INFR-2411U: Case Study

11.21.2016

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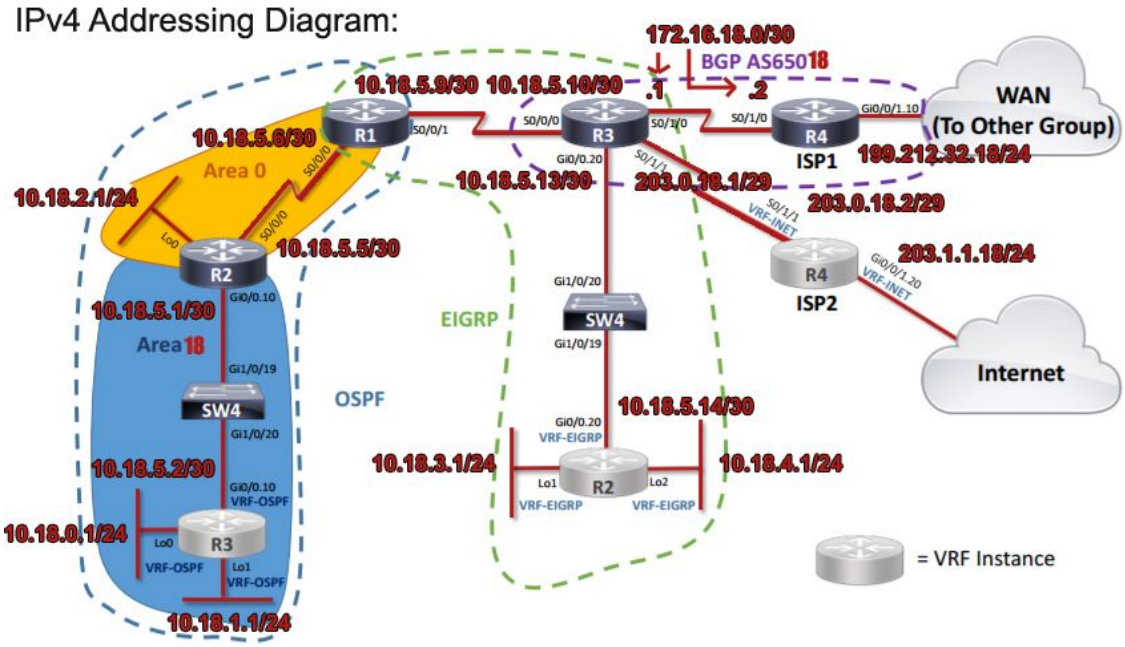
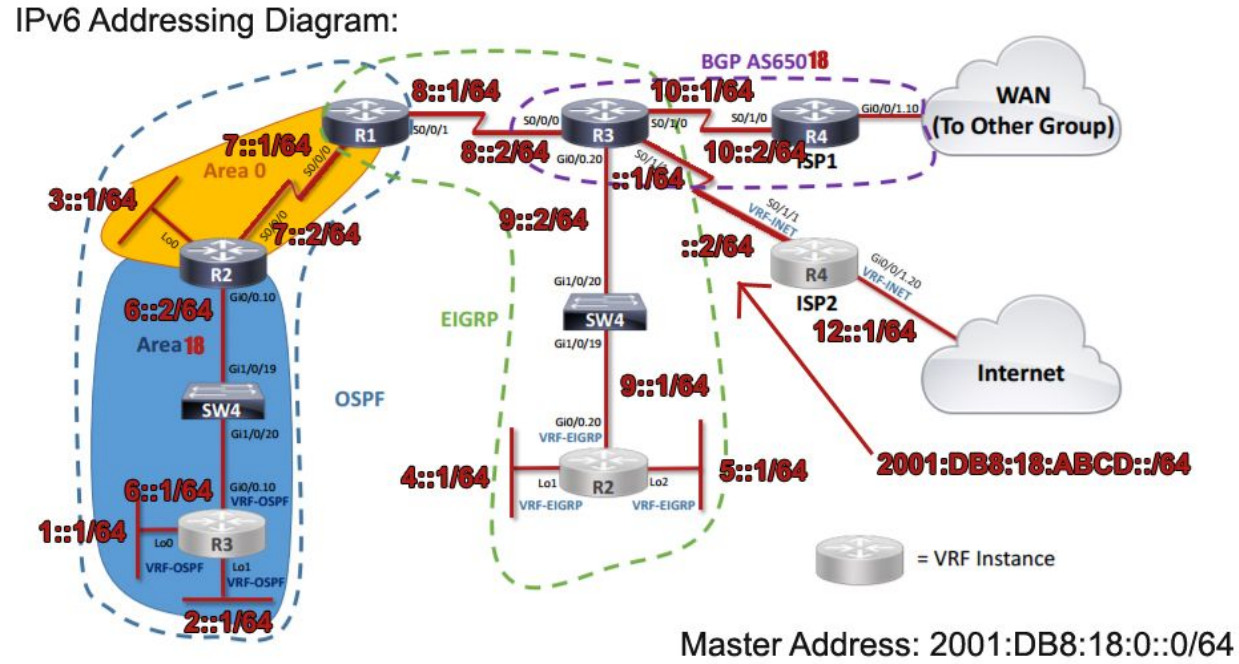


IPv6 Topology Diagram:



Logical Setup

- Name all devices according to the topology diagram (R1-R4, SW4).

As illustrated below the four routers, and the single layer 2 switch, have had their hostnames changed in global configuration mode to avoid confusion when configuring them remotely. This is done with the "*hostname [name]*" command issued in global config mode.

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname R1
R1(config)#
```

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname R2
R2(config)#
```

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname R3
```

```
Router>EN
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname R4
```

```
Switch>en
Switch#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#hostname SW4
```

- Be sure to shut down any unused ports on the routers and switches. Failure to do so will result in unexpected route selections.

Ports can be shutdown by issuing the "*shutdown*" command while in the desired interface within the CLI. In this case we used "*int range [int # - #]*" to shut down multiple ports at once while on the switch. As illustrated below gigabit ports ranged from 1 - 18 and 21 - 28 have been put into a shutdown state. Gigabit ports g0/0/0 and g0/0/2 have been shut down on router

four. Serial port s0/0/1 has been shut down on router three. Serial 0/0/1 and gigabit port 0/1 were shut down on router two. Finally, Gigabit port 0/0 and 0/1 were shut down.

Switch #4:

```
SW4(config)#int range g1/0/1 - 18
SW4(config-if-range)#shutdown
```

```
SW4(config)#int range g1/0/21 - 28
SW4(config-if-range)#shutdown
```

```
Interface              IP-Address      OK? Method Status                Protocol
Vlan1                  unassigned      YES unset  up                    down
FastEthernet0          unassigned      YES unset  up                    up
GigabitEthernet1/0/1   unassigned      YES unset  administratively down down
GigabitEthernet1/0/2   unassigned      YES unset  administratively down down
GigabitEthernet1/0/3   unassigned      YES unset  administratively down down
GigabitEthernet1/0/4   unassigned      YES unset  administratively down down
GigabitEthernet1/0/5   unassigned      YES unset  administratively down down
GigabitEthernet1/0/6   unassigned      YES unset  administratively down down
GigabitEthernet1/0/7   unassigned      YES unset  administratively down down
GigabitEthernet1/0/8   unassigned      YES unset  administratively down down
GigabitEthernet1/0/9   unassigned      YES unset  administratively down down
GigabitEthernet1/0/10  unassigned      YES unset  administratively down down
GigabitEthernet1/0/11  unassigned      YES unset  administratively down down
GigabitEthernet1/0/12  unassigned      YES unset  administratively down down
GigabitEthernet1/0/13  unassigned      YES unset  administratively down down
GigabitEthernet1/0/14  unassigned      YES unset  administratively down down
GigabitEthernet1/0/15  unassigned      YES unset  administratively down down
GigabitEthernet1/0/16  unassigned      YES unset  administratively down down
GigabitEthernet1/0/17  unassigned      YES unset  administratively down down
GigabitEthernet1/0/18  unassigned      YES unset  administratively down down
GigabitEthernet1/0/19  unassigned      YES unset  down                  down
GigabitEthernet1/0/20  unassigned      YES unset  down                  down
GigabitEthernet1/0/21  unassigned      YES unset  administratively down down
GigabitEthernet1/0/22  unassigned      YES unset  administratively down down
GigabitEthernet1/0/23  unassigned      YES unset  administratively down down
GigabitEthernet1/0/24  unassigned      YES unset  administratively down down
GigabitEthernet1/0/25  unassigned      YES unset  administratively down down
GigabitEthernet1/0/26  unassigned      YES unset  administratively down down
GigabitEthernet1/0/27  unassigned      YES unset  administratively down down
GigabitEthernet1/0/28  unassigned      YES unset  administratively down down
```

Router #4:

```
R4(config)#int g0/0/0
R4(config-if)#shutdown
R4(config-if)#
R4(config-if)#int g0/0/2
R4(config-if)#shutdown
```

```
R4(config-if)#do show ip int brief
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0/0   unassigned      YES unset  administratively down down
GigabitEthernet0/0/1   unassigned      YES unset  administratively down down
GigabitEthernet0/0/2   unassigned      YES unset  administratively down down
Serial0/1/0            unassigned      YES unset  administratively down down
Serial0/1/1            unassigned      YES unset  administratively down down
GigabitEthernet0       unassigned      YES unset  administratively down down
```

Router #3:

```
R3(config-if)#int s0/0/1
R3(config-if)#shutdown
R3(config-if)#do show ip int brief
Interface                  IP-Address      OK? Method Status                Protoc
ol
Embedded-Service-Engine0/0 unassigned      YES unset  administratively down down

GigabitEthernet0/0         unassigned      YES unset  administratively down down

GigabitEthernet0/1         unassigned      YES unset  administratively down down

Serial0/0/0                unassigned      YES unset  administratively down down

Serial0/0/1                unassigned      YES unset  administratively down down

Serial0/1/0                unassigned      YES unset  administratively down down

Serial0/1/1                unassigned      YES unset  administratively down down
```

Router #2:

```
R2(config)#int s0/0/1
R2(config-if)#shutdown
R2(config-if)#
R2(config-if)#int g0/1
R2(config-if)#shutdown
R2(config-if)#do show ip int brief
Interface                  IP-Address      OK? Method Status                Protocol
Embedded-Service-Engine0/0 unassigned      YES unset  administratively down down
GigabitEthernet0/0         unassigned      YES unset  up                    up
GigabitEthernet0/0.10      10.18.5.1       YES manual up                    up
GigabitEthernet0/0.20      10.18.5.14      YES manual up                    up
GigabitEthernet0/1         unassigned      YES unset  administratively down down
Serial0/0/0                10.18.5.5       YES manual up                    up
Serial0/0/1                unassigned      YES unset  administratively down down
Loopback0                  10.18.2.1       YES manual up                    up
Loopback1                  10.18.3.1       YES manual up                    up
Loopback2                  10.18.4.1       YES manual up                    up
```

Router #1:

```
Router(config)#int g0/0
Router(config-if)#shutdown
Router(config-if)#
Router(config-if)#int g0/1
Router(config-if)#shutdown
Router(config-if)#
Router(config-if)#do show ip int brief
Interface                  IP-Address      OK? Method Status                Protocol
Embedded-Service-Engine0/0 unassigned      YES unset  administratively down down
GigabitEthernet0/0         unassigned      YES unset  administratively down down
GigabitEthernet0/1         unassigned      YES unset  administratively down down
Serial0/0/0                10.18.5.6       YES SLARP  up                    up
Serial0/0/1                unassigned      YES unset  administratively down down
```

- Turn on ipv6 unicast-routing on all routers.

Routers one through four were enabled for ipv6 unicast routing while in global configuration mode, as illustrated below.

```
R1(config)#ipv6 unicast-routing
```

```
R2(config)#ipv6 unicast-routing
```

```
R3(config)#ipv6 unicast-routing
```

```
R4(config)#ipv6 unicast-routing
```

- Make a VRF named VRF-OSPF on R3, a VRF named VRF-EIGRP on R2, and a VRF called VRFINET on R4. Make sure you use the vrf definition command, not the ip vrf command.

A VRF can be created by entering the "*vrf definition [vrf name]*" command into the global config mode. Three VRF's were created: "*VRF-EIGRP*" on router two, "*VRF-OSPF*" on router three, and "*VRF-INET*" on router four.

```
R2(config)#vrf definition VRF-EIGRP
R2(config-vrf)#
```

```
R3(config)#vrf definition VRF-OSPF
R3(config-vrf)#
```

```
R4(config)#vrf definition VRF-INET
R4(config-vrf)#
```

- Assign route distinguishers 650xx:y where xx is your 2-digit group number (e.g. 01, 02, 03…10, 11, etc.) and y is the router number (e.g. on R2 y = 2) to your VRFs.

The "*rd 650xx:y*" command can be entered in the desired VRF by entering the VRF config area from the global configuration mode. VRF configuration mode can be entered using the "*vrf definition [vrf name]*" command while in global configuration mode. Router two was assigned a route distinguisher of 65018:2. The two signifies this RD belongs to router two. The same RD was applied to routers three and four; except with the difference of the final digit being incremented by one for each router.

```
R2(config-vrf)#rd 65018:2
R2(config-vrf)#
```

```
R3(config-vrf)#rd 65018:3
R3(config-vrf)#
```

```
R4(config-vrf)#rd 65018:4
R4(config-vrf)#
```

- Add both the IPv4 and IPv6 address families to each VRF

Whilst in the "config-vrf" mode, reached from the global config mode, we added address families to VRF-EIGRP on R2, VRF-OSPF on R3, and VRF-INET on R4 as illustrated below.

```
R2(config-vrf)#address-family ipv4
R2(config-vrf-af)#exit-address-family
R2(config-vrf)#address-family ipv6
R2(config-vrf-af)#exit-address-family
R2(config-vrf)#
```

```
R3(config-vrf)#address-family ipv4 unicast
R3(config-vrf-af)#exit address-family ipv4 unicast
                   ^
% Invalid input detected at '^' marker.

R3(config-vrf-af)#exit-address-family
R3(config-vrf)#address-family ipv6 unicast
R3(config-vrf-af)#exit-address-family
R3(config-vrf)#
```

```
R4(config-vrf)#address-family ipv4 unicast
R4(config-vrf-af)#exit-address-family
R4(config-vrf)#address-family ipv6 unicast
R4(config-vrf-af)#exit-address-family
R4(config-vrf)#
```

- Assign interfaces to the VRFs as shown in the topology diagram.

Loopback interfaces one and two on router two were added to the “VRF-EIGRP” VRF using the “*vrf forwarding [vrf name]*” command issued in the desired interfaces. Gigabit interface g0/0.10 and loopback interfaces zero and one on router three were added to the “VRF-OSPF” VRF using the “*vrf forwarding [vrf name]*” command issued in the desired interfaces.

```
R2(config)#int lo1
R2(config-if)#
*Nov 26 14:47:19.751: %LINEPROTO-5-UPDOWN: Line protocol on Interface Loopb
ack1, changed state to up
R2(config-if)#vrf forwarding VRF-EIGRP
R2(config-if)#int lo2
R2(config-if)#
*Nov 26 14:47:52.787: %LINEPROTO-5-UPDOWN: Line protocol on Interface Loopb
ack2, changed state to upvrf forwarding VRF-EIGRP
R2(config-if)#
```

```
R3(config-if)#int g0/0.10
R3(config-subif)#vrf forwarding VRF-OSPF
R3(config-subif)#int lo0
R3(config-if)#vr
*Nov 26 14:56:44.371: %LINEPROTO-5-UPDOWN: Line protocol on Interface Loopb
ack0, changed state to
R3(config-if)#vrf forwarding VRF-OSPF
R3(config-if)#int lo1
R3(config-if)#
*Nov 26 14:57:08.939: %LINEPROTO-5-UPDOWN: Line protocol on Interface Loopb
ack1, changed state to up
R3(config-if)#vrf forwarding VRF-OSPF
R3(config-if)#
```

- Create the VLANs on the switch as indicated in the topology diagram. Gi1/0/19 & Gi1/0/20 should both be set as static trunk links. Set VTP to Transparent mode.

First we created two VLAN's, 10 and 20, with the names of "vlan 10 and "vlan 20". Interfaces G1/0/19 and G1/0/20 were first set to be trunk links using the "switchport mode trunk" command in the desired interface. This means the switch can exchange and identify traffic tagged as either VLAN 10 or 20. After this the "*switchport trunk allowed vlan 10,20*" command was issued which tells the switch what vlan traffic is allowed to flow through that interface. The interfaces were then turned on using "*no shut*".

```
SW4(config)#vlan 10
SW4(config-vlan)#name VLAN10
SW4(config-vlan)#
SW4(config-vlan)#vlan 20
SW4(config-vlan)#name VLAN20
SW4(config-vlan)#
SW4(config-vlan)#int g1/0/19
SW4(config-if)#switchport mode trunk
SW4(config-if)#switchport trunk allowed vlan 10,20
SW4(config-if)#no shut
SW4(config-if)#
SW4(config-if)#int g1/0/20
SW4(config-if)#switchport mode trunk
SW4(config-if)#switchport trunk allowed vlan 10,20
SW4(config-if)#no shut
SW4(config-if)#exit
SW4(config)#
SW4(config)#vtp mode transparent
Device mode already VTP Transparent for VLANS.
SW4(config)#
```

- Set the clock rate of each serial link to 64,000 bps on all DCE interfaces.

All DCE serial interfaces on routers one and three, illustrated below, were set to a clock-rate of 64000. This was done using the "*clockrate [speed in bps]*" command within the desired interface in CLI. The interface can be selected while in the global configuration mode.

```
R1(config)#int s0/0/1
R1(config-if)#int s0/0/0
R1(config-if)#clockrate 64000
R1(config-if)#
```

```
R3(config)#int s0/1/0
R3(config-if)#clockrate 64000
R3(config-if)#int s0/1/1
R3(config-if)#clockrate 64000
R3(config-if)#int s0/0/0
R3(config-if)#clockrate 64000
R3(config-if)#
```

Addressing

- Assign R3 s0/1/1 the IPv4 address 203.0.x.1/29 and R4 s0/1/1 the IPv4 address 203.0.x.2/29.

```
R3(config)#int s0/1/1
R3(config-if)#ip add 203.0.18.1 255.255.255.248
```

```
R4(config)#int s0/1/1
R4(config-if)#ip add 203.0.18.2 255.255.255.248
```

This is the point-to-point link between R3 and R4. Both respective addresses are configured with a /29 subnet mask.

- Assign R3 s0/1/0 the IPv4 address 172.16.x.1/30 and R4 s0/1/0 the IPv4 address 172.16.x.2/30.

```
R3(config)#int s0/1/0
R3(config-if)#ip add 172.16.18.1 255.255.255.252
```

```
R4(config)#int s0/1/0
R4(config-if)#ip add 172.16.18.2 255.255.255.252
```

This is the point-to-point link between R3 and VRF-INET. Both respective addresses are configured with a /30 subnet mask.

- Assign R3 s0/1/1 the IPv6 address 2001:DB8:x:ABCD::1/64 and R4 s0/1/1 the IPv6 address 2001:DB8:x:ABCD::2/64.

```
R3(config)#int s0/1/1
R3(config-if)#ipv6 add 2001:db8:18:ABCD::1/64
```

```
R4(config)#int s0/1/1
R4(config-if)#ipv6 add 2001:db8:18:ABCD::2/64
```

This is the point-to-point link between R3 and R4. Both are configured with their respective ipv6 addresses and a /64 subnet.

- Assign R4 Gi0/0/1.10 (VLAN 10) the IPv4 address 199.212.32.x/24.

```
R4(config)#interface GigabitEthernet0/0/1.10
R4(config-subif)#encapsulation dot1Q 10
R4(config-subif)#ip address 199.212.32.18 255.255.255.0
```

R4's G0/0/1.10 interface is configured with its respective ip address with a subnet mask of /24. Since the interface is a sub-interface, encapsulation must be configured before addressing.

- Assign R4 Gi0/0/1.20 (VLAN 20) the IPv4 address 203.1.1.x/24 and the IPv6 address 2001:DB8:0:0::x/64.

```
R4(config)#int g0/0/1.20
R4(config-subif)#ip add 203.1.1.18 255.255.255.0
R4(config-subif)#ipv6 add 2001:db8:0:0::18/64
```

R4's G0/0/1.20 sub-interface is configured with its respective Ipv4 and Ipv6 addresses. Before this, encapsulation dot1q 20 was configured to enable the sub-interface.

- Assign a /24 IPv4 subnet and a /64 IPv6 subnet to each Loopback interface. Use the pools shown in the diagram. Assign the first address in the range to the router interface.

```
R2(config)#int lo1
R2(config-if)#ip add 10.18.3.1 255.255.255.0
R2(config-if)#ipv6 add 2001:db8:18:5::1/64
```

This is just one of the many loopback interfaces assigned an ipv4 and ipv6 address. They use the subnet mask of /24 and /64 respectively. All loopbacks are addressed in the same fashion except with different addresses.

- Assign a /30 IPv4 subnet and a /64 IPv6 subnet to each point-to-point link between routers. Use the pools shown in the diagram. Give the lower numbered router the first address in each range, and the other router the second address.

```
R1(config)#int s0/0/0
R1(config-if)#ip add 10.18.5.6 255.255.255.252
R1(config-if)#ipv6 add 2001:db8:18:7::1/64
```

```
R2(config)#int s0/0/0
R2(config-if)#ip address 10.18.5.5 255.255.255.252
R2(config-if)#ipv6 address 2001:DB8:18:7::2/64
```

This is just one of many point-to-point links configured with a ipv4 and ipv6 address. They use a subnet mask of /30 and /64 respectively. All other point-to-point links are addressed in the same fashion except with different addresses.

- Statically configure link-local addresses on each router interface to be FE80::y, where y is the router number (e.g. R3 would have FE80::3 on all of its interfaces).

```
R2(config)#int s0/0/0
R2(config-if)#ipv6 address FE80::2 link-local
```

```
R2(config)#int g0/0.10
R2(config-subif)#ipv6 add FE80::2 link-local
```

```
R2(config)#int g0/0.20
R2(config-subif)#ipv6 add FE80::2 link-local
```

These three interfaces on R2 are configured with the same ipv6 link local address, FE80::2. All other routers configured with IPv6 are configured the same way except their link local addresses use their respective router number.

OSPF

- Use a process number equal to your group number.

While in global config mode the "*router ospfv3 [AS #]*" command is issued with a autonomous system number of 18. 18 Represents our group number.

```
R1(config)#router ospfv3 18
R1(config-router)#
```

```
R2(config)#router ospfv3 18
R2(config-router)#
```

```
R3(config)#router ospfv3 18
R3(config-router)#
```

- Set the bandwidth of all interfaces appropriately.

Serial interfaces 0/0/1 and 0/0/0 on router one were given a bandwidth rating of 64 bytes using the "*bandwidth [bandwidth in bytes]*" command whilst in the desired interface. Interfaces

loopback 0, 1, 2, gigabit 0/0, 0/0.10, 0/0.20 were set to a bandwidth of 1024 bytes. And serial 0/0/0 was set to a bandwidth of 64 bytes on router two. Router three gigabit interfaces g0/0 g0/0.10, g0/0.20, loopback lo0, and lo1 were given a bandwidth of 1024. While the serial interfaces 0/0/0, and 0/1/0 were given a bandwidth of 64 bytes. Finally gigabit interfaces on router four 0/0/1, 0/0/1.10, and 0/0/1.20 were given a bandwidth of 1024 bytes. The serial interfaces 0/1/0, and 0/1/1 were given a bandwidth of 64 bytes.

```
R1(config)#int s0/0/1
R1(config-if)#bandwidth 64
R1(config-if)#int s0/0/0
R1(config-if)#bandwidth 64
R1(config-if)#
```

```
R2(config)#int lo0
R2(config-if)#bandwidth
*Nov 26 15:38:11.019: %LINEPROTO-5-UPDOWN: Line protocol on Interface Loopb
ack0, changed state to up 1024
R2(config-if)#int lo1
R2(config-if)#bandwidth 1024
R2(config-if)#int lo2
R2(config-if)#bandwidth 1024
R2(config-if)#int g0/0
R2(config-if)#bandwidth 1024
R2(config-if)#int g0/0.20
R2(config-subif)#bandwidth 1024
R2(config-subif)#int s0/0/0
R2(config-if)#bandwidth 64
R2(config-if)#int g0/0.10
R2(config-subif)#bandwidth 1024
R2(config-subif)#
```

```
R3(config)#int g0/0
R3(config-if)#bandwidth 1024
R3(config-if)#int g0/0.10
R3(config-subif)#bandwidth 1024
R3(config-subif)#int lo0
R3(config-if)#bandwidth 1024
R3(config-if)#int lo1
R3(config-if)#bandwidth 1024
R3(config-if)#int s0/1/0
R3(config-if)#bandwidth 64
R3(config-if)#int s0/0/0
R3(config-if)#bandwidth 64
R3(config-if)#int g0/0.20
R3(config-subif)#bandwidth 1024
R3(config-subif)#
```

```
R4(config)#int g0/0/1
R4(config-if)#bandwidth 1024
R4(config-if)#int g0/0/1.20
R4(config-subif)#bandwidth 1024
R4(config-subif)#int g0/0/1.10
R4(config-subif)#bandwidth 1024
R4(config-subif)#int s0/1/0
R4(config-if)#bandwidth 64
R4(config-if)#int s0/1/1
R4(config-if)#bandwidth 64
R4(config-if)#
```

- Change the OSPF reference bandwidth to 100Gbps.

Within the OSPFV3 18 process on routers one, two, and three the "*auto-cost reference-bandwidth 100000*" command was issued. This command ensures that gigabit capable interfaces are not given the same cost as a slower interface such as fast ethernet. Which is only capable of 100 megabits bandwidth at any given point of time.

```
R1(config)#router ospfv3 18
R1(config-router)#auto-cost reference-bandwidth 100000
R1(config-router)#
```

```
R2(config)#router ospfv3 18
R2(config-router)#auto-cost refer
R2(config-router)#auto-cost reference-bandwidth 100000
R2(config-router)#
```

```
R3(config)#router ospfv3 18
R3(config-router)#auto-cost refer
R3(config-router)#auto-cost reference-bandwidth 100000
R3(config-router)#
```

- Enable OSPFv3 on R1, R2, and R3 for both IPv4 and IPv6 address families, on the interfaces indicated in the diagram. (Note that the commands all start with "ospfv3", not the older "ipv6 router ospf" or "ip ospf" commands).

On routers one, two, and three the commands "*ospfv3 18 ipv4 area [AS #]*" and "*ospfv3 18 ipv6 area [AS #]*" were entered while in the desired interface taking part in OSPFV3 operation. These commands are in equivalent to the "*network [network IP] [wildcard mask]*" command seen in typical OSPF. R1 had the interface s0/0/0 added to the backbone area 0. R2 had the interfaces lo0, s0/0/0, and g0/0.10 added to the backbone area 0. R3 had interfaces lo0, lo1, and g0/0.10 added to the area 18. It is also important to note that an interface must have a IPv4 address, IPv6 address, and in the case of subinterfaces dot1q encapsulation enabled in order to be added to both IPv4 and IPv6 OSPFV3 areas.

```
R1(config-router)#int s0/0/0
R1(config-if)#ospfv3 18 ipv4 area 0
% OSPFv3-18-IPv4:  Reference bandwidth is changed.
        Please ensure reference bandwidth is consistent across all routers.
R1(config-if)#ospfv4 18 ipv6 area 0
                ^
% Invalid input detected at '^' marker.

R1(config-if)#ospfv3 18 ipv6 area 0
% OSPFv3-18-IPv6:  Reference bandwidth is changed.
        Please ensure reference bandwidth is consistent across all routers.
R1(config-if)#
```

```
R2(config)#int lo0
R2(config-if)#ospfv3 18 ipv4 area 0
% OSPFv3: IPV6 is not enabled on this interface
R2(config-if)#ipv6 enable
R2(config-if)#ospfv3 18 ipv4 area 0
% OSPFv3-18-IPv4:  Reference bandwidth is changed.
        Please ensure reference bandwidth is consistent across all routers.
% OSPFv3: OSPFv3 will not operate on this interface until IP is configured
on it.
R2(config-if)#int s0/0/0
R2(config-if)#ipv6 enable
R2(config-if)#ospfv3 18 ipv4 area 0
R2(config-if)#
*Nov 26 16:01:43.583: %OSPFv3-5-ADJCHG: Process 18, IPv4, Nbr 10.21.8.5 on
Serial0/0/0 from LOADING to FULL, Loading Done
R2(config-if)#ospfv3 18 ipv6 area 0
% OSPFv3-18-IPv6:  Reference bandwidth is changed.
        Please ensure reference bandwidth is consistent across all routers.
R2(config-if)#
*Nov 26 16:02:08.699: %OSPFv3-5-ADJCHG: Process 18, IPv6, Nbr 10.21.8.5 on
Serial0/0/0 from LOADING to FULL, Loading Done
R2(config-if)#int g0/0.10
R2(config-subif)#ipv6 enable
R2(config-subif)#ospfv3 18 ipv4 area 18
% OSPFv3: OSPFv3 will not operate on this interface until IP is configured
on it.
R2(config-subif)#ip address 10.18.5.1 255.255.255.255

% Configuring IP routing on a LAN subinterface is only allowed if that
subinterface is already configured as part of an IEEE 802.10, IEEE 802.1Q,
or ISL vLAN.

R2(config-subif)#encap
R2(config-subif)#encapsulation dot
R2(config-subif)#encapsulation dot1Q 10
R2(config-subif)#ip address 10.18.5.1 255.255.255.252
R2(config-subif)#ipv6 address 2001:db8:18:6::1/64
R2(config-subif)#ospfv3 18 ipv4 area 18
R2(config-subif)#ospfv3 18 ipv6 area 18
R2(config-subif)#
```

```
R3(config-if)#int lo0
R3(config-if)#ospfv3 18 ipv4 area 18
R3(config-if)#ospfv3 18 ipv4 area 18
R3(config-if)#
R3(config-if)#int lo1
R3(config-if)#ip address 10.18.1.1 255.255.255.0
R3(config-if)#ipv6 address 2001:db8:18:2::1/64
R3(config-if)#ospfv3 18 ipv4 area 18
R3(config-if)#ospfv3 18 ipv6 area 18
R3(config-if)#int g0/0.10
R3(config-subif)#encap
R3(config-subif)#encapsulation dot
R3(config-subif)#encapsulation dot1Q 10
R3(config-subif)#ospfv3 18 ipv4 area 18
% OSPFv3: IPV6 is not enabled on this interface
R3(config-subif)#ipv6 enable
R3(config-subif)#ospfv3 18 ipv4 area 18
% OSPFv3: OSPFv3 will not operate on this interface until IP is configured
on it.
R3(config-subif)#ip address 10.18.5.2 255.255.255.252
R3(config-subif)#ipv6 address 2001:db8:18:6::2/64
R3(config-subif)#ospfv3 18 ipv4 area 18
R3(config-subif)#ospfv3 18 ipv6 area 18
R3(config-subif)#
```

- Use the router number as the router ID (e.g., on R1 use 1.1.1.1). Use this router ID for IPv4, IPv6, and the VRF address families as applicable.

To configure both the IPv4 and IPv6 address-family router ID's we must first enter the OPSFV3 autonomous process from the global config mode; this is done with the "*router ospfv3 [AS #]*" command. From there we enter the "*address-family [ipv4 | ipv6] unicast*" command. Once inside the desired address family we enter the "*router-id [x.x.x.x]*" command for both IPv4 and IPv6 address families. Typically the ID will be the number of the router for ease of viewing in the OSPFV3 route table. For the IPv6 address family the last router ID number will be 6, signifying that it is a IPv6 dynamically distributed route.

```
R1(config)#router ospfv3 18
R1(config-router)#address-family ipv4 unicast
R1(config-router-af)#router-id 1.1.1.1
% OSPFv3-18-IPv4: Reload or use "clear ospfv3 process" command, for this to
 take effect
R1(config-router-af)#address-family ipv6 unicast
R1(config-router-af)#router-id 1.1.1.6
% OSPFv3-18-IPv6: Reload or use "clear ospfv3 process" command, for this to
 take effect
R1(config-router-af)#
```

```
R2(config)#router ospfv3 18
R2(config-router)#address-family ipv4 unicast
R2(config-router-af)#router-id 2.2.2.2
% OSPFv3-18-IPv4: Reload or use "clear ospfv3 process" command, for this to
 take effect
R2(config-router-af)#address-family ipv6 unicast
R2(config-router-af)#router-id 3.3.3.6
% OSPFv3-18-IPv6: Reload or use "clear ospfv3 process" command, for this to
 take effect
R2(config-router-af)#
```

```
R3(config-router)#address-family ipv4 unicast vrf VRF-OSPF
R3(config-router-af)#router-id 3.3.3.3
R3(config-router-af)#address-family ipv4 unicast vrf VRF-OSPF
R3(config-router-af)#router-id 3.3.3.6
R3(config-router-af)#
```

- Change the network type on the loopback interfaces so that the routes are advertised with the correct subnet mask.

Entering the "*ospfv3 network point-to-point*" command, whilst on the desired OSPFV3 involved interface, will tell OSPFV3 we wish to have the entire subnet of the connected route distributed in routing updates. This is done for the lo0 interface on R2 and the lo0 and lo1 interfaces on R3.

```
R2(config-if)#int lo0
R2(config-if)#ospfv3 network point-to-point
R2(config-if)#
```

```
R3(config)#int lo0
R3(config-if)#ospfv3 network point-to-point
R3(config-if)#int lo1
R3(config-if)#ospfv3 network point-to-point
R3(config-if)#
```

- Configure all Loopback interfaces as passive.

Issuing the "*passive-interface [interface type] [int #]*" command in either the IPv4 or IPv6 address family, within the OSPFV3 process of your choice, will prevent the interface from sending out "hello" packets. Thus preventing it from developing neighbor adjacencies. In this case on router two we have set the loopback interface 0 to passive in both IPv4 and IPv6. On router three we have set loopback interface 0 and 1 to passive in both IPv4 and IPv6.

```
R2(config-router)#router ospfv3 18
R2(config-router)#address-family ipv4 unicast
R2(config-router-af)#passive-interface loopback 0
R2(config-router-af)#address-family ipv6 unicast
R2(config-router-af)#passive-interface loopback 0
R2(config-router-af)#
```

```
R3(config-router)#router ospfv3 18
R3(config-router)#address-family ipv4 unicast vrf VRF-OSPF
R3(config-router-af)#passive-interface lo0
R3(config-router-af)#passive-interface lo1
R3(config-router-af)#address-family ipv6 unicast vrf VRF-OSPF
R3(config-router-af)#passive-interface lo0
R3(config-router-af)#passive-interface lo1
R3(config-router-af)#
```

- Configure area x as a totally stubby area for both IPv4 and IPv6.

In our topology router two is the border router between OSPFV3 autonomous system areas 0 and 18. This means we need to set both of its address families as totally stubby areas. A TSA prevents types 3,4, and 5 LSA's except default summary routes through. This can be done by entering the "*area [AS #] stub no-summary*" command into both the IPv4 and IPv6 address families in the router ospfv3 18 process. **Please note that the stub area was changed to the backbone area 0 after this screenshot was taken. You can view the change in the show-run output later in this report.

```
R2(config)#router ospfv3 18
R2(config-router)#address-family ipv4 unicast
R2(config-router-af)#area 18 stub no-summary
R2(config-router-af)#address-family ipv6 unicast
R2(config-router-af)#area 18 stub no-summary
R2(config-router-af)#
```

- Note that on R3 in the VRF address family (IPv4 and IPv6) you must include the following command for your routes to show up in the routing table: capability vrf-lite.

The "*capability vrf-lite*" command can be entered into both the IPv4 and IPv6 address families in the OSPFV3 process of choice. In this case we have entered the "*router ospfv3 18*" process from the global config mode. From here we need to enter the "*address-family [ipv4 | ipv6] unicast vrf [VRF Name]*" command to get to where we can enter the VRF capability command.

```
R3(config)#router ospfv3 18
R3(config-router)#address-family ipv4 unicast vrf VRF-OSPF
R3(config-router-af)#capability vrf-lite
R3(config-router-af)#address-family ipv6 unicast vrf VRF-OSPF
R3(config-router-af)#capability vrf-lite
R3(config-router-af)#
```

EIGRP

- Set the bandwidth of all interfaces appropriately.

```
R1(config)#int s0/0/0
R1(config-if)#bandwidth 64
```

All interfaces are configured the same way, with a bandwidth of 64.

- Enable EIGRP Named Mode on R1, R2, and R3, for both IPv4 and IPv6, as indicated in the diagram. Name your EIGRP process CASE2016

```
R3(config)#router eigrp CASE2016
R3(config-router)#address-fam ipv4 unicast autonomous-system 18
R3(config-router-af)#exi
R3(config-router)#address-fam ipv6 unicast autonomous-system 18
```

We'll use R3's EIGRP named mode config as an example since it is the same on every other EIGRP router.

- Use /32 wildcard masks for each interface in your network commands

```
R3(config-router)#address-fam ipv4 unicast autonomous-system 18
R3(config-router-af)#network 10.18.5.10 0.0.0.0
R3(config-router-af)#network 10.18.5.13 0.0.0.0
R3(config-router-af)#network 203.0.18.1 0.0.0.0
R3(config-router-af)#network 172.16.18.1 0.0.0.0
```

- Use the router number as the router ID (e.g., on R1 use 1.1.1.1). Use this router ID for IPv4, IPv6, and the VRF address families as applicable

```
R3(config)#router eigrp CASE2016
R3(config-router)#address-fam ipv4 unicast autonomous-system 18
R3(config-router-af)#eigrp router-id 3.3.3.3
R3(config-router-af)#exi
R3(config-router)#address-fam ipv6 unicast autonomous-system 18
R3(config-router-af)#eigrp router-id 3.3.3.6
```

This is only one of various configurations including R1 (1.1.1.1, 1.1.1.6), and R2 (2.2.2.2, 2.2.2.6).

- By default, all IPv6 interfaces participate in EIGRP Named Mode. Remove EIGRP from interfaces where it is not required (check show ipv6 eigrp interface).

These IPv6 interfaces not participating in the EIGRP are removed using these commands within the EIGRP named mode.

- Configure all Loopback interfaces as passive

```
R2(config)#router eigrp CASE2016
R2(config-router)#$ily ipv4 unicast vrf VRF-EIGRP autonomous-system 18
R2(config-router-af)#af-interface lo1
R2(config-router-af-interface)#passive-interface
R2(config-router-af-interface)#exit-af-interface
R2(config-router-af)#
R2(config-router-af)#af-interface lo2
R2(config-router-af-interface)#passive-interface
R2(config-router-af-interface)#exit-af-interface
R2(config-router-af)#exit-address-family
R2(config-router)#
R2(config-router)#$ily ipv6 unicast vrf VRF-EIGRP autonomous-system 18
R2(config-router-af)#af-interface lo1
R2(config-router-af-interface)#passive-interface
R2(config-router-af-interface)#exit-af-interface
R2(config-router-af)#
R2(config-router-af)#af-interface lo2
R2(config-router-af-interface)#passive-interface
R2(config-router-af-interface)#exit-af-interface
R2(config-router-af)#exit-address-family
```

Loopbacks 1 and 2 on VRF-EIGRP are set to passive.

- Configure R2 VRF-EIGRP as a stub router in both IPv4 and IPv6, advertising only connected routes.

```
R2(config-router-af)#router eigrp CASE2016
R2(config-router)#$ily ipv4 unicast vrf VRF-EIGRP autonomous-system 18
R2(config-router-af)#eigrp stub connected
R2(config-router-af)#$ily ipv6 unicast vrf VRF-EIGRP autonomous-system 18
R2(config-router-af)#
R2(config-router-af)#
R2(config-router-af)#eigrp stub connected
```

VRF-EIGRP is configured as a stub router in both address-families IPv4 and IPv6, AS 18.

Redistribution

- Perform mutual redistribution between EIGRP and OSPF on R1 for both IPv4 and IPv6. For EIGRP metrics use the following values:
- Bandwidth: 1 Gbps
- Delay: 100 µsec
- Reliability: 255/255
- Load: 1/255
- MTU: 1500

```
R1(config)#router ospfv3 18
R1(config-router)#address-family ipv4 unicast
R1(config-router-af)#redistribute eigrp 18
R1(config-router-af)#default-information originate
R1(config-router-af)#address-fam ipv6 unicast
R1(config-router-af)#default-information originate
R1(config-router-af)#redistribute eigrp 18 include-connected
R1(config-router-af)#
```

This is redistributing EIGRP into OSPF.

```
R1(config)#router eigrp CASE2016
R1(config-router)#address-fam ipv4 unicast autonomous-system 18
R1(config-router-af)#topology base
R1(config-router-af-topology)#$e ospfv3 18 metric 100000 100 255 1 1500
```

```
R1(config-router)#address-family ipv6 unicast autonomous-system 18
R1(config-router-af)#topology base
R1(config-router-af-topology)#$e ospf 18 metric 100000 100 255 1 1500
```

This is redistributing OSPF into EIGRP using the given metrics in the order of Bandwidth, Delay, Reliability, Load, and MTU.

- Create a static default route on R3 pointing to the IPv4 address of ISP2 (R4). Do the same for IPv6.

A default route is created on R3 that uses a next hop address configured on ISP2 (R4)

- Create a static default route on R4 to 203.1.1.254 (a gateway on the Internet).

```
R4(config)#ip route 0.0.0.0 0.0.0.0 203.1.1.254
```

A last resort static route that directs IPv4 traffic from any address to the destination IPv4 address 203.1.1.254.

- Distribute the default route for IPv4 and IPv6 via redistribution into EIGRP, using the metrics given previously for R1.

```
R1(config)#router ospfv3 18
R1(config-router)#address-fam ipv4 unicast
R1(config-router-af)#redistribute static metric 100000
```

```
R1(config-router)#address-fam ipv6 unicast
R1(config-router-af)#redistribute static metric 100000
```

Within both OSPFv3 address families, the default is redistributed with the given metrics.

- On R1, originate a default route into OSPFv3, only as long as there is a default route already in R1's routing table

```
R1(config)#router ospfv3 18
R1(config-router)#address-fam ipv4 unicast
R1(config-router-af)#default-info originate
R1(config-router-af)#exi
R1(config-router)#address-fam ipv6 unicast
R1(config-router-af)#default-info originate
```

Within both OSPFv3 address families, a default route is originated if there is a default route already in R1's routing table.

- Create a static route on R4 to the 2001:db8:x::/48 subnet. Be sure this route is created in the VRF-INET VRF.

```
R4(config)#ipv6 route vrf VRF-INET 2001:db8:18::/48 s0/1/1
```

An IPv6 VRF static route is made to the 2001:db8:18::/48 network through the s0/1/1 interface on the VRF.

- Summarize the IPv4 routes in OSPF Area x to the most efficient summary address and advertise it into Area 0.

```
R2(config)#router ospfv3 18
R2(config-router)#address-fam ipv4 unicast
R2(config-router-af)#area 18 range 10.18.0.0 255.255.248.0
```

All Ipv4 addresses in Area 18 are summarized to a /21 subnet mask. It is then advertised to area 0 within the OSPFv3 process on R2.

MP-BGP

- The BGP AS number is 650xx, where xx is your 2-digit group number (e.g. 01, 02, 03…10, 11, etc.).

Illustrated below we have created two BGP routing processes within the same AS number. This was achieved by entering the "*router bgp 65018*" command into the global configuration mode.

```
R3(config)#router bgp 65018
R3(config-router)#
```

```
R4(config)#router bgp 65018
R4(config-router)#
```

- Use router ID x.y.y.y, where x is your group number and y is the router number (e.g. Group 5 would use 5.3.3.3 on R3).

Next we entered the "*bgp router-id [Group-ID-#.Router#.Router#.Router#]*" command while in the BGP "config-router" CLI location. In this case we entered "*bgp router-id 18.3.3.3*" for router three; and "*bgp router-id 18.4.4.4*" for router four.

```
R4(config-router)#router bgp 65018
R4(config-router)#bgp router-id 18.4.4.4
R4(config-router)#
```

```
R3(config)#router bgp 65018
R3(config-router)#bgp router-id 18.3.3.3
R3(config-router)#
```

- Configure iBGP neighbor relationships between R3 and R4 as shown in the topology diagram.

In order to establish a neighbor adjacency with another router in BGP, you must manually specify the other neighbor in which you wish to form that relationship with. Illustraited below we entered "*neighbor 172.16.18.2 remote-as 65018*" in router threes BGP routing process. The same command was entered on router four, except the address in the IP field of the command belonged to router three. Because of this the two routers formed a iBGP adjacency.

```
R3(config)#router bgp 65018
R3(config-router)#neighbor 172.16.18.2 remote-as 65018
R3(config-router)#
```

```
R4(config)#router bgp 65018
R4(config-router)#neighbor 172.16.18.1 remote-as 65018
```

- Configure R3 and R4 to advertise themselves as the next hop for all IPv4 routes they exchange with each other.

Illustrated below we entered the "*neighbor [Desired Neighbor's IP] next-hop-self*" command while in the relevant BGP autonomous process. The desired neighbors IP in this case is the IPv4 address of the opposing router we are in a BGP neighborship with. Router three (172.16.18.2) tells router four (172.16.18.1) that it is the next hop for all possible IPv4 routes exchanged between the two; and vice versa.

```
R3(config)#router bgp 65018
R3(config-router)#neighbor 172.16.18.2 next-hop-self
```

```
R4(config)#router bgp 65018
R4(config-router)#neighbor 172.16.18.1 next-hop-self
```

- The configuration should use MP-BGP to carry both IPv4 and IPv6 routes (IPv6 will be configured in Task 8).

In this step we must identify a "driver" and "passenger" IP scheme for the MP-BGP process. You will notice that on router three we configure the same IPv4 neighbor address in both the IPv4 address family and the IPv6 address family. This is done with the combination of commands "*address-family [ipv4 | ipv6] unicast*" followed by the neighbor command "*neighbor [Neighbor's IP Address] activate*". What we accomplish by doing this is tell the router that IPv4 will be the driver IP scheme for any traffic exchanged between the two routers. If IPv6 traffic is being transmitted between the two it will be encapsulated in an IPv4 header layout.

```
R3(config)#router bgp 65018
R3(config-router)#address-family ipv4 unicast
R3(config-router-af)#neighbor 172.16.18.2 unicast
                                           ^
% Invalid input detected at '^' marker.

R3(config-router-af)#neighbor 172.16.18.2 activate
R3(config-router-af)#address-family ipv6 unicast
R3(config-router-af)#neighbor 172.16.18.2 activate
```

```
R4(config)#router bgp 65018
R4(config-router)#address-family ipv4 unicast
R4(config-router-af)#network 172.16.18.1 activate
                                         ^
% Invalid input detected at '^' marker.

R4(config-router-af)#neighbor 172.16.18.1 activate
R4(config-router-af)#address-family ipv6 unicast
R4(config-router-af)#neighbor 172.16.18.1 activate
```

- Advertise all subnets of the 10.x.0.0/16 networks, except any /32 routes, from R3 to R4. Do not add any static or summary routes to accomplish this.

The illustration below is achieved by entering the "*network [x.x.x.x] mask [x.x.x.x]*" command into the IPv4 address family of the 65018 BGP routing process on router three. The advertised networks are all of the IPv4 subnets located inside the ITA's topology; this includes point-to-point links.

```
R3(config)#router bgp 65018
R3(config-router)#address-family ipv4 unicast
R3(config-router-af)#network 10.18.0.0 mask 255.255.0.0
R3(config-router-af)#network 172.16.18.0 mask 255.255.255.252
R3(config-router-af)#network 10.18.1.0 mask 255.255.255.0
R3(config-router-af)#network 10.18.0.0 mask 255.255.255.0
R3(config-router-af)#network 10.18.5.0 mask 255.255.255.252
R3(config-router-af)#network 10.10.2.0 mask 255.255.255.0
R3(config-router-af)#network 10.18.5.4 mask 255.255.255.252
R3(config-router-af)#network 10.18.5.8 mask 255.255.255.252
R3(config-router-af)#network 10.18.5.12 mask 255.255.255.252
R3(config-router-af)#network 10.18.3.0 mask 255.255.255.0
R3(config-router-af)#network 10.18.4.0 mask 255.255.255.0
```

- Also advertise the 172.16.x.0/30 subnet

This command is entered in the exact same location, for the exact same purpose as the commands located in the previous step.

```
R3(config-router-af)#network 172.16.18.0 mask 255.255.255.252
```

- Configure R3 to set a Local Preference of 500 on all routes received from R4

Firstly we are creating a route map with the name of “LOCALPREF” for IPv4 traffic, and “LOCALPREFV6” for IPv6 traffic from the global config mode. Both of these route maps will apply a local preference value of 500 to any traffic sent through them. From there we navigate to the BGP 65018 process to apply them to traffic received from R4.

```
R3(config)#route-map LOCALPREF permit 10
R3(config-route-map)#set local-preference 500
R3(config-route-map)#exit
R3(config)#
R3(config)#route-map LOCALPREFV6 permit 11
R3(config-route-map)#set local-preference 500
R3(config-route-map)#exit
R3(config)#
R3(config)#router bgp 65018
R3(config-router)#neighbor 172.16.18.2 route-map LOCALPREF in
R3(config-router)#neighbor 172.16.18.2 route-map LOCALPREFV6 in
R3(config-router)#
```

NAT

- Configure NAT on R3 for all IPv4 connections to the Internet. Specifically, use NAT Overload (PAT) so that all outbound connections from 10.x.0.0/16 will be translated to the IP address assigned to the s0/1/1 interface of R3.

```
R3(config)#ip access-list standard NAT
R3(config-std-nacl)#permit 10.18.0.0 0.0.255.255
R3(config-std-nacl)#exit
R3(config)#
R3(config)#ip nat inside source list NAT interface Serial 0/1/1 overload
```

A standard access list is created and permits 10.18.0.0 traffic coming into R3. This traffic will then be translated to the s0/1/1 Ipv4 address when leaving the other s0/1/1 interface to the internet.

```
R3(config)#int s0/0/0
R3(config-if)#ip nat inside
R3(config-if)#
R3(config-if)#int g0/0.20
R3(config-subif)#ip nat inside
R3(config-subif)#
R3(config-subif)#int s0/1/1
R3(config-if)#ip nat outside
```

Interfaces s0/0/0 and g0/0.20 are located on the internal network so they are configured as inside. S0/1/1 leads to the internet, so it is configured as outside.

- Create a static NAT mapping for the IPv4 address of R2's Loopback interface to the global address 203.0.x.3

```
R3(config)#ip nat inside source static 10.18.2.1 203.0.18.3
```

This command translates 10.18.2.1 packets to 203.0.18.3 when they leave s0/1/1 on R3.

Connecting Pods

- Create a tunnel interface on R3 running GRE over IPv4. The tunnel source should be s0/1/0 and the destination should be the address of the other pods R3 s0/1/0 interface. Give the tunnel interface the IPv6 address FEC0:1::x/64. The tunnel should not have any IPv4 address.

  Firstly we must

```
R3(config)#int tunnel 0

R3(config-if)#ipv6 address FEC0:1::18/64
R3(config-if)#tunnel source s0/1/0
R3(config-if)#tunnel dest 172.16.4.1
%LINK-5-CHANGED: Interface Tunnel0, changed state to up

R3(config-if)#
```

- Configure MP-BGP on both R3 routers and form eBGP neighbor relationships between them using their FEC0:1::/64 addresses. These BGP routers should exchange only IPv6 routes.

```
router bgp 65018
neighbor FEC0:1::4 remote-as 65004
address-family ipv6 unicast
neighbor FEC0:1::4 activate
```

The other group's tunnel ipv6 address was FEC0:1::4 and their BGP AS was 65004. We created a neighbor using that address and AS. We then activated it in the IPv6 address family so that we only advertised IPv6 routes to them.

- Advertise all subnets of the 2001:db8:x::/48 from R3 to the other pod, except any /128 routes you may have in your routing table.

```
router bgp 65018
neighbor FEC0:1::4 remote-as 65004
address-family ipv6 unicast
network 2001:DB8:18:ABCD::/64
network 2001:DB8:18:2::/64
```

network 2001:DB8:18:1::/64
network 2001:DB8:18:6::/64
network 2001:DB8:18:3::/64
network 2001:DB8:18:7::/64
network 2001:DB8:18:8::/64
network 2001:DB8:18:9::/64
network 2001:DB8:18:4::/64
network 2001:DB8:18:5::/64
network 2001:DB8:18:10::/64

All IPv6 routes we had in our topology was added into the IPv6 address family in the BGP process.

- Form an eBGP neighbor relationship between R4 on your pod an R4 on the other pod. This relationship should be made using the IPv4 addresses on your Gi0/0/1.10 interfaces.

router bgp 65018
bgp router-id 18.4.4.4
neighbor 199.212.32.4 remote-as 65004

A neighbor was configured on R4 using the other groups R4 g0/1.10 address, 199..212.32.4, and their AS, 65004.

- Advertise all IPv4 routes available on R4 to the other group via MP-BGP.

router bgp 65018
address-family ipv4 unicast
network 172.16.18.0 mask 255.255.255.252
neighbor 199.212.32.4 activate

The neighbor 199.212.32.4 is activated in our IPv4 address family in BGP.

- Configure R4 to set the MED to 50 on all IPv4 routes sent to the other pod.

route-map SET_MED permit 12
set Metric 50
Exi

router bgp 65018
neighbor 199.212.32.4 route-map SET-MED out

A route map is created to set the metric of packets it's applied to. The metric set is 50. Out is specified to make sure this only happens to outgoing packets.

2.

Why Area 18 is configured as totally stubby:

Area 18 is configured as totally stubby most likely to conserve memory on the routers in the area. There are many possible external routes in the topology and Area 18's routers do not need to know them. This can be proven by the fact that Totally Stubby Areas prevent types 3,4, and 5 LSA's; except default summary routes through. Because of this the only way traffic can leave the area is through the default route that points out of R2.

Why NAT Overload is configured on R3:

Since external IPv4 addresses have run out, NAT is used to translate multiple IP addresses to one, or a minimal pool of global addresses, that are used for traversing the internet. NAT overload allows the inside addresses to be applied to different port numbers that are then recorded in a port lookup table on the translating router. This means that an extremely large number of internal IPv4 addresses can communicate over one, or an extremely limited, pool of external IPv4 addresses with minimal slow-down.

Why Redistribution was configured on R1:

Without redistribution, both OSPF and EIGRP would not be able to share their dynamic routing tables with each other. Since we want devices within R2's loopback 0's subnet, and IP's being routed from OSPFV3 area 18 towards the external network (internet) to communicate freely we configure redistribution on the router that borders them both; in this case R1.

Why we used the subnet mask /30 on the point-to-point networks.

We used the subnet mask /30 on the point-to-point networks because we wanted to conserve internal IPv4 address space. Point-to-point networks only require two usable IP addresses and a /30 prefix happens to have only two usable host addresses. This way we are effectively wasting zero address space.

How we chose our addressing scheme.

Networks that are adjacent to each other were placed in adjacent subnets. For example, the 10.18.0.0/30 subnet was adjacent to the 10.18.0.4/30 subnet. We made it this way in an effort to reduce the size of our routing tables by allowing efficient route summarization.

3.

1. I think the EIGRP configuration is unnecessary. OSPF would have sufficed rather than having two routing protocols. It's also inefficient to have two routing protocols redistributing routes into each other. Routing would be much faster if the EIGRP section was turned into another an OSPF area.
2. A GRE tunnel should be configured between R2 and R3. R1 is unnecessary when it comes to routing in this topology. It has no alternative routes, it's simply on a path to the other side of the topology. The only reason it is there is because the topology spans across ITA's entire site and an intermediate router was needed to re-generate packets sent across the network. A GRE tunnel would simplify the topology and make it more optimized and less error prone.

SHOW COMMANDS

OSPF Neighbors

```
R1#show ospfv3 neighbor

          OSPFv3 18 address-family ipv4 (router-id 1.1.1.1)

Neighbor ID     Pri   State           Dead Time   Interface ID    Interface
2.2.2.2           0   FULL/  -        00:00:33    7               Serial0/0/0

          OSPFv3 18 address-family ipv6 (router-id 1.1.1.6)

Neighbor ID     Pri   State           Dead Time   Interface ID    Interface
2.2.2.6           0   FULL/  -        00:00:32    7               Serial0/0/0
```

```
R2#show ospfv3 neighbor

          OSPFv3 18 address-family ipv4 (router-id 2.2.2.2)

Neighbor ID     Pri   State           Dead Time   Interface ID    Interface
1.1.1.1           0   FULL/  -        00:00:36    7               Serial0/0/0
3.3.3.3           1   FULL/BDR        00:00:34    25              GigabitEthernet0/0.10

          OSPFv3 18 address-family ipv6 (router-id 2.2.2.6)

Neighbor ID     Pri   State           Dead Time   Interface ID    Interface
1.1.1.6           0   FULL/  -        00:00:36    7               Serial0/0/0
3.3.3.6           1   FULL/BDR        00:00:31    25              GigabitEthernet0/0.10
```

Note, Router ID 3.3.3.3 and 3.3.3.6 belong to VRF-OSPF

EIGRP Neighbors

```
R1#show ip eigrp neighbors
EIGRP-IPv4 VR(CASE2016) Address-Family Neighbors for AS(18)
H   Address                 Interface              Hold Uptime   SRTT   RTO  Q  Seq
                                                   (sec)         (ms)       Cnt Num
0   10.18.5.10              Se0/0/1                  13 00:45:22   32  2340  0  10
```

```
R1#show ipv6 eigrp neighbors
EIGRP-IPv6 VR(CASE2016) Address-Family Neighbors for AS(18)
H   Address                 Interface              Hold Uptime   SRTT   RTO  Q  Seq
                                                   (sec)         (ms)       Cnt Num
0   Link-local address:     Se0/0/1                  12 00:46:03   37  2370  0  11
    FE80::3
```

```
R3#show ip eigrp neighbors
EIGRP-IPv4 VR(CASE2016) Address-Family Neighbors for AS(18)
H   Address                 Interface              Hold Uptime   SRTT   RTO  Q  Seq
                                                   (sec)         (ms)       Cnt Num
1   10.18.5.14              Gi0/0.20                 14 00:46:18 1274  5000  0  2
0   10.18.5.9               Se0/0/0                  12 00:46:46  669  4014  0  6
```

```
R3#show ipv6 eigrp neighbors
EIGRP-IPv6 VR(CASE2016) Address-Family Neighbors for AS(18)
H   Address                 Interface              Hold Uptime   SRTT   RTO  Q  Seq
                                                   (sec)         (ms)       Cnt Num
1   Link-local address:     Gi0/0.20                 14 00:46:43 1274  5000  0  2
    FE80::7
0   Link-local address:     Se0/0/0                  14 00:47:12  545  3270  0  6
    FE80::1
```

BGP Neighbors

```
R3#show ip bgp neighbors
BGP neighbor is 172.16.18.2,  remote AS 65018, internal link
  BGP version 4, remote router ID 18.4.4.4
  BGP state = Established, up for 00:45:51
  Last read 00:00:49, last write 00:00:10, hold time is 180, keepalive interval is 60 seconds
  Neighbor sessions:
    1 active, is not multisession capable (disabled)
  Neighbor capabilities:
    Route refresh: advertised and received(new)
    Four-octets ASN Capability: advertised and received
    Address family IPv4 Unicast: advertised and received
    Address family IPv6 Unicast: advertised
    Enhanced Refresh Capability: advertised and received
```

```
R4#show ip bgp neighbors
BGP neighbor is 172.16.18.1,  remote AS 65018, internal link
  BGP version 4, remote router ID 18.3.3.3
  BGP state = Established, up for 00:51:24
  Last read 00:00:21, last write 00:00:01, hold time is 180, keepalive interval is 60 seconds
  Neighbor sessions:
    1 active, is not multisession capable (disabled)
  Neighbor capabilities:
    Route refresh: advertised and received(new)
    Four-octets ASN Capability: advertised and received
    Address family IPv4 Unicast: advertised and received
    Address family IPv6 Unicast: received
    Enhanced Refresh Capability: advertised and received
```

BGP Remote Pod Neighbor

```
BGP neighbor is 199.212.32.4,  remote AS 65004, external link
  BGP version 4, remote router ID 0.0.0.0
  BGP state = Idle
  Neighbor sessions:
    0 active, is not multisession capable (disabled)
    Stateful switchover support enabled: NO
  Default minimum time between advertisement runs is 30 seconds

 For address family: IPv4 Unicast
  BGP table version 15, neighbor version 1/15
  Output queue size : 0
  Index 0, Advertise bit 0
  Outbound path policy configured
  Route map for outgoing advertisements is SET-MED
  Slow-peer detection is disabled
  Slow-peer split-update-group dynamic is disabled
```

Note, this is connecting to group 4's pod.

Various pings across the network

```
R2#ping 172.16.18.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.18.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 80/82/84 ms
```

All Router and Switch Show Running Configurations

R1

Current configuration : 2982 bytes
!
! Last configuration change at 18:17:48 UTC Sun Nov 16 2014
!
version 15.4
service timestamps debug datetime msec
service timestamps log datetime msec

no service password-encryption
no service password-recovery
!
hostname R1
!
boot-start-marker
boot-end-marker
!
!
!
no aaa new-model
memory-size iomem 10
!
!
!
!
!
!
!
!
!
!
!
!
!

!
!
!
!
no ip domain lookup
ip cef
ipv6 unicast-routing
ipv6 cef
!
multilink bundle-name authenticated
!
!
!
!
!

```
!
cts logging verbose
!
!
voice-card 0
!
!
!
!
!
!
!
!
license udi pid CISCO2901/K9 sn FJC1928A154
license boot module c2900 technology-package securityk9
license boot module c2900 technology-package uck9
license boot module c2900 technology-package datak9
license boot module c2900 technology-package CollabProSuitek9
!
!
vtp mode transparent
!
redundancy
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
interface Embedded-Service-Engine0/0
 no ip address
 shutdown
!
interface GigabitEthernet0/0
```

```
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface GigabitEthernet0/1
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface Serial0/0/0
 bandwidth 64
 ip address 10.18.5.6 255.255.255.252
 ipv6 address FE80::1 link-local
 ipv6 address 2001:DB8:18:7::1/64
 ipv6 enable
 ospfv3 18 ipv6 area 0
 ospfv3 18 ipv4 area 0
 clock rate 64000
!
interface Serial0/0/1
 bandwidth 64
 ip address 10.18.5.9 255.255.255.252
 ipv6 address FE80::1 link-local
 ipv6 address 2001:DB8:18:8::1/64
 ipv6 enable
 ipv6 summary-address eigrp 18 2001:DB8:18:8::/64
!
!
!
router eigrp CASE2016
 !
 address-family ipv4 unicast autonomous-system 18
  !
  topology base
   redistribute ospfv3 18 metric 100000 100 255 1 1500
  exit-af-topology
  network 10.18.5.9 0.0.0.0
  eigrp router-id 1.1.1.1
 exit-address-family
 !
 address-family ipv6 unicast autonomous-system 18
```

```
 !
 af-interface Serial0/0/0
  shutdown
 exit-af-interface
 !
 topology base
  redistribute ospf 18 metric 100000 100 255 1 1500
 exit-af-topology
 eigrp router-id 1.1.1.6
exit-address-family
!
router ospfv3 18
 !
 address-family ipv4 unicast
  redistribute eigrp 18
  default-information originate
  router-id 1.1.1.1
  auto-cost reference-bandwidth 100000
  area 18 range 10.18.0.0 255.255.248.0
 exit-address-family
 !
 address-family ipv6 unicast
  default-information originate
  redistribute eigrp 18 include-connected
  router-id 1.1.1.6
  auto-cost reference-bandwidth 100000
 exit-address-family
!
ip forward-protocol nd
!
no ip http server
no ip http secure-server
!
!
!
!
!
control-plane
!
 !
 !
 !
 !
```

```
!
mgcp behavior rsip-range tgcp-only
mgcp behavior comedia-role none
mgcp behavior comedia-check-media-src disable
mgcp behavior comedia-sdp-force disable
!
mgcp profile default
!
!
!
!
!
!
!
gatekeeper
 shutdown
!
!
!
line con 0
line aux 0
line 2
 no activation-character
 no exec
 transport preferred none
 transport output lat pad telnet rlogin lapb-ta mop udptn v120 ssh
 stopbits 1
line vty 0 4
 login
 transport input none
!
scheduler allocate 20000 1000
!
end
```

R2

```
Current configuration : 4289 bytes
!
! Last configuration change at 21:58:04 UTC Sun Oct 30 2016
!
```

```
version 15.4
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
no service password-recovery
!
hostname R2
!
boot-start-marker
boot-end-marker
!
!
vrf definition VRF-EIGRP
 rd 65018:2
 !
 address-family ipv4
 exit-address-family
 !
 address-family ipv6
 exit-address-family
!
! card type command needed for slot/vwic-slot 0/1
!
no aaa new-model
memory-size iomem 10
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!


!
!
```

```
!
!
no ip domain lookup
ip cef
ipv6 unicast-routing
ipv6 cef
!
multilink bundle-name authenticated
!
!
!
!
!
!
cts logging verbose
!
!
voice-card 0
!
!
!
!
!
!
!
!
license udi pid CISCO2901/K9 sn FJC1928A150
license boot module c2900 technology-package securityk9
license boot module c2900 technology-package uck9
license boot module c2900 technology-package datak9
license boot module c2900 technology-package CollabProSuitek9
hw-module pvdm 0/0
!
!
!
vtp mode transparent
!
redundancy
!
!
!
!
!
```

```
!
!
!
!
!
!
!
!
!
!
interface Loopback0
 bandwidth 1024
 ip address 10.18.2.1 255.255.255.0
 ipv6 address FE80::1 link-local
 ipv6 address 2001:DB8:18:3::1/64
 ipv6 enable
 ospfv3 network point-to-point
 ospfv3 18 ipv6 area 0
 ospfv3 18 ipv4 area 0
!
interface Loopback1
 bandwidth 1024
 vrf forwarding VRF-EIGRP
 ip address 10.18.3.1 255.255.255.0
 ipv6 address FE80::7 link-local
 ipv6 address 2001:DB8:21:4::1/64
!
interface Loopback2
 bandwidth 1024
 vrf forwarding VRF-EIGRP
 ip address 10.18.4.1 255.255.255.0
 ipv6 address FE80::7 link-local
 ipv6 address 2001:DB8:18:5::1/64
!
interface Embedded-Service-Engine0/0
 no ip address
 shutdown
!
interface GigabitEthernet0/0
 bandwidth 1024
 no ip address
 duplex auto
 speed auto
```

```
!
interface GigabitEthernet0/0.10
 bandwidth 1024
 encapsulation dot1Q 10
 ip address 10.18.5.1 255.255.255.252
 ipv6 address FE80::2 link-local
 ipv6 address 2001:DB8:18:6::1/64
 ipv6 enable
 ospfv3 18 ipv6 area 18
 ospfv3 18 ipv4 area 18
!
interface GigabitEthernet0/0.20
 bandwidth 1024
 encapsulation dot1Q 20
 vrf forwarding VRF-EIGRP
 ip address 10.18.5.14 255.255.255.252
 ipv6 address FE80::7 link-local
 ipv6 address 2001:DB8:20:9::1/64
!
interface GigabitEthernet0/1
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface Serial0/0/0
 bandwidth 64
 ip address 10.18.5.5 255.255.255.252
 ipv6 address FE80::2 link-local
 ipv6 address 2001:DB8:18:7::2/64
 ospfv3 18 ipv6 area 0
 ospfv3 18 ipv4 area 0
!
interface Serial0/0/1
 no ip address
 shutdown
 clock rate 2000000
!
!
!
router eigrp CASE2016
 !
 address-family ipv4 unicast vrf VRF-EIGRP autonomous-system 18
```

```
 !
 af-interface Loopback1
  passive-interface
 exit-af-interface
 !
 af-interface Loopback2
  passive-interface
 exit-af-interface
 !
 topology base
 exit-af-topology
 network 10.18.3.1 0.0.0.0
 network 10.18.4.1 0.0.0.0
 network 10.18.5.14 0.0.0.0
 eigrp router-id 2.2.2.2
 eigrp stub connected
exit-address-family
!
address-family ipv6 unicast vrf VRF-EIGRP autonomous-system 18
 !
 af-interface Loopback1
  passive-interface
 exit-af-interface
 !
 af-interface Loopback2
  passive-interface
 exit-af-interface
 !
 topology base
 exit-af-topology
 eigrp router-id 2.2.2.6
 eigrp stub connected
exit-address-family
!
router ospfv3 18
 !
 address-family ipv4 unicast
  passive-interface Loopback0
  router-id 2.2.2.2
  auto-cost reference-bandwidth 100000
  area 0 stub no-summary
 exit-address-family
 !
```

```
 address-family ipv6 unicast
  passive-interface Loopback0
  router-id 2.2.2.6
  auto-cost reference-bandwidth 100000
  area 0 stub no-summary
 exit-address-family
!
ip forward-protocol nd
!
no ip http server
no ip http secure-server
!
!
!
!
!
control-plane
!
!
voice-port 0/2/0
!
voice-port 0/2/1
!
voice-port 0/3/0
!
voice-port 0/3/1
 !
 !
 !
 !
!
mgcp behavior rsip-range tgcp-only
mgcp behavior comedia-role none
mgcp behavior comedia-check-media-src disable
mgcp behavior comedia-sdp-force disable
!
mgcp profile default
!
!
!
!
!
!
```

```
!
gatekeeper
 shutdown
!
!
!
line con 0
line aux 0
line 2
 no activation-character
 no exec
 transport preferred none
 transport output lat pad telnet rlogin lapb-ta mop udptn v120 ssh
 stopbits 1
line vty 0 4
 login
 transport input none
!
scheduler allocate 20000 1000
!
end
```

R3

```
Current configuration : 6299 bytes
!
! Last configuration change at 19:01:42 UTC Sun Nov 16 2014
!
version 15.4
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
no service password-recovery
!
hostname R3
!
boot-start-marker
boot-end-marker
!
!
vrf definition VRF-OSPF
 rd 65018:3
 !
```

```
 address-family ipv4
 exit-address-family
 !
 --More--
*Nov 16 19:01:42.195: %SYS-5-CONFIG_I: Configured from console  address-family ipv6
 exit-address-family
!
!
no aaa new-model
memory-size iomem 10
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!


!
!
!
!
no ip domain lookup
ip cef
ipv6 unicast-routing
ipv6 cef
!
multilink bundle-name authenticated
!
!
!
!
!
!
cts logging verbose
```

```
!
!
voice-card 0
!
!
!
!
!
!
!
!
license udi pid CISCO2901/K9 sn FJC1928A158
license boot module c2900 technology-package securityk9
license boot module c2900 technology-package uck9
license boot module c2900 technology-package datak9
hw-module pvdm 0/0
!
!
!
!
redundancy
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
interface Loopback0
 bandwidth 1024
 vrf forwarding VRF-OSPF
 ip address 10.18.0.1 255.255.255.0
 ipv6 address FE80::6 link-local
 ipv6 address 2001:DB8:18:1::1/64
 ospfv3 network point-to-point
```

```
 ospfv3 18 ipv6 area 18
 ospfv3 18 ipv4 area 18
!
interface Loopback1
 bandwidth 64
 vrf forwarding VRF-OSPF
 ip address 10.18.1.1 255.255.255.0
 ipv6 address FE80::6 link-local
 ipv6 address 2001:DB8:18:2::1/64
 ospfv3 network point-to-point
 ospfv3 18 ipv4 area 18
!
interface Tunnel0
 no ip address
 ipv6 address FEC0:1::18/64
 tunnel source Serial0/1/0
 tunnel destination 172.16.4.1
!
interface Embedded-Service-Engine0/0
 no ip address
 shutdown
!
interface GigabitEthernet0/0
 bandwidth 1024
 no ip address
 duplex auto
 speed auto
!
interface GigabitEthernet0/0.10
 bandwidth 1024
 encapsulation dot1Q 10
 vrf forwarding VRF-OSPF
 ip address 10.18.5.2 255.255.255.252
 ipv6 address FE80::6 link-local
 ipv6 address 2001:DB8:18:6::2/64
 ospfv3 18 ipv6 area 18
 ospfv3 18 ipv4 area 18
!
interface GigabitEthernet0/0.20
 bandwidth 1024
 encapsulation dot1Q 20
 ip address 10.18.5.13 255.255.255.252
 ip nat inside
```

```
 ip virtual-reassembly in
 ipv6 address FE80::3 link-local
 ipv6 address 2001:DB8:18:9::2/64
!
interface GigabitEthernet0/1
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface Serial0/0/0
 bandwidth 64
 ip address 10.18.5.10 255.255.255.252
 ip nat inside
 ip virtual-reassembly in
 ipv6 address FE80::3 link-local
 ipv6 address 2001:DB8:18:8::2/64
 clock rate 64000
!
interface Serial0/0/1
 no ip address
 shutdown
!
interface Serial0/1/0
 bandwidth 64
 ip address 172.16.18.1 255.255.255.252
 ip nat outside
 ip virtual-reassembly in
 ipv6 address FE80::3 link-local
 ipv6 address 2001:DB8:18:10::1/64
 clock rate 64000
!
interface Serial0/1/1
 bandwidth 64
 ip address 203.0.18.1 255.255.255.248
 ip nat outside
 ip virtual-reassembly in
 ipv6 address FE80::3 link-local
 ipv6 address 2001:DB8:18:ABCD::1/64
 clock rate 64000
!
!
!
```

```
router eigrp CASE2016
 !
 address-family ipv4 unicast autonomous-system 18
  !
  topology base
   redistribute bgp 65018
  exit-af-topology
  network 10.18.5.10 0.0.0.0
  network 10.18.5.13 0.0.0.0
  network 172.16.18.1 0.0.0.0
  network 203.0.18.1 0.0.0.0
  eigrp router-id 3.3.3.3
 exit-address-family
 !
 address-family ipv6 unicast autonomous-system 18
  !
  af-interface Serial0/1/1
   shutdown
  exit-af-interface
  !
  af-interface Serial0/1/0
   shutdown
  exit-af-interface
  !
  topology base
   redistribute bgp 65018
  exit-af-topology
  eigrp router-id 3.3.3.6
 exit-address-family
!
router ospfv3 18
 !
 address-family ipv4 unicast vrf VRF-OSPF
  passive-interface Loopback0
  passive-interface Loopback1
  router-id 3.3.3.3
  auto-cost reference-bandwidth 100000
  capability vrf-lite
  area 18 stub no-summary
 exit-address-family
 !
 address-family ipv6 unicast vrf VRF-OSPF
  passive-interface Loopback0
```

```
 passive-interface Loopback1
 router-id 3.3.3.6
 auto-cost reference-bandwidth 100000
 capability vrf-lite
 area 18 stub no-summary
exit-address-family
!
router bgp 65018
 bgp router-id 18.3.3.3
 bgp log-neighbor-changes
 neighbor 2001:DB8:18:10::2 remote-as 65018
 neighbor 172.16.18.2 remote-as 65018
 neighbor 172.16.18.2 password cisco123
 neighbor FEC0:1::4 remote-as 65004
 !
 address-family ipv4
  network 10.10.2.0 mask 255.255.255.0
  network 10.18.0.0 mask 255.255.0.0
  network 10.18.0.0 mask 255.255.255.0
  network 10.18.1.0 mask 255.255.255.0
  network 10.18.3.0 mask 255.255.255.0
  network 10.18.4.0 mask 255.255.255.0
  network 10.18.5.0 mask 255.255.255.252
  network 10.18.5.4 mask 255.255.255.252
  network 10.18.5.8 mask 255.255.255.252
  network 10.18.5.12 mask 255.255.255.252
  network 172.16.18.0 mask 255.255.255.252
  redistribute eigrp 18
  no neighbor 2001:DB8:18:10::2 activate
  neighbor 172.16.18.2 activate
  neighbor 172.16.18.2 next-hop-self
  neighbor 172.16.18.2 route-map LOCALPREFV6 in
  no neighbor FEC0:1::4 activate
 exit-address-family
 !
 address-family ipv6
  redistribute eigrp 18
  network 2001:DB8:18:1::/64
  network 2001:DB8:18:2::/64
  network 2001:DB8:18:3::/64
  network 2001:DB8:18:4::/64
  network 2001:DB8:18:5::/64
  network 2001:DB8:18:6::/64
```

```
  network 2001:DB8:18:7::/64
  network 2001:DB8:18:8::/64
  network 2001:DB8:18:9::/64
  network 2001:DB8:18:10::/64
  network 2001:DB8:18:ABCD::/64
  neighbor 172.16.18.2 activate
 exit-address-family
!
ip forward-protocol nd
!
no ip http server
no ip http secure-server
!
ip nat inside source list NAT interface Serial0/1/1 overload
ip nat inside source static 10.18.2.1 203.0.18.3
ip route 0.0.0.0 0.0.0.0 Serial0/1/1
!
ip access-list standard NAT
 permit 10.18.0.0 0.0.255.255
!
ipv6 route ::/0 Serial0/1/1
!
route-map LOCALPREFV6 permit 11
 set local-preference 500
!
route-map LOCALPREF permit 10
 set local-preference 500
!
!
!
control-plane
!
!
voice-port 0/2/0
!
voice-port 0/2/1
!
voice-port 0/3/0
!
voice-port 0/3/1
 !
 !
 !
```

```
 !
!
mgcp behavior rsip-range tgcp-only
mgcp behavior comedia-role none
mgcp behavior comedia-check-media-src disable
mgcp behavior comedia-sdp-force disable
!
mgcp profile default
!
!
!
!
!
!
!
gatekeeper
 shutdown
!
!
!
line con 0
line aux 0
line 2
 no activation-character
 no exec
 transport preferred none
 transport output lat pad telnet rlogin lapb-ta mop udptn v120 ssh
 stopbits 1
line vty 0 4
 login
 transport input none
!
scheduler allocate 20000 1000
!
end
```

R4

```
Current configuration : 2651 bytes
!
! Last configuration change at 02:19:19 UTC Mon Nov 28 2016
!
version 15.4
```

```
service timestamps debug datetime msec
service timestamps log datetime msec
no platform punt-keepalive disable-kernel-core
!
hostname R4
!
boot-start-marker
boot-end-marker
!
!
vrf definition Mgmt-intf
 !
 address-family ipv4
 exit-address-family
 !
 address-family ipv6
 exit-address-family
!
vrf definition VRF-INET
 rd 65018:4
 !
 address-family ipv4
 exit-address-family
 !
 address-family ipv6
 exit-address-family
!
!
no aaa new-model
!
!
!
!
!
!
!
!
!


no ip domain lookup

!
```

```
!
!
ipv6 unicast-routing
!
!
!
!
!
!
!
subscriber templating
multilink bundle-name authenticated
!
!
!
!
license udi pid ISR4331/K9 sn FDO19260EUZ
!
!
redundancy
 mode none
!
!
!
ip tftp source-interface GigabitEthernet0
!
!
!
!
interface GigabitEthernet0/0/0
 no ip address
 shutdown
 negotiation auto
!
interface GigabitEthernet0/0/1
 bandwidth 1024
 no ip address
 negotiation auto
!
interface GigabitEthernet0/0/1.10
 bandwidth 1024
 encapsulation dot1Q 10
 ip address 199.212.32.18 255.255.255.0
```

```
!
interface GigabitEthernet0/0/1.20
 bandwidth 1024
 encapsulation dot1Q 20
 vrf forwarding VRF-INET
 ip address 203.1.1.18 255.255.255.0
 ipv6 address FE80::5 link-local
 ipv6 address 2001:DB8:18:12::1/64
!
interface GigabitEthernet0/0/2
 no ip address
 shutdown
 negotiation auto
!
interface Serial0/1/0
 bandwidth 64
 ip address 172.16.18.2 255.255.255.252
 ipv6 address FE80::4 link-local
 ipv6 address 2001:DB8:18:10::2/64
!
interface Serial0/1/1
 bandwidth 64
 vrf forwarding VRF-INET
 ip address 203.0.18.2 255.255.255.248
 ipv6 address FE80::5 link-local
 ipv6 address 2001:DB8:18:ABCD::2/64
!
interface GigabitEthernet0
 vrf forwarding Mgmt-intf
 no ip address
 shutdown
 negotiation auto
!
router bgp 65018
 bgp router-id 18.4.4.4
 bgp log-neighbor-changes
 neighbor 2001:DB8:18:10::1 remote-as 65018
 neighbor 172.16.18.1 remote-as 65018
 neighbor 172.16.18.1 password cisco123
 neighbor 199.212.32.4 remote-as 65004
 !
 address-family ipv4
  network 172.16.18.0 mask 255.255.255.252
```

```
 no neighbor 2001:DB8:18:10::1 activate
 neighbor 172.16.18.1 activate
 neighbor 172.16.18.1 next-hop-self
 neighbor 199.212.32.4 activate
 neighbor 199.212.32.4 route-map SET-MED out
exit-address-family
!
address-family ipv6
 neighbor 199.212.32.4 activate
exit-address-family
!
ip forward-protocol nd
no ip http server
no ip http secure-server
ip route 0.0.0.0 0.0.0.0 203.1.1.254
!
!
ipv6 route vrf VRF-INET 2001:DB8:18::/48 Serial0/1/1
!
route-map SET_MED permit 12
 set metric 50
!
!
!
control-plane
!
!
line con 0
 stopbits 1
line aux 0
 stopbits 1
line vty 0 4
 login
!
!
end
```

SW4

```
Current configuration : 3244 bytes
!
! Last configuration change at 09:08:44 UTC Sun Nov 27 2016
```

```
!
version 15.0
no service pad
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname SW4
!
boot-start-marker
boot-end-marker
!
!
no aaa new-model
switch 1 provision ws-c2960x-24ts-l
!
!
vtp mode transparent
!
!
crypto pki trustpoint TP-self-signed-402393984
 enrollment selfsigned
 subject-name cn=IOS-Self-Signed-Certificate-402393984
 revocation-check none
 rsakeypair TP-self-signed-402393984
!
!
crypto pki certificate chain TP-self-signed-402393984
 certificate self-signed 01
  30820229 30820192 A0030201 02020101 300D0609 2A864886 F70D0101 05050030
  30312E30 2C060355 04031325 494F532D 53656C66 2D536967 6E65642D 43657274
  69666963 6174652D 34303233 39333938 34301E17 0D313631 31323730 39303735
  325A170D 32303031 30313030 30303030 5A303031 2E302C06 03550403 1325494F
  532D5365 6C662D53 69676E65 642D4365 72746966 69636174 652D3430 32333933
  39383430 819F300D 06092A86 4886F70D 01010105 0003818D 00308189 02818100
  AC3DCABC 66D87503 C14BB092 7F33E813 48D57C5C 28B087A8 5D401B23 2C13F3C5
  720FD11F F1F1EEF5 A6C6A95F 5C3EC32E B432A66C E1FDDC69 BC2C73B3 0029578B
  B97D6473 6FE20A6B 1B1F2846 DA2EE449 A75F4971 1EED597B 9883BBE2 6664E8DD
  D6E3B0B0 C56DA8AA 07B8AE61 F2F915BD 9B722523 29ABEEDF 3D38D6CE 92DA1CA9
  02030100 01A35330 51300F06 03551D13 0101FF04 05300301 01FF301F 0603551D
  23041830 16801410 5DED54A9 33CFBA52 55F5F7E1 3020A7E2 52EBD030 1D060355
  1D0E0416 0414105D ED54A933 CFBA5255 F5F7E130 20A7E252 EBD0300D 06092A86
  4886F70D 01010505 00038181 00015CE9 6C63717C 6DB1EEC1 216F3152 6E181BE2
```

```
 DB820A83 A27086D7 50361576 304C58DC 9C62889E 3A5622D1 2B73C3DC AC2195BE
 BEA0CFA5 71CA56C9 ECEE2507 1370EA79 35FC0A72 70E78B44 93462D22 4D2E115C
 4B41128D 21933E38 C0E2B158 B0AE256A 10AEFC66 95C59E53 60FF39B1 D1ED0E7C
 3C936D24 A880F05E 976DC97D 66
      quit
spanning-tree mode pvst
spanning-tree extend system-id
!
!
!
!
!
!
vlan internal allocation policy ascending
!
vlan 10,20
!
!
!
!
!
!
interface FastEthernet0
 no ip address
 shutdown
!
interface GigabitEthernet1/0/1
!
interface GigabitEthernet1/0/2
!
interface GigabitEthernet1/0/3
!
interface GigabitEthernet1/0/4
!
interface GigabitEthernet1/0/5
!
interface GigabitEthernet1/0/6
!
interface GigabitEthernet1/0/7
!
interface GigabitEthernet1/0/8
!
interface GigabitEthernet1/0/9
```

```
!
interface GigabitEthernet1/0/10
!
interface GigabitEthernet1/0/11
!
interface GigabitEthernet1/0/12
!
interface GigabitEthernet1/0/13
!
interface GigabitEthernet1/0/14
!
interface GigabitEthernet1/0/15
!
interface GigabitEthernet1/0/16
!
interface GigabitEthernet1/0/17
!
interface GigabitEthernet1/0/18
!
interface GigabitEthernet1/0/19
 switchport mode trunk
!
interface GigabitEthernet1/0/20
 switchport mode trunk
!
interface GigabitEthernet1/0/21
!
interface GigabitEthernet1/0/22
!
interface GigabitEthernet1/0/23
!
interface GigabitEthernet1/0/24
!
interface GigabitEthernet1/0/25
!
interface GigabitEthernet1/0/26
!
interface GigabitEthernet1/0/27
!
interface GigabitEthernet1/0/28
!
interface Vlan1
 no ip address
```

```
 shutdown
!
ip http server
ip http secure-server
!
!
!
!
line con 0
line vty 0 4
 login
line vty 5 15
 login
!
end
```