel adapter isatap.{AACE8791-5527-4A5A-9310-04

   Media State . . . . . . . . . . . : Media disc
   Connection-specific DNS Suffix  . :

Tunnel adapter isatap.{E2CC3B72-E264-498A-89F8-43

   Media State . . . . . . . . . . . : Media disc
   Connection-specific DNS Suffix  . :

Tunnel adapter isatap.{647D2DBA-1FC7-4380-BC04-CA

   Media State . . . . . . . . . . . : Media disc
   Connection-specific DNS Suffix  . :

Tunnel adapter Teredo Tunneling Pseudo-Interface:

   Media State . . . . . . . . . . . : Media disc
   Connection-specific DNS Suffix  . :

C:\Users\Admin>
```

PC2 ipconfig

```
Administrator: C:\Windows\system32\cmd.exe
C:\Users\Admin>ipconfig

Windows IP Configuration

Ethernet adapter Local Area Connection:

   Connection-specific DNS Suffix  . :
   IPv6 Address. . . . . . . . . . . : 2021::2
   IPv6 Address. . . . . . . . . . . : 2021::cdef:1f3c:7edf:3c5a
   Temporary IPv6 Address. . . . . . : 2021::b9f0:cb68:6ee6:a8ad
   Link-local IPv6 Address . . . . . : fe80::cdef:1f3c:7edf:3c5a%11
   IPv4 Address. . . . . . . . . . . : 192.168.3.2
   Subnet Mask . . . . . . . . . . . : 255.255.255.252
   Default Gateway . . . . . . . . . : 2021::1
                                       fe80::4255:39ff:feb7:61e9%11
                                       192.168.3.1

Ethernet adapter VMware Network Adapter VMnet1:

   Connection-specific DNS Suffix  . :
   Link-local IPv6 Address . . . . . : fe80::201c:d6fe:aae3:e8e7%12
   IPv4 Address. . . . . . . . . . . : 192.168.112.1
   Subnet Mask . . . . . . . . . . . : 255.255.255.0
   Default Gateway . . . . . . . . . :

Ethernet adapter VMware Network Adapter VMnet8:

   Connection-specific DNS Suffix  . :
   Link-local IPv6 Address . . . . . : fe80::517c:c367:6816:faac%13
   IPv4 Address. . . . . . . . . . . : 192.168.146.1
   Subnet Mask . . . . . . . . . . . : 255.255.255.0
   Default Gateway . . . . . . . . . :

Tunnel adapter isatap.{AACE8791-5527-4A5A-9310-049B51E260FC}:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :

Tunnel adapter isatap.{E2CC3B72-E264-498A-89F8-43E763E78808}:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :

Tunnel adapter isatap.{647D2DBA-1FC7-4380-BC04-CAD7D63A093A}:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :

Tunnel adapter Teredo Tunneling Pseudo-Interface:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :

C:\Users\Admin>
```

IPv4 tracert and ping



Router/Switch show run and show ip route / show ipv6 route

Router 1

```
Building configuration...

Current configuration : 1496 bytes
!
! Last configuration change at 14:55:17
UTC Fri Sep 20 2013
version 15.1
no service timestamps debug uptime
no service timestamps log uptime
no service password-encryption
!
hostname R1
!
!
no aaa new-model
memory-size iomem 10
!
ipv6 unicast-routing
ipv6 cef
ip source-route
ip cef
!
!
!
!
!
multilink bundle-name authenticated
!
!
crypto pki token default removal
timeout 0
!
!
license udi pid CISCO2901/K9 sn
FTX1704Y03B
```

```
!
interface GigabitEthernet0/0
 ip address 192.168.1.1 255.255.255.192
 duplex auto
 speed auto
 ipv6 address 2000::1/64
 ipv6 ospf 1 area 0
!
interface GigabitEthernet0/1
 ip address 192.168.2.5 255.255.255.252
 duplex auto
 speed auto
 ipv6 address 2020::1/64
 ipv6 ospf 1 area 0
!
router ospf 1
 router-id 192.168.1.1
 network 192.168.1.0 0.0.0.63 area 0
 network 192.168.2.4 0.0.0.3 area 0
!
ip forward-protocol nd
!
no ip http server
no ip http secure-server
!
!
ipv6 router ospf 1
 router-id 192.168.1.1
!
!
!
!
control-plane
!
!
!
line con 0
line aux 0
line 2
 no activation-character
 no exec
 transport preferred none
 transport input all
 transport output pad telnet rlogin
lapb-ta mop udptn v120 ssh
 stopbits 1
line vty 0 4
 login
 transport input all
!
scheduler allocate 20000 1000
end
```

```
      192.168.1.0/24 is variably
subnetted, 7 subnets, 6 masks
C        192.168.1.0/26 is directly
connected, GigabitEthernet0/0
L        192.168.1.1/32 is directly
connected, GigabitEthernet0/0
O        192.168.1.64/27
           [110/2] via 192.168.1.62,
01:06:26, GigabitEthernet0/0
O        192.168.1.96/28
           [110/3] via 192.168.1.62,
01:06:26, GigabitEthernet0/0
O        192.168.1.112/29
           [110/4] via 192.168.1.62,
01:05:48, GigabitEthernet0/0
O E2     192.168.1.120/30
           [110/20] via 192.168.1.62,
01:06:26, GigabitEthernet0/0
O E2     192.168.1.124/30
           [110/20] via 192.168.1.62,
00:36:28, GigabitEthernet0/0
      192.168.2.0/24 is variably
subnetted, 2 subnets, 2 masks
C        192.168.2.4/30 is directly
connected, GigabitEthernet0/1
L        192.168.2.5/32 is directly
connected, GigabitEthernet0/1
      192.168.3.0/30 is subnetted, 1
subnets
O        192.168.3.0 [110/5] via
192.168.1.62, 01:05:48,
GigabitEthernet0/0
```

```
IPv6 Routing Table - default - 10
entries
Codes: C - Connected, L - Local, S -
Static, U - Per-user Static route
       B - BGP, R - RIP, I1 - ISIS L1,
I2 - ISIS L2
       IA - ISIS interarea, IS - ISIS
summary, D - EIGRP, EX - EIGRP external
       ND - Neighbor Discovery, l -
LISP
       O - OSPF Intra, OI - OSPF Inter,
OE1 - OSPF ext 1, OE2 - OSPF ext 2
       ON1 - OSPF NSSA ext 1, ON2 -
OSPF NSSA ext 2
C   2000::/64 [0/0]
     via GigabitEthernet0/0, directly
connected
L   2000::1/128 [0/0]
     via GigabitEthernet0/0, receive
O   2001::/64 [110/2]
     via FE80::217:E0FF:FE51:B2B0,
GigabitEthernet0/0
O   2002::/64 [110/3]
     via FE80::217:E0FF:FE51:B2B0,
GigabitEthernet0/0
O   2003::/64 [110/4]
     via FE80::217:E0FF:FE51:B2B0,
GigabitEthernet0/0
```

```
OE2 2005::/64 [110/10]
     via FE80::217:E0FF:FE51:B2B0,
GigabitEthernet0/0
C   2020::/64 [0/0]
     via GigabitEthernet0/1, directly
connected
L   2020::1/128 [0/0]
```

Router 2

```
Current configuration : 1619 bytes
!
version 12.4
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname R2
!
boot-start-marker
boot-end-marker
!
logging message-counter syslog
!
no aaa new-model
memory-size iomem 10
!
dot11 syslog
ip source-route
!
!
ip cef
!
!
ipv6 unicast-routing
ipv6 cef
!

interface FastEthernet0/0
 ip address 192.168.1.62
255.255.255.192
 duplex auto
 speed auto
 ipv6 address 2000::2/64
 ipv6 ospf 1 area 0
!
interface FastEthernet0/1
 ip address 192.168.1.65
255.255.255.224
 duplex auto
 speed auto
 ipv6 address 2001::1/64
 ipv6 ospf 1 area 0

!
router ospf 1
 router-id 192.168.1.65
 log-adjacency-changes
     via GigabitEthernet0/1, receive
O   2021::/64 [110/5]
     via FE80::217:E0FF:FE51:B2B0,
GigabitEthernet0/0
L   FF00::/8 [0/0]
     via Null0, receive

 network 192.168.1.0 0.0.0.63 area 0
 network 192.168.1.64 0.0.0.31 area 0
!
ip forward-protocol nd
no ip http server
no ip http secure-server
!
!
!
ipv6 router ospf 1
 router-id 192.168.1.65
 log-adjacency-changes
!
!
control-plane
!
!
line con 0
line aux 0
line vty 0 4
 login
!
scheduler allocate 20000 1000
end


IPv6 Routing Table - Default - 11
entries
Codes: C - Connected, L - Local, S -
Static, U - Per-user Static route
       B - BGP, M - MIPv6, R - RIP, I1
- ISIS L1
       I2 - ISIS L2, IA - ISIS
interarea, IS - ISIS summary, D - EIGRP
       EX - EIGRP external
       O - OSPF Intra, OI - OSPF Inter,
OE1 - OSPF ext 1, OE2 - OSPF ext 2
       ON1 - OSPF NSSA ext 1, ON2 -
OSPF NSSA ext 2
C   2000::/64 [0/0]
     via FastEthernet0/0, directly
connected
L   2000::2/128 [0/0]
     via FastEthernet0/0, receive
C   2001::/64 [0/0]
     via FastEthernet0/1, directly
connected
L   2001::1/128 [0/0]
     via FastEthernet0/1, receive
O   2002::/64 [110/2]
```

```
     via FE80::2D0:2BFF:FE15:110A,
FastEthernet0/1
O   2003::/64 [110/3]
     via FE80::2D0:2BFF:FE15:110A,
FastEthernet0/1
O   2004::/64 [110/2]
     via FE80::2D0:2BFF:FE15:110A,
FastEthernet0/1
OE2 2005::/64 [110/10]
     via FE80::2D0:2BFF:FE15:110A,
FastEthernet0/1
O   2020::/64 [110/2]
     via FE80::AEF2:C5FF:FE55:9788,
FastEthernet0/0
O   2021::/64 [110/4]
     via FE80::2D0:2BFF:FE15:110A,
FastEthernet0/1
L   FF00::/8 [0/0]
     via Null0, receive


Codes: C - connected, S - static, R -
RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external,
O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1,
N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 -
OSPF external type 2
       i - IS-IS, su - IS-IS summary,
L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * -
candidate default, U - per-user static
route
       o - ODR, P - periodic downloaded
static route

Gateway of last resort is not set

     192.168.1.0/24 is variably
subnetted, 6 subnets, 5 masks
O       192.168.1.96/28 [110/2] via
192.168.1.94, 01:15:18, FastEthernet0/1
O E2    192.168.1.120/30 [110/20] via
192.168.1.94, 01:15:18, FastEthernet0/1
O E2    192.168.1.124/30 [110/20] via
192.168.1.94, 00:45:18, FastEthernet0/1
O       192.168.1.112/29 [110/3] via
192.168.1.94, 01:14:38, FastEthernet0/1
C       192.168.1.64/27 is directly
connected, FastEthernet0/1
C       192.168.1.0/26 is directly
connected, FastEthernet0/0
     192.168.2.0/30 is subnetted, 1
subnets
O       192.168.2.4 [110/2] via
192.168.1.1, 01:15:09, FastEthernet0/0
     192.168.3.0/30 is subnetted, 1
subnets
O       192.168.3.0 [110/4] via
192.168.1.94, 01:14:39, FastEthernet0/1
```

Router 3

```
Current configuration : 1454 bytes
!
version 12.4
no service timestamps debug uptime
no service timestamps log uptime
no service password-encryption
!
hostname R3
!
boot-start-marker
boot-end-marker
!
logging message-counter syslog
!
no aaa new-model
memory-size iomem 10
!
dot11 syslog
ip source-route
!
!
ip cef
!
!
no ip domain lookup
ipv6 unicast-routing
ipv6 cef
!
multilink bundle-name authenticated
!
!
!
!
!
!
!
!
interface FastEthernet0/0
 ip address 192.168.1.110
255.255.255.240
 duplex auto
 speed auto
```

```
 ipv6 address 2002::2/64
 ipv6 ospf 1 area 0
!
interface FastEthernet0/1
 ip address 192.168.1.113
255.255.255.248
 duplex auto
 speed auto
 ipv6 address 2003::1/64
 ipv6 ospf 1 area 0
!
router ospf 1
 router-id 192.168.1.113
 log-adjacency-changes
 network 192.168.1.96 0.0.0.15 area 0
 network 192.168.1.112 0.0.0.7 area 0
!
ip forward-protocol nd
no ip http server
no ip http secure-server
!
!
!
ipv6 router ospf 1
 router-id 192.168.1.113
 log-adjacency-changes
!
!
!
line con 0
line aux 0
line vty 0 4
 login
!
end

Codes: C - connected, S - static, R -
RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external,
O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1,
N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 -
OSPF external type 2
       i - IS-IS, su - IS-IS summary,
L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * -
candidate default, U - per-user static
route
       o - ODR, P - periodic downloaded
static route

Gateway of last resort is not set

     192.168.1.0/24 is variably
subnetted, 6 subnets, 5 masks
C       192.168.1.96/28 is directly
connected, FastEthernet0/0
O E2    192.168.1.120/30 [110/20] via
192.168.1.97, 01:16:06, FastEthernet0/0
O E2    192.168.1.124/30 [110/20] via
192.168.1.97, 00:46:36, FastEthernet0/0
C       192.168.1.112/29 is directly
connected, FastEthernet0/1
O       192.168.1.64/27 [110/2] via
192.168.1.97, 01:16:06, FastEthernet0/0
O       192.168.1.0/26 [110/3] via
192.168.1.97, 01:16:06, FastEthernet0/0
     192.168.2.0/30 is subnetted, 1
subnets
O       192.168.2.4 [110/4] via
192.168.1.97, 01:16:07, FastEthernet0/0
     192.168.3.0/30 is subnetted, 1
subnets
O       192.168.3.0 [110/2] via
192.168.1.118, 01:15:57,
FastEthernet0/1


IPv6 Routing Table - Default - 11
entries
Codes: C - Connected, L - Local, S -
Static, U - Per-user Static route
       B - BGP, M - MIPv6, R - RIP, I1
- ISIS L1
       I2 - ISIS L2, IA - ISIS
interarea, IS - ISIS summary, D - EIGRP
       EX - EIGRP external
       O - OSPF Intra, OI - OSPF Inter,
OE1 - OSPF ext 1, OE2 - OSPF ext 2
       ON1 - OSPF NSSA ext 1, ON2 -
OSPF NSSA ext 2
O   2000::/64 [110/3]
     via FE80::2D0:2BFF:FE15:110A,
FastEthernet0/0
O   2001::/64 [110/2]
     via FE80::2D0:2BFF:FE15:110A,
FastEthernet0/0
C   2002::/64 [0/0]
     via FastEthernet0/0, directly
connected
L   2002::2/128 [0/0]
     via FastEthernet0/0, receive
C   2003::/64 [0/0]
     via FastEthernet0/1, directly
connected
L   2003::1/128 [0/0]
     via FastEthernet0/1, receive
O   2004::/64 [110/2]
     via FE80::2D0:2BFF:FE15:110A,
FastEthernet0/0
OE2 2005::/64 [110/10]
     via FE80::2D0:2BFF:FE15:110A,
FastEthernet0/0
O   2020::/64 [110/4]
```

```
     via FE80::2D0:2BFF:FE15:110A,
FastEthernet0/0
O   2021::/64 [110/2]
     via FE80::4255:39FF:FEB7:61E8,
FastEthernet0/1
L   FF00::/8 [0/0]
     via Null0, receive
```

Router 4

```
Current configuration : 1290 bytes
!
!
version 15.0
no service timestamps debug uptime
no service timestamps log uptime
no service password-encryption
!
hostname R4
!
boot-start-marker
boot-end-marker
!
!
no aaa new-model
!
!
!
memory-size iomem 25
!
ipv6 unicast-routing
ipv6 cef
ip source-route
ip cef
!
!
!
!
!
!
!
interface GigabitEthernet0/0
 ip address 192.168.1.118
255.255.255.248
 duplex auto
 speed auto
 ipv6 address 2003::2/64
 ipv6 ospf 1 area 0
 !
!
interface GigabitEthernet0/1
 ip address 192.168.3.1 255.255.255.252
 duplex auto
 speed auto
 ipv6 address 2021::1/64
 ipv6 ospf 1 area 0
!
!
router ospf 1
 router-id 192.168.1.112
 log-adjacency-changes
 network 192.168.1.112 0.0.0.7 area 0
 network 192.168.3.0 0.0.0.3 area 0
!
ip forward-protocol nd
!
no ip http server
no ip http secure-server
!
!
ipv6 router ospf 1
 router-id 192.168.1.112
 log-adjacency-changes
!
!
line con 0
line aux 0
line vty 0 4
 login
!
scheduler allocate 20000 1000
end


Codes: L - local, C - connected, S -
static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external,
O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1,
N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 -
OSPF external type 2
       i - IS-IS, su - IS-IS summary,
L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * -
candidate default, U - per-user static
route
       o - ODR, P - periodic downloaded
static route, + - replicated route

Gateway of last resort is not set

      192.168.1.0/24 is variably
subnetted, 7 subnets, 6 masks
O        192.168.1.0/26
           [110/4] via 192.168.1.113,
01:17:33, GigabitEthernet0/0
O        192.168.1.64/27
           [110/3] via 192.168.1.113,
01:17:33, GigabitEthernet0/0
```

```
O        192.168.1.96/28
           [110/2] via 192.168.1.113,
01:17:33, GigabitEthernet0/0
C        192.168.1.112/29 is directly
connected, GigabitEthernet0/0
L        192.168.1.118/32 is directly
connected, GigabitEthernet0/0
O E2     192.168.1.120/30
           [110/20] via 192.168.1.113,
01:17:33, GigabitEthernet0/0
O E2     192.168.1.124/30
           [110/20] via 192.168.1.113,
00:48:12, GigabitEthernet0/0
      192.168.2.0/30 is subnetted, 1
subnets
O        192.168.2.4 [110/5] via
192.168.1.113, 01:17:34,
GigabitEthernet0/0
      192.168.3.0/24 is variably
subnetted, 2 subnets, 2 masks
C        192.168.3.0/30 is directly
connected, GigabitEthernet0/1
L        192.168.3.1/32 is directly
connected, GigabitEthernet0/1


IPv6 Routing Table - default - 11
entries
Codes: C - Connected, L - Local, S -
Static, U - Per-user Static route
       B - BGP, HA - Home Agent, MR -
Mobile Router, R - RIP
       I1 - ISIS L1, I2 - ISIS L2, IA -
ISIS interarea, IS - ISIS summary
       D - EIGRP, EX - EIGRP external,
ND - Neighbor Discovery
       O - OSPF Intra, OI - OSPF Inter,
OE1 - OSPF ext 1, OE2 - OSPF ext 2
       ON1 - OSPF NSSA ext 1, ON2 -
OSPF NSSA ext 2
O   2000::/64 [110/4]
     via FE80::218:19FF:FECD:92C9,
GigabitEthernet0/0
O   2001::/64 [110/3]
     via FE80::218:19FF:FECD:92C9,
GigabitEthernet0/0
O   2002::/64 [110/2]
     via FE80::218:19FF:FECD:92C9,
GigabitEthernet0/0
C   2003::/64 [0/0]
     via GigabitEthernet0/0, directly
connected
L   2003::2/128 [0/0]
     via GigabitEthernet0/0, receive
O   2004::/64 [110/3]
     via FE80::218:19FF:FECD:92C9,
GigabitEthernet0/0
OE2 2005::/64 [110/10]
     via FE80::218:19FF:FECD:92C9,
GigabitEthernet0/0
O   2020::/64 [110/5]
     via FE80::218:19FF:FECD:92C9,
GigabitEthernet0/0
C   2021::/64 [0/0]
     via GigabitEthernet0/1, directly
connected
L   2021::1/128 [0/0]
     via GigabitEthernet0/1, receive
L   FF00::/8 [0/0]
     via Null0, receive
```

Router 5

```
Current configuration : 1464 bytes
!
!
version 15.0
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname R5
!
boot-start-marker
boot-end-marker
!
!
no aaa new-model
!
!
!
memory-size iomem 10
!
ipv6 unicast-routing
ipv6 cef
ip source-route
ip cef
!
!

interface Tunnel0
 no ip address
 ipv6 address 2010::1/64
 tunnel source GigabitEthernet0/1
 tunnel destination 192.168.1.126
 !
!
interface GigabitEthernet0/0
 ip address 192.168.1.122
255.255.255.252
 duplex auto
```

```
 speed auto
 ipv6 address 2004::2/64
 ipv6 rip cisco enable
 !
!
interface GigabitEthernet0/1
 ip address 192.168.1.125
255.255.255.252
 duplex auto
 speed auto
 ipv6 address 2005::1/64
 ipv6 rip cisco enable
 !
!

!
router rip
 version 2
 network 192.168.1.0
 no auto-summary
!
ip forward-protocol nd
!
no ip http server
no ip http secure-server
!
!
ipv6 router rip cisco
!
!
line con 0
line aux 0
line vty 0 4
 login
!
scheduler allocate 20000 1000
end


Codes: L - local, C - connected, S -
static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external,
O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1,
N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 -
OSPF external type 2
       i - IS-IS, su - IS-IS summary,
L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * -
candidate default, U - per-user static
route
       o - ODR, P - periodic downloaded
static route, + - replicated route

Gateway of last resort is not set

      192.168.1.0/24 is variably
subnetted, 8 subnets, 6 masks
R        192.168.1.0/26
           [120/10] via 192.168.1.121,
00:00:22, GigabitEthernet0/0
R        192.168.1.64/27
           [120/1] via 192.168.1.121,
00:00:22, GigabitEthernet0/0
R        192.168.1.96/28
           [120/1] via 192.168.1.121,
00:00:22, GigabitEthernet0/0
R        192.168.1.112/29
           [120/10] via 192.168.1.121,
00:00:22, GigabitEthernet0/0
C        192.168.1.120/30 is directly
connected, GigabitEthernet0/0
L        192.168.1.122/32 is directly
connected, GigabitEthernet0/0
C        192.168.1.124/30 is directly
connected, GigabitEthernet0/1
L        192.168.1.125/32 is directly
connected, GigabitEthernet0/1
      192.168.2.0/30 is subnetted, 1
subnets
R        192.168.2.4 [120/10] via
192.168.1.121, 00:00:23,
GigabitEthernet0/0
      192.168.3.0/30 is subnetted, 1
subnets
R        192.168.3.0 [120/10] via
192.168.1.121, 00:00:23,
GigabitEthernet0/0


IPv6 Routing Table - default - 11
entries
Codes: C - Connected, L - Local, S -
Static, U - Per-user Static route
       B - BGP, HA - Home Agent, MR -
Mobile Router, R - RIP
       I1 - ISIS L1, I2 - ISIS L2, IA -
ISIS interarea, IS - ISIS summary
       D - EIGRP, EX - EIGRP external,
ND - Neighbor Discovery
       O - OSPF Intra, OI - OSPF Inter,
OE1 - OSPF ext 1, OE2 - OSPF ext 2
       ON1 - OSPF NSSA ext 1, ON2 -
OSPF NSSA ext 2
R   2000::/64 [120/11]
     via FE80::2D0:2BFF:FE15:110A,
GigabitEthernet0/0
R   2001::/64 [120/2]
     via FE80::2D0:2BFF:FE15:110A,
GigabitEthernet0/0
R   2002::/64 [120/2]
     via FE80::2D0:2BFF:FE15:110A,
GigabitEthernet0/0
R   2003::/64 [120/11]
```

```
     via FE80::2D0:2BFF:FE15:110A,
GigabitEthernet0/0
C   2004::/64 [0/0]
     via GigabitEthernet0/0, directly
connected
L   2004::2/128 [0/0]
     via GigabitEthernet0/0, receive
C   2005::/64 [0/0]
     via GigabitEthernet0/1, directly
connected
L   2005::1/128 [0/0]
     via GigabitEthernet0/1, receive
R   2020::/64 [120/11]
     via FE80::2D0:2BFF:FE15:110A,
GigabitEthernet0/0
R   2021::/64 [120/11]
     via FE80::2D0:2BFF:FE15:110A,
GigabitEthernet0/0
L   FF00::/8 [0/0]
     via Null0, receive
```

Router 6

```
Current configuration : 1957 bytes
!
version 12.4
no service timestamps debug uptime
no service timestamps log uptime
no service password-encryption
!
hostname R6
!
boot-start-marker
boot-end-marker
!
logging message-counter syslog
!
no aaa new-model
memory-size iomem 10
no network-clock-participate slot 1
!
dot11 syslog
ip source-route
!
!
ip cef
!
!
ipv6 unicast-routing
ipv6 cef
!
archive
 log config
  hidekeys
!
!
interface FastEthernet0/0
 ip address 192.168.1.126
255.255.255.252
 duplex auto
 speed auto
 ipv6 address 2005::2/64
 ipv6 rip cisco enable
!
router ospf 1
 router-id 192.168.1.126
 log-adjacency-changes
!
router rip
 version 2
 network 192.168.1.0
 no auto-summary
!
ip forward-protocol nd
no ip http server
no ip http secure-server
!
!
!
ipv6 router ospf 1
 router-id 192.168.1.126
 log-adjacency-changes
!
ipv6 router rip cisco
!
!
!
line con 0
line aux 0
line vty 0 4
 login
!
scheduler allocate 20000 1000
end

Codes: C - connected, S - static, R -
RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external,
O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1,
N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 -
OSPF external type 2
       i - IS-IS, su - IS-IS summary,
L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * -
candidate default, U - per-user static
route
       o - ODR, P - periodic downloaded
static route

Gateway of last resort is not set
```

```
     192.168.1.0/24 is variably
subnetted, 6 subnets, 5 masks
R       192.168.1.96/28 [120/2] via
192.168.1.125, 00:00:18,
FastEthernet0/0
R       192.168.1.120/30 [120/1] via
192.168.1.125, 00:00:18,
FastEthernet0/0
C       192.168.1.124/30 is directly
connected, FastEthernet0/0
R       192.168.1.112/29 [120/11] via
192.168.1.125, 00:00:18,
FastEthernet0/0
R       192.168.1.64/27 [120/2] via
192.168.1.125, 00:00:18,
FastEthernet0/0

R       192.168.1.0/26 [120/11] via
192.168.1.125, 00:00:18,
FastEthernet0/0
     192.168.2.0/30 is subnetted, 1
subnets
R       192.168.2.4 [120/11] via
192.168.1.125, 00:00:20,
FastEthernet0/0
     192.168.3.0/30 is subnetted, 1
subnets
R       192.168.3.0 [120/11] via
192.168.1.125, 00:00:20,
FastEthernet0/0


IPv6 Routing Table - Default - 9
entries
Codes: C - Connected, L - Local, S -
Static, U - Per-user Static route
       B - BGP, M - MIPv6, R - RIP, I1
- ISIS L1
       I2 - ISIS L2, IA - ISIS
interarea, IS - ISIS summary, D - EIGRP
       EX - EIGRP external
       O - OSPF Intra, OI - OSPF Inter,
OE1 - OSPF ext 1, OE2 - OSPF ext 2
       ON1 - OSPF NSSA ext 1, ON2 -
OSPF NSSA ext 2
R   2000::/64 [120/12]
     via FE80::EAB7:48FF:FE6E:89,
FastEthernet0/0
R   2002::/64 [120/3]
     via FE80::EAB7:48FF:FE6E:89,
FastEthernet0/0
R   2003::/64 [120/12]
     via FE80::EAB7:48FF:FE6E:89,
FastEthernet0/0
R   2004::/64 [120/2]
     via FE80::EAB7:48FF:FE6E:89,
FastEthernet0/0
C   2005::/64 [0/0]
     via FastEthernet0/0, directly
connected
L   2005::2/128 [0/0]
     via FastEthernet0/0, receive
R   2020::/64 [120/12]
     via FE80::EAB7:48FF:FE6E:89,
FastEthernet0/0
R   2021::/64 [120/12]
     via FE80::EAB7:48FF:FE6E:89,
FastEthernet0/0
L   FF00::/8 [0/0]
     via Null0, receive
```

Switch 1

```
Building configuration...

Current configuration : 16931 bytes
!
upgrade fpd auto
version 12.2
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
service counters max age 5
!
hostname S1
!
boot system slot0:s222-
adventerprisek9_wan-mz.122-
18.SXF17b.bin
!
no aaa new-model
ip subnet-zero
!
!
!
ipv6 unicast-routing

!
!
!
!
!
vlan internal allocation policy
ascending
!
!
!
!

interface FastEthernet4/1
```

```
 ip address 192.168.1.94
255.255.255.224
 ipv6 address 2001::2/64
 ipv6 ospf 1 area 0
 no shutdown
!
interface FastEthernet4/2
 ip address 192.168.1.97
255.255.255.240
 ipv6 address 2002::1/64
 ipv6 ospf 1 area 0
 no shutdown
!
interface FastEthernet4/3
 ip address 192.168.1.121
255.255.255.252
 ipv6 address 2004::1/64
 ipv6 rip cisco enable
 no shutdown
!
router ospf 1
 router-id 192.168.1.121
 log-adjacency-changes
 redistribute rip subnets
 network 192.168.1.64 0.0.0.31 area 0
 network 192.168.1.96 0.0.0.15 area 0
!
router rip
 version 2
 redistribute ospf 1 metric 10
 network 192.168.1.0
 no auto-summary
!
ip classless
!
no ip http server
!
ipv6 router ospf 1
 router-id 192.168.1.121
 log-adjacency-changes
 redistribute rip cisco metric 10
!
ipv6 router rip cisco
 redistribute ospf 1 metric 10
!
!
!
line con 0
line vty 0 4
 login
!
no cns aaa enable
end
```

```
IPv6 Routing Table - 13 entries
Codes: C - Connected, L - Local, S -
Static, R - RIP, B - BGP
       U - Per-user Static route
       I1 - ISIS L1, I2 - ISIS L2, IA -
ISIS interarea, IS - ISIS summary
       O - OSPF intra, OI - OSPF inter,
OE1 - OSPF ext 1, OE2 - OSPF ext 2
       ON1 - OSPF NSSA ext 1, ON2 -
OSPF NSSA ext 2
O   2000::/64 [110/2]
     via FE80::217:E0FF:FE51:B2B1,
FastEthernet4/1
C   2001::/64 [0/0]
     via ::, FastEthernet4/1
L   2001::2/128 [0/0]
     via ::, FastEthernet4/1
C   2002::/64 [0/0]
     via ::, FastEthernet4/2
L   2002::1/128 [0/0]
     via ::, FastEthernet4/2
O   2003::/64 [110/2]
     via FE80::218:19FF:FECD:92C8,
FastEthernet4/2
C   2004::/64 [0/0]
     via ::, FastEthernet4/3
L   2004::1/128 [0/0]
     via ::, FastEthernet4/3
R   2005::/64 [120/2]
     via FE80::EAB7:48FF:FE6E:88,
FastEthernet4/3
O   2020::/64 [110/3]
     via FE80::217:E0FF:FE51:B2B1,
FastEthernet4/1
O   2021::/64 [110/3]
     via FE80::218:19FF:FECD:92C8,
FastEthernet4/2
L   FE80::/10 [0/0]
     via ::, Null0
L   FF00::/8 [0/0]
     via ::, Null0
```

```
Codes: C - connected, S - static, R -
RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external,
O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1,
N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 -
OSPF external type 2, E - EGP
       i - IS-IS, su - IS-IS summary,
L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * -
candidate default, U - per-user static
route
       o - ODR, P - periodic downloaded
static route
```

```
Gateway of last resort is not set

     192.168.1.0/24 is variably
subnetted, 6 subnets, 5 masks
C       192.168.1.96/28 is directly
connected, FastEthernet4/2
C       192.168.1.120/30 is directly
connected, FastEthernet4/3
R       192.168.1.124/30 [120/1] via
192.168.1.122, 00:00:05,
FastEthernet4/3
O       192.168.1.112/29 [110/2] via
192.168.1.110, 00:58:18,
FastEthernet4/2
C       192.168.1.64/27 is directly
connected, FastEthernet4/1
O       192.168.1.0/26 [110/2] via
192.168.1.65, 00:58:18, FastEthernet4/1
     192.168.2.0/30 is subnetted, 1
subnets
O       192.168.2.4 [110/3] via
192.168.1.65, 00:58:19, FastEthernet4/1
     192.168.3.0/30 is subnetted, 1
subnets
O       192.168.3.0 [110/3] via
192.168.1.110, 00:58:19,
FastEthernet4/2
```

Problems

Problems with redistribution were prevalent in this lab. As I mentioned earlier, network statements with “O E2” were not showing up on any routers and I could not ping nor trace route between any of the top Routers with the bottom routers. The process of researching the appropriate protocols consumed more time than I expected. I eventually reached the point where all routes were present except the redistribution and thus had to struggle to fix the redistribution problems.

Conclusion

Although the lab consumed more time than I had expected due to the difficulty with redistributing different routing protocols, the overall result of this lab was satisfactory. I enabled the concurrent run on IPv4 and IPv6 on every network present being able to ping and trace route from one end to the other. I’ve learned how to manage OSPF, OSPF v3, RIP, and RIPng simultaneously, with IPv4 and IPv6 addresses, an experience that I never had in CCNA.