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Fault 1: The ip subnet-zero command is needed for the 140.X.0.0/25 subnet
Fault 2: SW2's VL82 IP address is 192.1.X.8/24 but should be 192.10.X.8/24

Task 2.1

SW1:

```
vtp domain CORE
!
vlan 8
name VLAN_E
vlan 14
name VLAN_A
vlan 28
name VLAN_B
vlan 33
name VLAN_BB3
vlan 57
name VLAN_C
vlan 82
name VLAN_BB2
vlan 356
name VLAN_D
!
interface FastEthernet0/1
switchport access vlan 14
switchport mode access
!
interface FastEthernet0/3
switchport access vlan 356
switchport mode access
!
interface FastEthernet0/5
switchport access vlan 356
switchport mode access
```


SW2:

```
vtp domain CORE
vtp mode client
!
interface FastEthernet0/2
 switchport access vlan 28
 switchport mode access
!
interface FastEthernet0/4
 switchport access vlan 14
 switchport mode access
!
interface FastEthernet0/6
 switchport access vlan 356
 switchport mode access
!
interface FastEthernet0/24
 switchport access vlan 82
 switchport mode access
```

SW3:

```
vtp domain CORE
vtp mode client
!
interface FastEthernet0/3
 switchport access vlan 33
 switchport mode access
!
interface FastEthernet0/5
 switchport access vlan 57
 switchport mode access
!
interface FastEthernet0/24
 switchport access vlan 33
 switchport mode access
```

SW4:

```
vtp domain CORE
vtp mode client
!
interface FastEthernet0/15
 switchport access vlan 57
 switchport mode access
 no shutdown
```


Task 2.1 Verification

```
Rack1SW1#show vtp status
VTP Version                     : 2
Configuration Revision          : 7
Maximum VLANs supported locally : 1005
Number of existing VLANs        : 12
VTP Operating Mode              : Server
VTP Domain Name                 : CORE
VTP Pruning Mode                : Disabled
VTP V2 Mode                     : Disabled
VTP Traps Generation            : Disabled
MD5 digest                      : 0xCB 0x2B 0x70 0x72 0xD0 0x9A
0x10  0x4F
Configuration last modified by 150.1.7.7 at 3-1-93 06:31:32
Local updater ID is 140.1.57.7 on interface Fa0/21 (first layer3
interface found)
```

SW2, SW3, and SW4:

```
Rack1SWX#show vtp status
VTP Version                     : 2
Configuration Revision          : 0
Maximum VLANs supported locally : 1005
Number of existing VLANs        : 5
VTP Operating Mode              : Client
VTP Domain Name                 : CORE
VTP Pruning Mode                : Disabled
VTP V2 Mode                     : Disabled
VTP Traps Generation            : Disabled
MD5 digest                      : 0xF6 0xA0 0x56 0x82 0x84 0xD4
0xBF  0xF6
Configuration last modified by 0.0.0.0 at 0-0-00 00:00:00
```

Task 2.2

SW1 and SW2:

```
interface Port-channel1
 switchport trunk encapsulation dot1q
 switchport mode trunk
!
interface range FastEthernet0/13 - 15
 switchport trunk encapsulation dot1q
 switchport mode trunk
 channel-group 1 mode on
```

Task 2.2 Verification

```
Rack1SW1#show etherchannel summary | begin Group
Group  Port-channel  Protocol    Ports
------+-------------+-----------+-----------------------------------
1      Po1(SU)         -        Fa0/13(P)   Fa0/14(P)   Fa0/15(P)
```



```
Rack1SW1#show interfaces trunk

Port        Mode      Encapsulation  Status      Native vlan
Po1         on        802.1q         trunking    1

Port        Vlans allowed on trunk
Po1         1-4094

Port        Vlans allowed and active in management domain
Po1         1,8,14,28,33,57,82,356

Port        Vlans in spanning tree forwarding state and not pruned
Po1         1,8,14,28,33,57,82,356
```

Task 2.3

SW2:

```
interface range Fa0/16, Fa0/19, Fa0/21
  switchport trunk encapsulation dot1q
  switchport mode trunk
```

SW3:

```
interface FastEthernet0/16
  switchport trunk encapsulation dot1q
  switchport mode trunk
```

SW4:

```
interface range Fa0/16, Fa0/18
  switchport trunk encapsulation dot1q
  switchport mode trunk
```

Task 2.3 Verification

```
Rack1SW2#show interfaces trunk | exclude Po1

Port        Mode      Encapsulation  Status      Native vlan
Fa0/16      on        802.1q         trunking    1
Fa0/19      on        802.1q         trunking    1
Fa0/21      on        802.1q         trunking    1

Port        Vlans allowed on trunk
Fa0/16      1-4094
Fa0/19      1-4094
Fa0/21      1-4094

Port        Vlans allowed and active in management domain
Fa0/16      1,8,14,28,33,57,82,356
Fa0/19      1,8,14,28,33,57,82,356
Fa0/21      1,8,14,28,33,57,82,356

Port        Vlans in spanning tree forwarding state and not pruned
Fa0/16      1,8,14,28,33,57,82,356
Fa0/19      1,8,14,28,33,57,82,356
Fa0/21      none
```



```
Rack1SW3#show interfaces trunk

Port        Mode         Encapsulation   Status     Native vlan
Fa0/16      on           802.1q          trunking   1

Port        Vlans allowed on trunk
Fa0/16      1-4094

Port        Vlans allowed and active in management domain
Fa0/16      1,8,14,28,33,57,82,356

Port        Vlans in spanning tree forwarding state and not pruned
Fa0/16      1,8,14,28,33,57,82,356

Rack1SW4#show interfaces trunk

Port        Mode         Encapsulation   Status     Native vlan
Fa0/16      on           802.1q          trunking   1
Fa0/18      on           802.1q          trunking   1

Port        Vlans allowed on trunk
Fa0/16      1-4094
Fa0/18      1-4094

Port        Vlans allowed and active in management domain
Fa0/16      1,8,14,28,33,57,82,356
Fa0/18      1,8,14,28,33,57,82,356

Port        Vlans in spanning tree forwarding state and not pruned
Fa0/16      1,8,14,28,33,57,82,356
Fa0/18      1,8,14,28,33,57,82,356
```

Task 2.4

SW2:

```
interface Port-channel23
  no switchport
  ip address 140.1.0.8 255.255.255.128
```

SW2 and SW3:

```
interface range FastEthernet0/17 - 18
  no switchport
  channel-group 23 mode desirable
  no shutdown
```


SW3:
```
interface Port-channel23
  no switchport
  ip address 140.1.0.9 255.255.255.128
!
interface Port-channel34
  no switchport
  ip address 140.1.0.129 255.255.255.128
```

SW4:
```
interface Port-channel34
  no switchport
  ip address 140.1.0.130 255.255.255.128
```

SW3 and SW4:
```
interface range FastEthernet0/19 - 21
  no switchport
  channel-group 34 mode desirable
  no shutdown
```

Task 2.4 Verification

Below is the Po23 configuration done in the correct "order of operations" for configuring a layer 3 Etherchannel link:

```
Rack1SW2#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Rack1SW2(config)#interface range fa0/17 - 18
Rack1SW2(config-if-range)#no switchport
Rack1SW2(config-if-range)#channel-group 23 mode desirable
Creating a port-channel interface Port-channel 23

Rack1SW2(config-if-range)#interface po 23
% Command exited out of interface range and its sub-modes.
  Not executing the command for second and later interfaces
Rack1SW2(config-if)#no switchport
Rack1SW2(config-if)#ip address 140.1.0.8 255.255.255.128
Rack1SW2(config-if)#
Rack1AS>9
[Resuming connection 9 to sw3 ... ]

Rack1SW3#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Rack1SW3(config)#interface range fa0/17 - 18
Rack1SW3(config-if-range)#no switchport
Rack1SW3(config-if-range)#channel-group 23 mode desirable
Creating a port-channel interface Port-channel 23
```



```
Rack1SW3(config-if-range)#interface po 23
% Command exited out of interface range and its sub-modes.
  Not executing the command for second and later interfaces
Rack1SW3(config-if)#ip address 140.1.0.9 255.255.255.128
Rack1SW3(config-if)#interface range fa0/17 - 18
Rack1SW3(config-if-range)#no shutdown
00:07:24: %LINK-3-UPDOWN: Interface FastEthernet0/17, changed state to
down
00:07:24: %LINK-3-UPDOWN: Interface FastEthernet0/18, changed state to
down
00:07:25: %LINEPROTO-5-UPDOWN: Line protocol on Interface
FastEthernet0/17, changed state to down
00:07:25: %LINEPROTO-5-UPDOWN: Line protocol on Interface
FastEthernet0/18, changed state to down
Rack1SW3(config-if-range)#
Rack1AS>8
[Resuming connection 8 to sw2 ... ]


Rack1SW2(config-if)#interface range fa0/17 - 18
Rack1SW2(config-if-range)#no shutdown
Rack1SW2(config-if-range)#
00:07:52: %LINK-3-UPDOWN: Interface FastEthernet0/17, changed state to
up
00:07:52: %LINK-3-UPDOWN: Interface FastEthernet0/18, changed state to
up
00:07:54: %LINEPROTO-5-UPDOWN: Line protocol on Interface
FastEthernet0/18, changed state to up
00:07:54: %LINEPROTO-5-UPDOWN: Line protocol on Interface
FastEthernet0/17, changed state to up
00:07:55: %LINK-3-UPDOWN: Interface Port-channel23, changed state to up
00:07:56: %LINEPROTO-5-UPDOWN: Line protocol on Interface
Portchannel23,
changed state to up
Rack1SW2(config-if-range)#^Z
00:07:58: %SYS-5-CONFIG_I: Configured from console by console
Rack1SW2#ping 140.1.0.9


Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 140.1.0.9, timeout is 2 seconds:
.!!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 1/1/1 ms
Rack1SW2#show etherchannel summary | begin Group
Group  Port-channel  Protocol    Ports
------+-------------+-----------+-----------------------------------
---------
23     Po23(RU)       PAgP        Fa0/17(P) Fa0/18(P)

Rack1SW2#
```


Task 3.1

R2:
```
interface Serial0/0
  ip address 140.1.245.2 255.255.255.0
  frame-relay map ip 140.1.245.4 205
  frame-relay map ip 140.1.245.5 205 broadcast
  no frame-relay inverse-arp
```

R4:
```
interface Serial0/0
  ip address 140.1.245.4 255.255.255.0
  frame-relay map ip 140.1.245.2 405
  frame-relay map ip 140.1.245.5 405 broadcast
  no frame-relay inverse-arp
```

R5:
```
interface Serial0/0
  ip address 140.1.245.5 255.255.255.0
  frame-relay map ip 140.1.245.2 502 broadcast
  frame-relay map ip 140.1.245.4 504 broadcast
  no frame-relay inverse-arp
```

Task 3.1 Verification

```
Rack1R5#show frame-relay map
Serial0/0 (up):   ip 140.1.245.2 dlci 502(0x1F6,0x7C60), static,
                  broadcast,
                  CISCO, status defined, active
Serial0/0 (up):   ip 140.1.245.4 dlci 504(0x1F8,0x7C80), static,
                  broadcast,
                  CISCO, status defined, active


Rack1R5#ping 140.1.245.2


Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 140.1.245.2, timeout is 2 seconds:
..!!!
Success rate is 60 percent (3/5), round-trip min/avg/max = 32/32/32 ms


Rack1R5#ping 140.1.245.4


Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 140.1.245.4, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 56/59/60 ms
```


Task 3.2

R6:

```
interface Serial0/0/0
 no ip address
 encapsulation frame-relay
!
interface Serial0/0/0.1 point-to-point
 ip address 54.1.2.6 255.255.255.0
 frame-relay interface-dlci 100
```

Task 3.2 Verification

```
Rack1R6#show frame-relay map
Serial0/0/0.1 (up):point-to-point dlci, dlci 100(0x64,0x1840),broadcast
      status defined, active


Rack1R6#ping 54.1.2.254


Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 54.1.2.254, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 32/32/32 ms
```

Task 3.3

R4:

```
username Rack1R5 password 0 CISCO
!
interface Serial0/1
  encapsulation ppp
  ppp authentication chap
```

R5:

```
username Rack1R4 password 0 CISCO
!
interface Serial0/1
  encapsulation ppp
  ppp authentication chap
  clockrate 64000
```

Task 3.3 Verification

```
Rack1R4#show interfaces s0/1
Serial0/1 is up, line protocol is up
  Hardware is QUICC Serial
  Internet address is 140.1.45.4/24
  MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation PPP, LCP Open
  Open: CDPCP, IPCP, loopback not set
<output omitted>
```



```
Rack1R4#ping 140.1.45.5

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 140.1.45.5, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 28/28/32 ms
```

Verify PPP authentication:

```
Rack1R5#debug ppp authentication
PPP authentication debugging is on
Rack1R5#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Rack1R5(config)#interface s0/1
Rack1R5(config-if)#shutdown
%LINK-5-CHANGED: Interface Serial0/1, changed state to administratively
down
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1, changed
state to down
Rack1R5(config-if)#no shutdown

%LINK-3-UPDOWN: Interface Serial0/1, changed state to up
Se0/1 PPP: Using default call direction
Se0/1 PPP: Treating connection as a dedicated line
Se0/1 PPP: Session handle[A6000008] Session id[7]
Se0/1 PPP: Authorization required
Se0/1 CHAP: O CHALLENGE id 1 len 28 from "Rack1R5"
Se0/1 CHAP: I CHALLENGE id 6 len 28 from "Rack1R4"
Se0/1 CHAP: Using hostname from unknown source
Se0/1 CHAP: Using password from AAA
Se0/1 CHAP: O RESPONSE id 6 len 28 from "Rack1R5"
Se0/1 CHAP: I RESPONSE id 1 len 28 from "Rack1R4"
Se0/1 PPP: Sent CHAP LOGIN Request
Se0/1 PPP: Received LOGIN Response PASS
Se0/1 PPP: Sent LCP AUTHOR Request
Se0/1 PPP: Sent IPCP AUTHOR Request
Se0/1 LCP: Received AAA AUTHOR Response PASS
Se0/1 CHAP: I SUCCESS id 6 len 4
Se0/1 IPCP: Received AAA AUTHOR Response PASS
Se0/1 CHAP: O SUCCESS id 1 len 4
Se0/1 PPP: Sent CDPCP AUTHOR Request
Se0/1 CDPCP: Received AAA AUTHOR Response PASS
Se0/1 PPP: Sent IPCP AUTHOR Request
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1, changed
state to up
```


Task 4.1

R2:
```
interface Serial0/0
 ip ospf priority 0
!
router ospf 1
 router-id 150.1.2.2
 network 140.1.245.2 0.0.0.0 area 0
```

R4:
```
interface Serial0/0
 ip ospf priority 0
!
router ospf 1
 router-id 150.1.4.4
 network 140.1.245.4 0.0.0.0 area 0
```

R5:
```
router ospf 1
 router-id 150.1.5.5
 network 140.1.245.5 0.0.0.0 area 0
 neighbor 140.1.245.2
 neighbor 140.1.245.4
```

Task 4.1 Verification

Verify OSPF neighbors and confirm that R5 is the DR:

```
Rack1R5#show ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
150.1.2.2         0   FULL/DROTHER    00:01:52    140.1.245.2     Serial0/0
150.1.4.4         0   FULL/DROTHER    00:01:52    140.1.245.4     Serial0/0
```

Verify *that R2 and R4 could not participate in DR/BDR election:*

```
Rack1R2#show ip ospf interface s0/0 | include Pri
  Transmit Delay is 1 sec, State DROTHER, Priority 0

Rack1R4#show ip ospf interface s0/0 | include Pri
  Transmit Delay is 1 sec, State DROTHER, Priority 0
```

Task 4.2

R2:
```
router ospf 1
 network 140.1.28.2 0.0.0.0 area 4
```

R3:
```
router ospf 1
```



```
 network 140.1.100.3 0.0.0.0 area 2
```

R5:

```
router ospf 1
 network 140.1.100.5 0.0.0.0 area 2
```

R6:

```
router ospf 1
 network 140.1.100.6 0.0.0.0 area 2
```

SW2:

```
ip routing
!
router ospf 1
 router-id 150.1.8.8
 network 140.1.0.8 0.0.0.0 area 4
 network 140.1.28.8 0.0.0.0 area 4
```

SW3:

```
ip routing
!
router ospf 1
 router-id 150.1.9.9
 network 140.1.0.9 0.0.0.0 area 4
 network 140.1.0.129 0.0.0.0 area 4
```

SW4:

```
ip routing
!
router ospf 1
router-id 150.1.10.10
network 140.1.0.130 0.0.0.0 area 4
```

Task 4.2 Verification

Verify OSPF neighbors on all OSPF routers. For instance on R5 and R2:

```
Rack1R5#show ip ospf neighbor

Neighbor ID  Pri   State           Dead Time   Address         Interface
150.1.2.2    0     FULL/DROTHER    00:01:38    140.1.245.2     Serial0/0
150.1.4.4    0     FULL/DROTHER    00:01:56    140.1.245.4     Serial0/0
150.1.3.3    1     FULL/DROTHER    00:00:37    140.1.0.3       Ethernet0/0
150.1.6.6    1     FULL/DR         00:00:39    140.1.0.6       Ethernet0/0
```

```
Rack1R2#show ip ospf neighbor

Neighbor ID  Pri   State           Dead Time   Address         Interface
150.1.5.5    1     FULL/DR         00:01:51    140.1.245.5     Serial0/0
150.1.8.8    1     FULL/BDR        00:00:30    140.1.28.8      FastEthernet0/0
```


Task 4.3

SW1:
```
ip routing
!
router ospf 1
 router-id 150.1.7.7
 area 3 stub
 network 140.1.57.7 0.0.0.0 area 3
```

R5:
```
router ospf 1
 area 3 stub
 network 140.1.57.5 0.0.0.0 area 3
```

Task 4.3 Verification

Verify OSPF neighbors on SW1:

```
Rack1SW1#show ip ospf neighbor

Neighbor ID  Pri   State           Dead Time   Address         Interface
150.1.5.5    1     FULL/DR         00:00:39    140.1.57.5      FastEthernet0/21
```

Confirm that Area 3 is a stub area:

```
Rack1SW1#show ip ospf | beg Area 3
    Area 3
        Number of interfaces in this area is 1
        It is a stub area
        Area has no authentication
        SPF algorithm last executed 00:00:06.584 ago
        SPF algorithm executed 3 times
        Area ranges are
        Number of LSA 7. Checksum Sum 0x035AED
        Number of opaque link LSA 0. Checksum Sum 0x000000
        Number of DCbitless LSA 0
        Number of indication LSA 0
        Number of DoNotAge LSA 0
        Flood list length 0
```

Verify the OSPF routes on SW1:

```
Rack1SW1#show ip route ospf
      140.1.0.0/24 is subnetted, 4 subnets
O IA    140.1.245.0 [110/65] via 140.1.57.5, 00:13:08, FastEthernet0/21
O IA    140.1.28.0 [110/66] via 140.1.57.5, 00:13:08, FastEthernet0/21
O IA    140.1.100.0 [110/11] via 140.1.57.5, 00:03:05, FastEthernet0/21
O*IA 0.0.0.0/0 [110/2] via 140.1.57.5, 00:13:08, FastEthernet0/21
```

Task 4.4

R2:
```
interface Loopback0
```



```
 ip ospf network point-to-point
!
router ospf 1
 network 150.1.2.2 0.0.0.0 area 4
```

R3:

```
interface Loopback0
 ip ospf network point-to-point
!
router ospf 1
 network 150.1.3.3 0.0.0.0 area 2
```

R4:

```
interface Loopback0
 ip ospf network point-to-point
!
router ospf 1
 network 150.1.4.4 0.0.0.0 area 0
```

R5:

```
interface Loopback0
 ip ospf network point-to-point
!
router ospf 1
 network 150.1.5.5 0.0.0.0 area 3
```

R6:

```
interface Loopback0
 ip ospf network point-to-point
!
router ospf 1
 network 150.1.6.6 0.0.0.0 area 2
```

SW1:

```
interface Loopback0
 ip ospf network point-to-point
!
router ospf 1
 network 150.1.7.7 0.0.0.0 area 3
```

SW2:

```
interface Loopback0
 ip ospf network point-to-point
!
router ospf 1
 network 150.1.8.8 0.0.0.0 area 4
```

SW3:

```
interface Loopback0
 ip ospf network point-to-point
!
router ospf 1
 network 150.1.9.9 0.0.0.0 area 4
```


SW4:

```
interface Loopback0
 ip ospf network point-to-point
!
router ospf 1
 network 150.1.10.10 0.0.0.0 area 4
```

Task 4.4 Verification

Confirm that all Loopback0 prefixes have been advertised with /24 mask:

```
Rack1R5#show ip route ospf | include 150
   150.1.0.0/24 is subnetted, 9 subnets
O       150.1.7.0 [110/11] via 140.1.57.7, 00:08:41, Ethernet0/1
O       150.1.6.0 [110/11] via 140.1.100.6, 00:08:41, Ethernet0/0
O       150.1.4.0 [110/65] via 140.1.245.4, 00:15:11, Serial0/0
O       150.1.3.0 [110/11] via 140.1.100.3, 00:08:41, Ethernet0/0
O IA    150.1.2.0 [110/65] via 140.1.245.2, 00:08:41, Serial0/0
O IA    150.1.10.0 [110/68] via 140.1.245.2, 00:08:41, Serial0/0
O IA    150.1.9.0 [110/67] via 140.1.245.2, 00:08:41, Serial0/0
O IA    150.1.8.0 [110/66] via 140.1.245.2, 00:08:41, Serial0/0

Rack1R2#show ip route ospf | include 150.1.5.0
O IA    150.1.5.0 [110/65] via 140.1.245.5, 00:09:24, Serial0/0
```

Task 4.5

R1:

```
router rip
 version 2
 network 140.1.0.0
 no auto-summary
```

R4:

```
router rip
 version 2
 passive-interface default
 no passive-interface Ethernet0/0
 no passive-interface Serial0/1
 network 140.1.0.0
 no auto-summary
```

R5:

```
router rip
 version 2
 passive-interface default
 no passive-interface Serial0/1
 network 140.1.0.0
 no auto-summary
```



```
SW2:
key chain RIP_KEY
  key 1
       key-string CISCO
!
interface Vlan82
  ip rip authentication mode md5
  ip rip authentication key-chain RIP_KEY
!
router rip
  version 2
  network 192.10.1.0
  no auto-summary
```

Task 4.5 Verification

```
Rack1SW2#show ip rout rip
R     222.22.2.0/24 [120/7] via 192.10.1.254, 00:00:04, Vlan82
R     220.20.3.0/24 [120/7] via 192.10.1.254, 00:00:04, Vlan82
R     205.90.31.0/24 [120/7] via 192.10.1.254, 00:00:04, Vlan82


Rack1R1#show ip route rip
   140.1.0.0/16 is variably subnetted, 4 subnets, 2 masks
R     140.1.245.0/24 [120/1] via 140.1.14.4, 00:00:05,
FastEthernet0/0
R     140.1.45.0/24 [120/1] via 140.1.14.4, 00:00:05, FastEthernet0/0
R     140.1.45.5/32 [120/1] via 140.1.14.4, 00:00:05, FastEthernet0/0
```

Task 4.6

```
R1:
router rip
  redistribute connected metric 10 route-map CONNECTED->RIP
!
route-map CONNECTED->RIP permit 10
  match interface Loopback0
```

Task 4.6 Verification

Verify that R4 has R1's Loopback0 prefix with the desired metric:

```
Rack1R4#show ip route rip
    150.1.0.0/24 is subnetted, 8 subnets
R      150.1.1.0 [120/10] via 140.1.14.1, 00:00:03, Ethernet0/0
```


Task 4.7

R3:
```
router ospf 1
 redistribute connected metric-type 1 subnets route-map CONNECTED->OSPF
!
route-map CONNECTED->OSPF permit 10
 match interface Ethernet0/1
```

R6:
```
router ospf 1
 redistribute connected metric-type 1 subnets route-map CONNECTED->OSPF
!
route-map CONNECTED->OSPF permit 10
 match interface Serial0/0/0.1
```

Task 4.7 Verification

Verify that the OSPF metric-types are correct:

```
Rack1R5#show ip route ospf | include E1
O E1  204.12.1.0/24 [110/30] via 140.1.0.3, 00:00:16, Ethernet0/0
O E1    54.1.2.0 [110/30] via 140.1.0.6, 00:00:16, Ethernet0/0
```

Task 4.8

R4:
```
router ospf 1
 redistribute rip subnets route-map RIP->OSPF
!
router rip
 redistribute ospf 1 metric 1
!
route-map RIP->OSPF permit 10
 set metric 400
```

R5:
```
router ospf 1
 redistribute rip subnets route-map RIP->OSPF
!
router rip
 redistribute ospf 1 metric 1
!
route-map RIP->OSPF permit 10
 set metric 500
```

SW2:
```
router ospf 1
 redistribute rip subnets
!
router rip
 redistribute ospf 1 metric 1
```

Task 4.8 Verification

Routes learned via R4:

```
Rack1R2#show ip route | include 400
O E2  140.1.14.0/24 [110/400] via 140.1.245.4, 00:06:53, Serial0/0
O E2  140.1.45.0/24 [110/400] via 140.1.245.4, 00:06:53, Serial0/0
O E2  140.1.45.5/32 [110/400] via 140.1.245.4, 00:06:53, Serial0/0
O E2  150.1.1.0 [110/400] via 140.1.245.4, 00:04:28, Serial0/0
```

Routes learned via R5:

```
Rack1R2#show ip route | include 500
O E2  140.1.45.4/32 [110/500] via 140.1.245.5, 00:06:58, Serial0/0
```

Task 4.9

R5:

```
router rip
 redistribute ospf 1 metric 1 route-map OSPF->RIP
!
access-list 1 deny 150.1.1.0
access-list 1 permit any
!
route-map OSPF->RIP permit 10
 match ip address 1
```

Task 4.9 Verification

```
Rack1R4#show ip route 150.1.1.1
Routing entry for 150.1.1.0/24
    Known via "rip", distance 120, metric 10
    Redistributing via ospf 1, rip
    Advertised by ospf 1 subnets route-map RIP->OSPF
    Last update from 140.1.14.1 on Ethernet0/0, 00:00:11 ago
    Routing Descriptor Blocks:
    * 140.1.14.1, from 140.1.14.1, 00:00:11 ago, via Ethernet0/0
        Route metric is 10, traffic share count is 1
```


Verify full internal connectivity as well as connectivity to backbone IGP prefixes with the following TCL script:

```
foreach i {
140.1.14.1
150.1.1.1
140.1.245.2
140.1.28.2
150.1.2.2
140.1.100.3
150.1.3.3
204.12.1.3
140.1.245.4
140.1.14.4
150.1.4.4
140.1.45.4
140.1.245.5
140.1.100.5
150.1.5.5
140.1.45.5
140.1.57.5
54.1.2.6
140.1.100.6
150.1.6.6
150.1.7.7
140.1.57.7
150.1.8.8
140.1.28.8
140.1.0.8
192.10.1.8
150.1.9.9
140.1.0.9
140.1.0.129
140.1.0.130
150.1.10.10
222.22.2.1
220.20.3.1
205.90.31.1
} { puts [exec "ping $i"] }
```

Note that VLAN8 is excluded from connectivity test since it's not part of any IGP.

Task 5.1

R1:
```
router bgp 300
 bgp router-id 150.1.1.1
 neighbor 140.1.14.4 remote-as 200
```

R2:
```
router bgp 200
 bgp router-id 150.1.2.2
 neighbor 140.1.28.8 remote-as 400
 neighbor 140.1.245.5 remote-as 200
```

R3:
```
router bgp 100
 bgp router-id 150.1.3.3
 neighbor 140.1.100.5 remote-as 200
 neighbor 140.1.100.6 remote-as 100
 neighbor 204.12.1.254 remote-as 54
```

R4:
```
router bgp 200
 bgp router-id 150.1.4.4
 neighbor 140.1.14.1 remote-as 300
 neighbor 150.1.5.5 remote-as 200
 neighbor 150.1.5.5 update-source Loopback0
```

R5:
```
router bgp 200
 bgp router-id 150.1.5.5
 neighbor 140.1.100.3 remote-as 100
 neighbor 140.1.100.6 remote-as 100
 neighbor 140.1.245.2 remote-as 200
 neighbor 140.1.245.2 route-reflector-client
 neighbor 150.1.4.4 remote-as 200
 neighbor 150.1.4.4 route-reflector-client
 neighbor 150.1.4.4 update-source Loopback0
```

R6:
```
router bgp 100
 bgp router-id 150.1.6.6
 neighbor 54.1.2.254 remote-as 54
 neighbor 140.1.100.3 remote-as 100
 neighbor 140.1.100.5 remote-as 200
```

SW2:
```
router bgp 400
 bgp router-id 150.1.8.8
 network 140.1.8.0 mask 255.255.255.0
 neighbor 140.1.28.2 remote-as 200
```


Task 5.1 Verification

```
Rack1R1#show ip bgp summary | begin Neighbor
Neighbor        V AS MsgRcvd MsgSent  TblVer  InQ OutQ Up/Down  State/PfxRcd
140.1.14.4      4       200       8        5       12      0      0 00:02:13 11


Rack1R2#show ip bgp summary | begin Neighbor
Neighbor        V AS MsgRcvd MsgSent  TblVer  InQ OutQ Up/Down  State/PfxRcd
140.1.28.8      4       400       5        6       12      0      0 00:01:43 1
140.1.245.5     4       200       8        6       12      0      0 00:02:18 10


Rack1R3#show ip bgp summary | begin Neighbor
Neighbor        V AS MsgRcvd MsgSent  TblVer  InQ OutQ Up/Down  State/PfxRcd
140.1.100.5     4       200       8       10       12      0      0 00:02:38 1
140.1.100.6     4       100      10       10       12      0      0 00:02:07 11
204.12.1.254    4        54      11       11       12      0      0 00:02:39 10
Rack1R3#


Rack1R4#show ip bgp summary | begin Neighbor
Neighbor        V AS MsgRcvd MsgSent  TblVer  InQ OutQ Up/Down  State/PfxRcd
140.1.14.1      4       300       5        8       12      0      0 00:02:33 0
150.1.5.5       4       200       8        5       12      0      0 00:02:23 11


Rack1R5#show ip bgp summary | begin Neighbor
Neighbor        V AS MsgRcvd MsgSent  TblVer  InQ OutQ Up/Down  State/PfxRcd
140.1.100.3     4       100      10        8       12      0      0 00:02:48 10
140.1.100.6     4       100      10        8       12      0      0 00:02:14 10
140.1.245.2     4       200       6        8       12      0      0 00:02:32 1
150.1.4.4       4       200       5        8       12      0      0 00:02:29 0


Rack1R6#show ip bgp summary | begin Neighbor
Neighbor        V AS MsgRcvd MsgSent  TblVer  InQ OutQ Up/Down  State/PfxRcd
54.1.2.254      4        54      10       11       12      0      0 00:02:06 10
140.1.100.3     4       100      10       10       12      0      0 00:02:21 11
140.1.100.5     4       200       8       10       12      0      0 00:02:19 1


Rack1SW2#show ip bgp summary | begin Neighbor
Neighbor        V AS MsgRcvd MsgSent  TblVer  InQ OutQ Up/Down  State/PfxRcd
140.1.28.2      4       200       7        6       12      0      0 00:02:08 10
```

Verify that VLAN8 is being advertised into BGP:


```
Rack1R5#show ip bgp 140.1.8.0
BGP routing table entry for 140.1.8.0/24, version 2
Paths: (1 available, best #1, table Default-IP-Routing-Table)
     Advertised to update-groups:
          1           3
     400, (Received from a RR-client)
          140.1.28.8 (metric 65) from 140.1.245.2 (150.1.2.2)
             Origin IGP, metric 0, localpref 100, valid, internal, best
```

Task 5.2

R1:

```
router bgp 300
 neighbor 140.1.14.4 password 7 1511021F0725
```

R4:

```
router bgp 200
 neighbor 140.1.14.1 password 7 1511021F0725
```

Task 5.2 Verification

Verify BGP authentication is enabled for the peering session:

```
Rack1R4#show ip bgp neighbors 140.1.14.1 | include md5
Flags: active open, nagle, md5

Rack1R4#show ip bgp summary | include 140.1.14.1
140.1.14.1    4     300      10      12     12    0 0    00:06:19      0
```


Task 5.3

R3:

```
router bgp 100
 aggregate-address 140.1.0.0 255.255.0.0 summary-only
 neighbor 140.1.100.5 route-map DENY_AGGREGATE out
!
ip prefix-list AGGREGATE seq 5 permit 140.1.0.0/16
!
route-map DENY_AGGREGATE deny 10
 match ip address prefix-list AGGREGATE
!
route-map DENY_AGGREGATE permit 1000
```

R6:

```
router bgp 100
 aggregate-address 140.1.0.0 255.255.0.0 summary-only
 neighbor 140.1.100.5 route-map DENY_AGGREGATE out
!
ip prefix-list AGGREGATE seq 5 permit 140.1.0.0/16
!
route-map DENY_AGGREGATE deny 10
 match ip address prefix-list AGGREGATE
!
route-map DENY_AGGREGATE permit 1000
```

Task 5.3 Verification

Verify that only the aggregate prefix of AS100 routes (no specifics) is advertised to AS54:

```
Rack1R6#show ip bgp neighbors 54.1.2.254 advertised-routes | begin Ne
Network          Next Hop            Metric LocPrf   Weight Path
*> 140.1.0.0     0.0.0.0                             32768 i

Total number of prefixes 11

Rack1R6# show ip bgp | include Status|s>
Status codes: s suppressed, d damped, h history, * valid, > best, i -
internal,
s> 140.1.8.0/24   140.1.100.5


Rack1R3#show ip bgp neighbors 204.12.1.254 advertised-routes | begin Ne
Network          Next Hop            Metric LocPrf   Weight Path
*> 140.1.0.0     0.0.0.0 3                           2768 i

Total number of prefixes 11

Rack1R3#show ip bgp | include Status|s>
Status codes: s suppressed, d damped, h history, * valid, > best, i -
internal,
s> 140.1.8.0/24   140.1.100.5
```


Confirm that the aggregate is filtered in updates to AS200:

```
Rack1R5#show ip bgp 140.1.0.0
% Network not in table
```

Task 5.4

R6:

```
ip access-list standard EVEN_FIRST_OCTET
 permit 0.0.0.0 254.255.255.255
!
route-map LOCAL_PREFERENCE permit 10
 match ip address EVEN_FIRST_OCTET
 set local-preference 150
!
route-map LOCAL_PREFERENCE permit 1000
 set local-preference 50
!
router bgp 100
 neighbor 54.1.2.254 route-map LOCAL_PREFERENCE in
```

Task 5.4 Verification

Verify the BGP table on R6. Note the local-preference for odd/even first-octet prefixes:

```
Rack1R6#show ip bgp
BGP table version is 18, local router ID is 150.1.6.6
Status codes: s suppressed, d damped, h history, * valid, > best, i -
internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

Network          Next Hop            Metric LocPrf     Weight Path
*> 28.119.16.0/24 54.1.2.254                150          0 54 i
*> 28.119.17.0/24 54.1.2.254                150          0 54 i
*> 112.0.0.0      54.1.2.254              0 150          0 54 50 60 i
*>i113.0.0.0      204.12.1.254            0 100          0 54 50 60 i
*                 54.1.2.254              0 50           0 54 50 60 i
*> 114.0.0.0      54.1.2.254              0 150          0 54 i
*>i115.0.0.0      204.12.1.254            0 100          0 54 i
*                 54.1.2.254              0 50           0 54 i
*> 116.0.0.0      54.1.2.254              0 150          0 54 i
*>i117.0.0.0      204.12.1.254            0 100          0 54 i
*                 54.1.2.254              0 50           0 54 i
*> 118.0.0.0      54.1.2.254              0 150          0 54 i
*>i119.0.0.0      204.12.1.254            0 100          0 54 i
*                 54.1.2.254              0 50           0 54 i
* i140.1.0.0      140.1.0.3               0 100          0 i
*>                0.0.0.0                             32768 i
s> 140.1.8.0/24   140.1.0.5                               0 200 400 i
```


Verify the paths that packets are taking to reach the odd/even firstoctet prefixes learned from AS54:

```
Rack1R3#traceroute 116.0.0.1

Type escape sequence to abort.
Tracing the route to 116.0.0.1

  1  140.1.100.6 4 msec 0 msec 4 msec
  2  54.1.2.254 20 msec * 20 msec

Rack1R3#traceroute 117.0.0.1 source e0/0

Type escape sequence to abort.
Tracing the route to 117.0.0.1

  1  204.12.1.254 4 msec 4 msec 4 msec
  2  172.16.4.1 28 msec * 16 msec
```


Task 1.1

Fault 1: Wrong subnet mask on R3 E0/0
Fault 2: R3's IP address 161.X.34.3/24 should be applied to S1/0 and not S1/1

Task 2.1

SW1:
```
interface FastEthernet0/16
 switchport trunk encapsulation isl
 switchport mode trunk
 switchport nonegotiate
!
interface range FastEthernet 0/13 - 15 , FastEthernet 0/17 - 21
 shutdown
```

SW2:
```
interface FastEthernet0/20
 switchport trunk encapsulation isl
 switchport mode trunk
 switchport nonegotiate
!
interface range FastEthernet 0/13 - 19 , FastEthernet 0/21
 shutdown
```

SW3:
```
interface FastEthernet0/13
 switchport trunk encapsulation isl
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet0/19
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet0/20
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
!
interface range FastEthernet 0/14 - 18 , FastEthernet 0/21
 shutdown
```

SW4:
```
interface FastEthernet0/17
 switchport trunk encapsulation isl
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet0/19
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
```



```
interface FastEthernet0/20
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
!
interface range Fast 0/13 - 16 , Fast 0/18 , Fast 0/21
 shutdown
```

Task 2.1 Verification

SW1:

```
Rack3SW1#show interfaces trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/16      on           isl            trunking      1

Port        Vlans allowed on trunk
Fa0/16      1-4094

Port        Vlans allowed and active in management domain
Fa0/16      1

Port        Vlans in spanning tree forwarding state and not pruned
Fa0/16      1
1
```

SW2:

```
Rack3SW2#show interfaces trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/20      on           isl            trunking      1

Port        Vlans allowed on trunk
Fa0/20      1-4094

Port        Vlans allowed and active in management domain
Fa0/20      1

Port        Vlans in spanning tree forwarding state and not pruned
Fa0/20      1
```


SW3:

```
Rack3SW3#show interfaces trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/13      on           isl            trunking      1
Fa0/19      on           802.1q         trunking      1
Fa0/20      on           802.1q         trunking      1

Port        Vlans allowed on trunk
Fa0/13      1-4094
Fa0/19      1-4094
Fa0/20      1-4094

Port        Vlans allowed and active in management domain
Fa0/13      1
Fa0/19      1
Fa0/20      1

Port        Vlans in spanning tree forwarding state and not pruned
Fa0/13      1
Fa0/19      1
Fa0/20      none
```

SW4:

```
Rack3SW4#show interfaces trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/17      on           isl            trunking      1
Fa0/19      on           802.1q         trunking      1
Fa0/20      on           802.1q         trunking      1

Port        Vlans allowed on trunk
Fa0/17      1-4094
Fa0/19      1-4094
Fa0/20      1-4094

Port        Vlans allowed and active in management domain
Fa0/17      1
Fa0/19      1
Fa0/20      1

Port        Vlans in spanning tree forwarding state and not pruned
Fa0/17      1
Fa0/19      1
Fa0/20      1
```


Task 2.2

SW3 and SW4:

```
interface Port-channel1
 switchport trunk encapsulation dot1q
 switchport mode trunk
!
interface range FastEthernet0/19 - 20
 switchport trunk encapsulation dot1q
 switchport mode trunk
 channel-group 1 mode on
```

Task 2.2 Verification

```
Rack3SW4#show etherchannel summary
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 1
Number of aggregators:           1

Group  Port-channel  Protocol    Ports
------+-------------+-----------+-----------------------------------
1      Po1(SU)          -        Fa0/19(P)   Fa0/20(P)

Rack3SW3#show etherchannel summary
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 1
Number of aggregators:           1

Group  Port-channel  Protocol    Ports
------+-------------+-----------+-----------------------------------
1      Po1(SU)          -        Fa0/19(P)   Fa0/20(P)
```


Task 2.3

SW1:

```
interface FastEthernet 0/21
 no switchport
 ip address 161.1.67.7 255.255.255.0
 no shutdown
!
interface FastEthernet 0/15
 no switchport
 ip address 161.1.78.7 255.255.255.0
 no shutdown
```

SW2:

```
interface FastEthernet 0/15
 no switchport
 no shutdown
 ip address 161.1.78.8 255.255.255.0
!
interface Vlan58
 ip address 161.1.58.8 255.255.255.0
```

SW3:

```
interface Vlan 59
 ip address 161.1.5.9 255.255.255.0
!
interface Vlan 9
 ip address 161.1.9.9 255.255.255.0
```

SW4:

```
interface FastEthernet 0/15
 no shutdown
 switchport mode access
 switchport access vlan 67
```


Task 2.4

SW1, SW2, SW4:

```
vtp mode client
vtp domain INTERNETWORKEXPERT
vtp password CISCO
```

SW3:

```
vtp mode server
vtp domain INTERNETWORKEXPERT
vtp password CISCO
vlan 10,32,59,23,58,43,43,67
```

SW1:

```
interface FastEthernet 0/1
 switchport mode access
 switchport access vlan 10
!
interface FastEthernet 0/3
 switchport mode access
 switchport access vlan 32
!
interface FastEthernet 0/5
 switchport mode access
 switchport access vlan 59
```

SW2:

```
interface FastEthernet 0/2
 switchport mode access
 switchport access vlan 23
!
interface FastEthernet 0/4
 switchport mode access
 switchport access vlan 43
!
interface FastEthernet 0/6
 switchport mode access
 switchport access vlan 67
!
interface FastEthernet 0/24
 switchport mode access
 switchport access vlan 32
```

SW3:

```
interface FastEthernet 0/3
 switchport mode access
 switchport access vlan 23
!
interface FastEthernet 0/5
 switchport mode access
 switchport access vlan 58
!
interface FastEthernet 0/24
 switchport mode access
 switchport access vlan 43
```


Task 2.4 Verification

```
Rack3SW1#show vtp status
VTP Version                     : 2
Configuration Revision          : 1
Maximum VLANs supported locally : 1005
Number of existing VLANs        : 12
VTP Operating Mode              : Client
VTP Domain Name                 : INTERNETWORKEXPERT
VTP Pruning Mode                : Disabled
VTP V2 Mode                     : Disabled
VTP Traps Generation            : Disabled
MD5 digest                      : 0xAA 0xDB 0x43 0xFB 0xAB 0x73 0xC8
0x35
Configuration last modified by 150.1.9.9 at 3-1-93 00:09:17

Rack3SW1#show vlan brief

VLAN Name                            Status    Ports
---- ----------------------------- --------- -------------------------
1    default                         active    Fa0/2, Fa0/4, Fa0/6, Fa0/7
                                               Fa0/8, Fa0/9, Fa0/10, Fa0/11
                                               Fa0/12, Fa0/13, Fa0/14, Fa0/17
                                               Fa0/18, Fa0/19, Fa0/20, Fa0/22
                                               Fa0/23, Fa0/24, Gi0/1, Gi0/2
10   VLAN0010                        active    Fa0/1
23   VLAN0023                        active
32   VLAN0032                        active    Fa0/3
43   VLAN0043                        active
58   VLAN0058                        active
59   VLAN0059                        active    Fa0/5
67   VLAN0067                        active

Rack3SW2#show vtp status
VTP Version                     : 2
Configuration Revision          : 1
Maximum VLANs supported locally : 1005
Number of existing VLANs        : 12
VTP Operating Mode              : Client
VTP Domain Name                 : INTERNETWORKEXPERT
VTP Pruning Mode                : Disabled
VTP V2 Mode                     : Disabled
VTP Traps Generation            : Disabled
MD5 digest                      : 0xAA 0xDB 0x43 0xFB 0xAB 0x73 0xC8
0x35
Configuration last modified by 150.1.9.9 at 3-1-93 00:09:17
```



```
Rack3SW2#show vlan brief

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------
1    default                          active    Fa0/1, Fa0/3, Fa0/5, Fa0/7
                                                Fa0/8, Fa0/9, Fa0/10, Fa0/11
                                                Fa0/12, Fa0/13, Fa0/14, Fa0/16
                                                Fa0/17, Fa0/18, Fa0/19, Fa0/21
                                                Fa0/22, Fa0/23, Gi0/1, Gi0/2
10   VLAN0010                         active
23   VLAN0023                         active    Fa0/2
32   VLAN0032                         active    Fa0/24
43   VLAN0043                         active    Fa0/4
58   VLAN0058                         active
59   VLAN0059                         active
67   VLAN0067                         active    Fa0/6

Rack3SW3#show vtp status
VTP Version                     : 2
Configuration Revision          : 1
Maximum VLANs supported locally : 1005
Number of existing VLANs        : 12
VTP Operating Mode              : Server
VTP Domain Name                 : INTERNETWORKEXPERT
VTP Pruning Mode                : Disabled
VTP V2 Mode                     : Disabled
VTP Traps Generation            : Disabled
MD5 digest                      : 0xAA 0xDB 0x43 0xFB 0xAB 0x73 0xC8
0x35
Configuration last modified by 150.1.9.9 at 3-1-93 00:09:17
Local updater ID is 161.1.5.9 on interface Vl59 (lowest numbered VLAN
interface found)

Rack3SW3#show vlan brief

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------
1    default                          active    Fa0/1, Fa0/2, Fa0/4, Fa0/6
                                                Fa0/7, Fa0/8, Fa0/9, Fa0/10
                                                Fa0/11, Fa0/12, Fa0/14, Fa0/15
                                                Fa0/16, Fa0/17, Fa0/18, Fa0/21
                                                Fa0/22, Fa0/23, Gi0/1, Gi0/2
10   VLAN0010                         active
23   VLAN0023                         active    Fa0/3
32   VLAN0032                         active
43   VLAN0043                         active    Fa0/24
58   VLAN0058                         active    Fa0/5
59   VLAN0059                         active
67   VLAN0067                         active
```



```
Rack3SW4#show vtp status
VTP Version                     : 2
Configuration Revision          : 1
Maximum VLANs supported locally : 1005
Number of existing VLANs        : 12
VTP Operating Mode              : Client
VTP Domain Name                 : INTERNETWORKEXPERT
VTP Pruning Mode                : Disabled
VTP V2 Mode                     : Disabled
VTP Traps Generation            : Disabled
MD5 digest                      : 0xAA 0xDB 0x43 0xFB 0xAB 0x73 0xC8
0x35
Configuration last modified by 150.1.9.9 at 3-1-93 00:09:17

Rack3SW4#show vlan brief

VLAN Name                            Status    Ports
---- ------------------------------- --------- -------------------------
1    default                         active    Fa0/1, Fa0/2, Fa0/3, Fa0/4
                                               Fa0/5, Fa0/6, Fa0/7, Fa0/8
                                               Fa0/9, Fa0/10, Fa0/11, Fa0/12
                                               Fa0/13, Fa0/14, Fa0/16, Fa0/18
                                               Fa0/21, Fa0/22, Fa0/23, Fa0/24
                                                      Gi0/1, Gi0/2
10   VLAN0010                        active
23   VLAN0023                        active
32   VLAN0032                        active
43   VLAN0043                        active
58   VLAN0058                        active
59   VLAN0059                        active
67   VLAN0067                        active    Fa0/15
```

Task 3.1

R1:

```
interface Serial0/0
 encapsulation frame-relay
 ip address 161.1.12.1 255.255.255.0
 no frame-relay inverse-arp
 frame-relay map ip 161.1.12.2 102 broadcast
 no shutdown
```

R2:

```
interface Serial0/0
 encapsulation frame-relay
 ip address 161.1.12.2 255.255.255.0
 no frame-relay inverse-arp
 frame-relay map ip 161.1.12.1 201 broadcast
 no shutdown
```


Task 3.1 Verification

```
Rack3R1#show frame-relay map
Serial0/0 (up): ip 161.1.12.2 dlci 102(0x66,0x1860), static,
              broadcast,
              CISCO, status defined, active

Rack3R2#show frame map
Serial0/0 (up): ip 161.1.12.1 dlci 201(0xC9,0x3090), static,
              broadcast,
              CISCO, status defined, active

Rack3R2#ping 161.1.12.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 161.1.12.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 56/56/56 ms
```

Task 3.2

R4:

```
interface Serial0/0
 no ip address
 encapsulation frame-relay
 no frame-relay inverse-arp
 no shut
!
interface Serial0/0.405 point-to-point
 ip address 161.1.45.4 255.255.255.0
 frame-relay interface-dlci 405
!
interface Serial0/0.403 point-to-point
 ip address 161.1.34.4 255.255.255.0
 frame-relay interface-dlci 403
```

R3:

```
interface Serial 1/0
 encapsulation frame-relay
 no frame-relay inverse-arp
 ip address 161.1.34.3 255.255.255.0
 frame-relay map ip 161.1.34.4 304
 no shut
```

R5:

```
interface Serial 0/0
 encapsulation frame-relay
 no frame-relay inverse-arp
 ip address 161.1.45.5 255.255.255.0
 frame-relay map ip 161.1.45.4 504 broadcast
 no shut
```


Task 3.2 Verification

```
Rack3R3#show frame-relay map
Serial1/0 (up): ip 161.1.34.4 dlci 304(0x130,0x4C00), static,
              CISCO, status defined, active

Rack3R3#ping 161.1.34.4

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 161.1.34.4, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 60/60/60 ms

Rack3R5#show frame map
Serial0/0 (up): ip 161.1.45.4 dlci 504(0x1F8,0x7C80), static,
              broadcast,
              CISCO, status defined, active

Rack3R5#ping 161.1.45.4

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 161.1.45.4, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 60/60/60 ms
```

Task 3.3

R6:

```
interface Serial0/0
 encapsulation frame-relay
 no shutdown
!
interface Serial 0/0.101 multipoint
 ip address 54.1.1.6 255.255.255.0
 frame-relay interface-dlci 101
!
interface Serial 0/0.1 multipoint
 frame-relay interface-dlci 51
 frame-relay interface-dlci 100
 frame-relay interface-dlci 201
 frame-relay interface-dlci 301
 frame-relay interface-dlci 401
```

Task 3.3 Verification

```
Rack3R6#show frame-relay map
Serial0/0.101 (up): ip 54.1.1.254 dlci 101(0x65,0x1850), dynamic,
              broadcast,, status defined, active

Rack3R6#ping 54.1.1.254

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 54.1.1.254, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 32/33/36 ms
```


Task 3.4 – 3.5

R4:

```
username Rack3R5 password 0 CCIE
!
interface Serial0/1
 encapsulation ppp
 ppp authentication pap
 ppp pap sent-username Rack3R4 password CCIE
 no shutdown
```

R5:

```
username Rack3R4 password 0 CCIE
!
interface Serial0/1
 no shutdown
 encapsulation ppp
 ppp pap sent-username Rack3R5 password CCIE
 ppp authentication pap
 clockrate 64000
```

Task 3.4 – 3.5 Verification

```
Rack3R5#ping 161.1.54.4

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 161.1.54.4, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 28/30/32 ms

Rack3R5#debug ppp negotiation
PPP protocol negotiation debugging is on

Rack3R5#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Rack3R5(config)#inter serial 0/1
Rack3R5(config-if)#shut
Rack3R5(config-if)#no shut
```



```
Se0/1 PPP: Using configured call direction
Se0/1 PPP: Treating connection as a dedicated line
Se0/1 PPP: Session handle[FF000024] Session id[36]
Se0/1 PPP: Phase is ESTABLISHING, Active Open
Se0/1 LCP: O CONFREQ [Closed] id 254 len 14
Se0/1 LCP:    AuthProto PAP (0x0304C023)
Se0/1 LCP:    MagicNumber 0x06DD69C1 (0x050606DD69C1)
Se0/1 LCP: I CONFREQ [REQsent] id 228 len 14
Se0/1 LCP:    AuthProto PAP (0x0304C023)
Se0/1 LCP:    MagicNumber 0x0714236A (0x05060714236A)
Se0/1 LCP: O CONFACK [REQsent] id 228 len 14
Se0/1 LCP:    AuthProto PAP (0x0304C023)
Se0/1 LCP:    MagicNumber 0x0714236A (0x05060714236A)
Se0/1 LCP: I CONFACK [ACKsent] id 254 len 14
Se0/1 LCP:    AuthProto PAP (0x0304C023)
Se0/1 LCP:    MagicNumber 0x06DD69C1 (0x050606DD69C1)
Se0/1 LCP: State is Open
Se0/1 PPP: Phase is AUTHENTICATING, by both
Se0/1 PAP: Using hostname from interface PAP
Se0/1 PAP: Using password from interface PAP
Se0/1 PAP:(config O AUTH-REQ id 3 len 17 from "Rack3R5"
Se0/1 PAP: I AUTH-REQ id 3 len 17 from "Rack3R4"
Se0/1 PAP: Authenticating peer Rack3R4
Se0/1 PPP: Phase is FORWARDING, Attempting Forward
Se0/1 PPP: Phase is AUTHENTICATING, Unauthenticated User
Se0/1 PPP: Phase is FORWARDING, Attempting Forward
Se0/1 PPP: Phase is AUTHENTICATING, Authenticated User
Se0/1 PAP: O AUTH-ACK id 3 len 5
Se0/1 PAP: I AUTH-ACK id 3 len 5
Se0/1 PPP: Phase is UP
Se0/1 IPCP: O CONFREQ [Closed] id 1 len 10
Se0/1 IPCP:    Address 161.1.54.5 (0x0306A1033605)
Se0/1 PPP: Process pending ncp packets
Se0/1 CDPCP: O CONFREQ [Closed] id 1 len 4
Se0/1 IPCP: I CONFREQ [REQsent] id 1 len 10
Se0/1 IPCP:    Address 161.1.54.4 (0x0306A1033604)
Se0/1 AAA/AUTHOR/IPCP: Start.  Her address 161.1.54.4, we want 0.0.0.0
Se0/1 CDPCP: I CONFREQ [REQsent] id 1 len 4
Se0/1 CDPCP: O CONFACK [REQsent] id 1 len 4
Se0/1 AAA/AUTHOR/IPCP: Reject 161.1.54.4, using 0.0.0.0
Se0/1 AAA/AUTHOR/IPCP: Done.  Her address 161.1.54.4, we want 0.0.0.0
Se0/1 IPCP: O CONFACK [REQsent] id 1 len 10
Se0/1 IPCP:    Address 161.1.54.4 (0x0306A1033604)
Se0/1 IPCP: I CONFACK [ACKsent] id 1 len 10
Se0/1 IPCP:    Address 161.1.54.5 (0x0306A1033605)
Se0/1 IPCP: State is Open
Se0/1 CDPCP: I CONFACK [ACKsent] id 1 len 4
Se0/1 CDPCP: State is Open
Se0/1 IPCP: Install route to 161.1.54.4
```


Task 4.1

R1:

```
router rip
 version 2
 no auto-summary
 passive-interface default
 network 161.1.0.0
 no passive-interface Serial 0/0
```

R2:

```
router rip
 version 2
 no auto-summary
 passive-interface default
 network 161.1.0.0
 no passive-interface Serial 0/0
```

Task 4.1 Verification

```
Rack3R1#show ip protocols
Routing Protocol is "rip"
  Sending updates every 30 seconds, next due in 10 seconds
  Invalid after 180 seconds, hold down 180, flushed after 240
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Redistributing: rip
  Default version control: send version 2, receive version 2
    Interface             Send  Recv  Triggered RIP  Key-chain
    Serial0/0             2     2
  Automatic network summarization is not in effect
  Maximum path: 4
  Routing for Networks:
    161.1.0.0
  Passive Interface(s):
    VoIP-Null0
    FastEthernet0/0
    Serial0/1
    Virtual-Access1
    Loopback0
  Routing Information Sources:
    Gateway         Distance      Last Update
    161.1.12.2           120      00:00:12
  Distance: (default is 120)

Rack3R1#show ip route rip
     161.1.0.0/24 is subnetted, 3 subnets
R       161.1.23.0 [120/1] via 161.1.12.2, 00:00:02, Serial0/0


Rack3R2#show ip route rip
     161.1.0.0/24 is subnetted, 3 subnets
R       161.1.10.0 [120/1] via 161.1.12.1, 00:00:09, Serial0/0
```



```
Rack3R2#show ip protocol
Routing Protocol is "rip"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Sending updates every 30 seconds, next due in 15 seconds
  Invalid after 180 seconds, hold down 180, flushed after 240
  Redistributing: rip
  Default version control: send version 2, receive version 2
    Interface             Send  Recv  Triggered RIP  Key-chain
    Serial0/0             2     2
  Automatic network summarization is not in effect
  Maximum path: 4
  Routing for Networks:
    161.1.0.0
  Passive Interface(s):
    FastEthernet0/0
    Serial0/1
    Loopback0
    VoIP-Null0
  Routing Information Sources:
    Gateway         Distance      Last Update
    161.1.12.1           120      00:00:14
  Distance: (default is 120)
```

Task 4.2

R1, R2:

```
route-map CONNECTED_TO_RIP
 match interface Loopback0
!
router rip
 redistribute connected route-map CONNECTED_TO_RIP
```

Task 4.2 Verification

```
Rack3R1#show ip route rip
     161.1.0.0/24 is subnetted, 3 subnets
R       161.1.23.0 [120/1] via 161.1.12.2, 00:00:01, Serial0/0
     150.1.0.0/24 is subnetted, 2 subnets
R       150.1.2.0 [120/1] via 161.1.12.2, 00:00:01, Serial0/0

Rack3R2#show ip route rip
     161.1.0.0/24 is subnetted, 3 subnets
R       161.1.10.0 [120/1] via 161.1.12.1, 00:00:21, Serial0/0
     150.1.0.0/24 is subnetted, 2 subnets
R       150.1.1.0 [120/1] via 161.1.12.1, 00:00:21, Serial0/0
```


Task 4.3

R3:

```
router ospf 1
 network 161.1.34.3 0.0.0.0 area 0
!
interface Serial 1/0
 ip ospf priority 0
```

R4:

```
interface Serial 0/0.403
 ip ospf network non-broadcast
!
router ospf 1
 network 161.1.34.4 0.0.0.0 area 0
 neighbor 161.1.34.3
```

Task 4.3 Verification

```
Rack3R3#show ip ospf interface
Serial1/0 is up, line protocol is up
  Internet Address 161.1.34.3/24, Area 0
  Process ID 1,Router ID 150.1.3.3,Network Type NON_BROADCAST,Cost: 781
  Transmit Delay is 1 sec, State DROTHER, Priority 0
  Designated Router (ID) 150.1.4.4, Interface address 161.1.34.4
  No backup designated router on this network
  Timer intervals configured, Hello 30, Dead 120, Wait 120,Retransmit 5
    oob-resync timeout 120
    Hello due in 00:00:04
  Supports Link-local Signaling (LLS)
  Index 1/1, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 1
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 1, Adjacent neighbor count is 1
    Adjacent with neighbor 150.1.4.4  (Designated Router)
  Suppress hello for 0 neighbor(s)

Rack3R4#show ip ospf interface serial 0/0.403
Serial0/0.403 is up, line protocol is up
  Internet Address 161.1.34.4/24, Area 0
  Process ID 1, Router ID 150.1.4.4,Network Type NON_BROADCAST,Cost: 64
  Transmit Delay is 1 sec, State DR, Priority 1
  Designated Router (ID) 150.1.4.4, Interface address 161.1.34.4
  No backup designated router on this network
  Timer intervals configured, Hello 30, Dead 120, Wait 120,Retransmit 5
    oob-resync timeout 120
    Hello due in 00:00:19
  Supports Link-local Signaling (LLS)
  Index 1/1, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 2
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 1, Adjacent neighbor count is 1
    Adjacent with neighbor 150.1.3.3
  Suppress hello for 0 neighbor(s)
```



```
Rack3R3#show ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
150.1.4.4         1   FULL/DR         00:01:31    161.1.34.4      Serial1/0
```

Task 4.4

R5:

```
router ospf 1
 network 161.1.45.5 0.0.0.0 area 0
 network 161.1.5.5 0.0.0.0 area 5
!
interface Serial 0/0
 ip ospf network point-to-point
```

R4:

```
router ospf 1
 network 161.1.45.4 0.0.0.0 area 0
```

SW3:

```
ip routing
!
router ospf 1
 network 161.1.5.9 0.0.0.0 area 5
 network 161.1.9.9 0.0.0.0 area 5
```

Task 4.4 Verification

```
Rack3R5#show ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
150.1.4.4         0   FULL/  -        00:00:38    161.1.45.4      Serial0/0
150.1.9.9         1   FULL/DR         00:00:39    161.1.5.9       Ethernet0/0

Rack3R5#show ip ospf interface serial 0/0
Serial0/0 is up, line protocol is up
  Internet Address 161.1.45.5/24, Area 0
  Process ID 1,Router ID 150.1.5.5,Network Type POINT_TO_POINT,Cost: 64
  Transmit Delay is 1 sec, State POINT_TO_POINT,
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    oob-resync timeout 40
    Hello due in 00:00:05
  Supports Link-local Signaling (LLS)
  Index 1/1, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 1
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 1, Adjacent neighbor count is 1
    Adjacent with neighbor 150.1.4.4
  Suppress hello for 0 neighbor(s)
```


Task 4.5

R3, R4, R5, SW3:

```
router ospf 1
 redistribute connected route-map CONNECTED_TO_OSPF subnets
!
route-map CONNECTED_TO_OSPF
 match interface Loopback0
```

Task 4.5 Verification

```
Rack3SW3#show ip route ospf
     161.1.0.0/24 is subnetted, 3 subnets
O IA    161.1.34.0 [110/129] via 161.1.5.5, 00:00:07, Vlan59
O IA    161.1.45.0 [110/65] via 161.1.5.5, 00:00:07, Vlan59
     150.1.0.0/24 is subnetted, 4 subnets
O E2    150.1.5.0 [110/20] via 161.1.5.5, 00:00:07, Vlan59
O E2    150.1.4.0 [110/20] via 161.1.5.5, 00:00:07, Vlan59
O E2    150.1.3.0 [110/20] via 161.1.5.5, 00:00:07, Vlan59

Rack3R4#show ip route ospf
     161.1.0.0/16 is variably subnetted, 5 subnets, 2 masks
O IA    161.1.5.0/24 [110/74] via 161.1.45.5, 00:00:35, Serial0/0.405
     150.1.0.0/24 is subnetted, 4 subnets
O E2    150.1.5.0 [110/20] via 161.1.45.5, 00:00:25, Serial0/0.405
O E2    150.1.3.0 [110/20] via 161.1.34.3, 00:00:25, Serial0/0.403
O E2    150.1.9.0 [110/20] via 161.1.45.5, 00:00:25, Serial0/0.405
```

Task 4.6

R3:

```
router ospf 2
 network 192.10.1.3 0.0.0.0 area 51
 redistribute ospf 1 subnets
 summary-address 161.1.0.0 255.255.0.0
 summary-address 150.1.0.0 255.255.0.0
!
router ospf 1
 redistribute ospf 2 subnets
 network 161.1.23.3 0.0.0.0 area 51
```

R2:

```
router ospf 1
 network 161.1.23.2 0.0.0.0 area 51
```


Task 4.6 Verification

```
Rack3R3#show ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
150.1.4.4         1   FULL/DR         00:01:54    161.1.34.4      Serial1/0
150.1.2.2         1   FULL/BDR        00:00:38    161.1.23.2      Ethernet0/1
192.10.1.254      1   FULL/DR         00:00:38    192.10.1.254    Ethernet0/0

BB2>show ip route ospf
O E2 161.1.0.0/16 [110/10] via 192.10.1.3, 00:01:22, Ethernet0
O E2 150.1.0.0/16 [110/20] via 192.10.1.3, 00:00:38, Ethernet0
```

Task 4.7

R4:

```
route-map CONNECTED_TO_OSPF 20
  match interface Ethernet 0/0
```

Task 4.7 Verification

```
Rack3R4#show ip ospf database external 204.12.1.0

            OSPF Router with ID (150.1.4.4) (Process ID 1)

            Type-5 AS External Link States

  LS age: 15
  Options: (No TOS-capability, DC)
  LS Type: AS External Link
  Link State ID: 204.12.1.0 (External Network Number )
  Advertising Router: 150.1.4.4
  LS Seq Number: 80000001
  Checksum: 0x38EA
  Length: 36
  Network Mask: /24
       Metric Type: 2 (Larger than any link state path)
       TOS: 0
       Metric: 20
       Forward Address: 0.0.0.0
       External Route Tag: 0
```


Task 4.8

R4:
```
router eigrp 10
 no auto-summary
 network 161.1.54.4 0.0.0.0
```

R5:
```
router eigrp 10
 no auto-summary
 network 161.1.54.5 0.0.0.0
 network 161.1.58.5 0.0.0.0
```

R6:
```
router eigrp 10
 no auto-summary
 network 161.1.67.6 0.0.0.0
 network 54.1.1.6 0.0.0.0
!
key chain EIGRP
 key 1
  key-string CISCO
!
interface Serial 0/0.101
 ip authentication mode eigrp 10 md5
 ip authentication key-chain eigrp 10 EIGRP
```

SW1:
```
ip routing
!
router eigrp 10
 no auto-summary
 network 161.1.78.7 0.0.0.0
 network 161.1.67.7 0.0.0.0
```

SW2:
```
ip routing
!
router eigrp 10
 no auto-summary
 network 161.1.58.8 0.0.0.0
 network 161.1.78.8 0.0.0.0
```


Task 4.8 Verification

```
Rack3R5#show ip eigrp neighbors
IP-EIGRP neighbors for process 10
H   Address           Interface       Hold Uptime   SRTT   RTO  Q  Seq
                                      (sec)         (ms)       Cnt Num
1   161.1.58.8        Et0/1             10 00:00:23    4   200  0  6
0   161.1.54.4        Se0/1             11 00:00:58   22   200  0  3

Rack3SW1#show ip eigrp neighbors
IP-EIGRP neighbors for process 10
H   Address       Interface       Hold Uptime   SRTT   RTO  Q  Seq Type
                                  (sec)         (ms)       Cnt Num
1   161.1.78.     Fa0/15            10 00:01:05   17   200  0  5
0   161.1.67.6    Fa0/21            11 00:01:15 1596  5000  0  4

Rack3R6#show ip eigrp neighbors
IP-EIGRP neighbors for process 10
H   Address       Interface       Hold Uptime   SRTT   RTO  Q  Seq
                                  (sec)         (ms)       Cnt Num
1   54.1.1.2      Se0/0.101         14 00:00:02 1045  5000  0  1929
0   161.1.67.     Fa0/0             14 00:08:37    4   200  0  23
```

Task 4.9

```
R6, SW1, SW2:
Route-map CONNECTED_TO_EIGRP
 match interface Loopback0
!
router eigrp 10
 redistribute connected route-map CONNECTED_TO_EIGRP
```

Task 4.9 Verification

```
Rack3R5#show ip route eigrp | inc 150.
D EX    150.1.7.0/24 [170/412160] via 161.1.58.8, 00:00:16, Ethernet0/1
D EX    150.1.6.0/24 [170/414720] via 161.1.58.8, 00:00:11, Ethernet0/1
D EX    150.1.8.0/24 [170/409600] via 161.1.58.8, 00:00:05, Ethernet0/1
```


Task 4.10

R2:

```
router rip
 redistribute ospf 1 metric 1
!
router ospf 1
 redistribute rip subnets metric 120
 redistribute connected subnets
```

R4, R5:

```
router eigrp 10
 redistribute ospf 1 metric 1 1 1 1 1
!
router ospf 1
 redistribute eigrp 10 metric 90 subnets
```

Task 4.11

R4, R5:

```
access-list 99 permit 150.1.6.0
access-list 99 permit 150.1.7.0
access-list 99 permit 150.1.8.0
!
router ospf 1
 distance 200 0.0.0.0 255.255.255.255 99
```


Task 4.10 – 4.11 Verification

```
Rack3R1#show ip route
<omitted>

Gateway of last resort is not set

     51.0.0.0/32 is subnetted, 1 subnets
R       51.51.51.51 [120/1] via 161.1.12.2, 00:00:25, Serial0/0
R    204.12.1.0/24 [120/1] via 161.1.12.2, 00:00:25, Serial0/0
R    200.0.0.0/24 [120/1] via 161.1.12.2, 00:00:25, Serial0/0
     54.0.0.0/24 is subnetted, 1 subnets
R       54.1.1.0 [120/1] via 161.1.12.2, 00:00:25, Serial0/0
R    200.0.1.0/24 [120/1] via 161.1.12.2, 00:00:25, Serial0/0
R    200.0.2.0/24 [120/1] via 161.1.12.2, 00:00:25, Serial0/0
R    200.0.3.0/24 [120/1] via 161.1.12.2, 00:00:25, Serial0/0
     161.1.0.0/16 is variably subnetted, 10 subnets, 2 masks
R       161.1.34.0/24 [120/1] via 161.1.12.2, 00:00:26, Serial0/0
R       161.1.45.0/24 [120/1] via 161.1.12.2, 00:00:26, Serial0/0
R       161.1.58.0/24 [120/1] via 161.1.12.2, 00:00:26, Serial0/0
R       161.1.0.0/16 [120/1] via 161.1.12.2, 00:00:27, Serial0/0
R       161.1.5.0/24 [120/1] via 161.1.12.2, 00:00:27, Serial0/0
C       161.1.10.0/24 is directly connected, FastEthernet0/0
C       161.1.12.0/24 is directly connected, Serial0/0
R       161.1.23.0/24 [120/1] via 161.1.12.2, 00:00:27, Serial0/0
R       161.1.67.0/24 [120/1] via 161.1.12.2, 00:00:27, Serial0/0
R       161.1.78.0/24 [120/1] via 161.1.12.2, 00:00:27, Serial0/0
     150.1.0.0/16 is variably subnetted, 10 subnets, 2 masks
R       150.1.5.0/24 [120/1] via 161.1.12.2, 00:00:27, Serial0/0
R       150.1.4.0/24 [120/1] via 161.1.12.2, 00:00:27, Serial0/0
R       150.1.7.0/24 [120/1] via 161.1.12.2, 00:00:27, Serial0/0
R       150.1.6.0/24 [120/1] via 161.1.12.2, 00:00:27, Serial0/0
C       150.1.1.0/24 is directly connected, Loopback0
R       150.1.0.0/16 [120/1] via 161.1.12.2, 00:00:27, Serial0/0
R       150.1.3.0/24 [120/1] via 161.1.12.2, 00:00:27, Serial0/0
R       150.1.2.0/24 [120/1] via 161.1.12.2, 00:00:28, Serial0/0
R       150.1.9.0/24 [120/1] via 161.1.12.2, 00:00:28, Serial0/0
R       150.1.8.0/24 [120/1] via 161.1.12.2, 00:00:28, Serial0/0
```



```
Rack3R2#show ip route
<output omitted>

 51.0.0.0/32 is subnetted, 1 subnets
O E2    51.51.51.51 [110/20] via 161.1.23.3, 00:05:42, FastEthernet0/0
O E2 204.12.1.0/24 [110/20] via 161.1.23.3, 00:05:42, FastEthernet0/0
O E2 200.0.0.0/24 [110/90] via 161.1.23.3, 00:00:53, FastEthernet0/0
     54.0.0.0/24 is subnetted, 1 subnets
O E2    54.1.1.0 [110/90] via 161.1.23.3, 00:00:58, FastEthernet0/0
O E2 200.0.1.0/24 [110/90] via 161.1.23.3, 00:00:53, FastEthernet0/0
O E2 200.0.2.0/24 [110/90] via 161.1.23.3, 00:00:53, FastEthernet0/0
O E2 200.0.3.0/24 [110/90] via 161.1.23.3, 00:00:54, FastEthernet0/0
     161.1.0.0/16 is variably subnetted, 10 subnets, 2 masks
O IA    161.1.34.0/24 [110/782] via 161.1.23.3, 00:05:43, FastEthernet0/0
O IA    161.1.45.0/24 [110/846] via 161.1.23.3, 00:05:43, FastEthernet0/0
O E2    161.1.58.0/24 [110/90] via 161.1.23.3, 00:05:36, FastEthernet0/0
O E2    161.1.0.0/16 [110/1] via 161.1.23.3, 00:05:45, FastEthernet0/0
O IA    161.1.5.0/24 [110/856] via 161.1.23.3, 00:05:45, FastEthernet0/0
R       161.1.10.0/24 [120/1] via 161.1.12.1, 00:00:02, Serial0/0
C       161.1.12.0/24 is directly connected, Serial0/0
C       161.1.23.0/24 is directly connected, FastEthernet0/0
O E2    161.1.67.0/24 [110/90] via 161.1.23.3, 00:05:32, FastEthernet0/0
O E2    161.1.78.0/24 [110/90] via 161.1.23.3, 00:05:32, FastEthernet0/0
     150.1.0.0/16 is variably subnetted, 10 subnets, 2 masks
O E2    150.1.5.0/24 [110/20] via 161.1.23.3, 00:05:45, FastEthernet0/0
O E2    150.1.4.0/24 [110/20] via 161.1.23.3, 00:05:45, FastEthernet0/0
O E2    150.1.7.0/24 [110/90] via 161.1.23.3, 00:05:04, FastEthernet0/0
O E2    150.1.6.0/24 [110/90] via 161.1.23.3, 00:05:04, FastEthernet0/0
R       150.1.1.0/24 [120/1] via 161.1.12.1, 00:00:02, Serial0/0
O E2    150.1.0.0/16 [110/1] via 161.1.23.3, 00:05:45, FastEthernet0/0
O E2    150.1.3.0/24 [110/20] via 161.1.23.3, 00:05:46, FastEthernet0/0
C       150.1.2.0/24 is directly connected, Loopback0
O E2    150.1.9.0/24 [110/20] via 161.1.23.3, 00:05:46, FastEthernet0/0
O E2    150.1.8.0/24 [110/90] via 161.1.23.3, 00:05:05, FastEthernet0/0
```



```
Rack3R3#show ip route
<omitted>

Gateway of last resort is not set

     51.0.0.0/32 is subnetted, 1 subnets
O E2    51.51.51.51 [110/20] via 192.10.1.254, 00:16:23, Ethernet0/0
O E2 204.12.1.0/24 [110/20] via 161.1.34.4, 00:09:04, Serial1/0
O E2 200.0.0.0/24 [110/90] via 161.1.34.4, 00:04:15, Serial1/0
     54.0.0.0/24 is subnetted, 1 subnets
O E2    54.1.1.0 [110/90] via 161.1.34.4, 00:04:20, Serial1/0
O E2 200.0.1.0/24 [110/90] via 161.1.34.4, 00:04:15, Serial1/0
O E2 200.0.2.0/24 [110/90] via 161.1.34.4, 00:04:15, Serial1/0
O E2 200.0.3.0/24 [110/90] via 161.1.34.4, 00:04:16, Serial1/0
     161.1.0.0/16 is variably subnetted, 10 subnets, 2 masks
C       161.1.34.0/24 is directly connected, Serial1/0
O       161.1.45.0/24 [110/845] via 161.1.34.4, 00:15:38, Serial1/0
O E2    161.1.58.0/24 [110/90] via 161.1.34.4, 00:08:58, Serial1/0
O       161.1.0.0/16 is a summary, 00:15:39, Null0
O IA    161.1.5.0/24 [110/855] via 161.1.34.4, 00:09:07, Serial1/0
O E2    161.1.10.0/24 [110/120] via 161.1.23.2, 00:09:07, Ethernet0/1
O E2    161.1.12.0/24 [110/20] via 161.1.23.2, 00:09:07, Ethernet0/1
C       161.1.23.0/24 is directly connected, Ethernet0/1
O E2    161.1.67.0/24 [110/90] via 161.1.34.4, 00:08:54, Serial1/0
O E2    161.1.78.0/24 [110/90] via 161.1.34.4, 00:08:54, Serial1/0
C    192.10.1.0/24 is directly connected, Ethernet0/0
     150.1.0.0/16 is variably subnetted, 10 subnets, 2 masks
O E2    150.1.5.0/24 [110/20] via 161.1.34.4, 00:09:07, Serial1/0
O E2    150.1.4.0/24 [110/20] via 161.1.34.4, 00:09:07, Serial1/0
O E2    150.1.7.0/24 [110/90] via 161.1.34.4, 00:08:26, Serial1/0
O E2    150.1.6.0/24 [110/90] via 161.1.34.4, 00:08:26, Serial1/0
O E2    150.1.1.0/24 [110/120] via 161.1.23.2, 00:09:07, Ethernet0/1
O       150.1.0.0/16 is a summary, 00:15:39, Null0
C       150.1.3.0/24 is directly connected, Loopback0
O E2    150.1.2.0/24 [110/20] via 161.1.23.2, 00:09:08, Ethernet0/1
O E2    150.1.9.0/24 [110/20] via 161.1.34.4, 00:09:08, Serial1/0
O E2    150.1.8.0/24 [110/90] via 161.1.34.4, 00:08:28, Serial1/0

etc..
```



```
Rack3R6#show ip route | inc ^D
D EX    51.51.51.51 [170/2560005632] via 161.1.67.7, 00:06:48, FastEthernet0/0
D EX 204.12.1.0/24 [170/2560005632] via 161.1.67.7, 00:06:48, FastEthernet0/0
D    200.0.0.0/24 [90/2297856] via 54.1.1.254, 00:02:39, Serial0/0.101
D    200.0.1.0/24 [90/2297856] via 54.1.1.254, 00:02:39, Serial0/0.101
D    200.0.2.0/24 [90/2297856] via 54.1.1.254, 00:02:39, Serial0/0.101
D    200.0.3.0/24 [90/2297856] via 54.1.1.254, 00:02:39, Serial0/0.101
D EX    161.1.34.0/24
D EX    161.1.45.0/24
D       161.1.54.4/32 [90/2175232] via 161.1.67.7, 00:11:02, FastEthernet0/0
D       161.1.54.0/24 [90/2175232] via 161.1.67.7, 00:11:02, FastEthernet0/0
D       161.1.58.0/24 [90/30976] via 161.1.67.7, 00:11:02, FastEthernet0/0
D EX    161.1.0.0/16
D EX    161.1.5.0/24
D EX    161.1.10.0/24
D EX    161.1.12.0/24
D EX    161.1.23.0/24
D       161.1.78.0/24 [90/30720] via 161.1.67.7, 00:11:16, FastEthernet0/0
D EX    150.1.4.0/24
D EX    150.1.7.0/24 [170/156160] via 161.1.67.7, 00:08:29, FastEthernet0/0
D EX    150.1.1.0/24
D EX    150.1.0.0/16
D EX    150.1.3.0/24
D EX    150.1.2.0/24
D EX    150.1.9.0/24
D EX    150.1.8.0/24 [170/158720] via 161.1.67.7, 00:08:21, FastEthernet0/0
```

Task 5.1

R2:

```
router bgp 200
 bgp router-id 150.1.2.2
 neighbor 150.1.3.3 remote-as 200
 neighbor 150.1.3.3 update-source loopback 0
```

R3:

```
router bgp 200
 bgp router-id 150.1.3.3
 neighbor 150.1.2.2 remote-as 200
 neighbor 150.1.2.2 update-source loopback 0
 neighbor 192.10.1.254 remote-as 254
 neighbor 192.10.1.254 password CISCO
 neighbor 161.1.34.4 remote-as 100
```

R4:

```
router bgp 65002
 bgp confederation ident 100
 bgp router-id 150.1.4.4
 neighbor 150.1.5.5 remote-as 65002
 neighbor 150.1.5.5 update-source loopback 0
 neighbor 150.1.9.9 remote-as 65002
 neighbor 150.1.9.9 update-source loopback 0
 neighbor 161.1.34.3 remote-as 200
 neighbor 204.12.1.254 remote-as 54
```


R5:
```
router bgp 65002
 bgp confederation ident 100
 bgp confederation peers 65001
 bgp router-id 150.1.5.5
 neighbor 150.1.4.4 remote-as 65002
 neighbor 150.1.4.4 update-source loopback 0
 neighbor 150.1.9.9 remote-as 65002
 neighbor 150.1.9.9 update-source loopback 0
 neighbor 161.1.58.8 remote-as 65001
```

SW3:
```
router bgp 65002
 bgp confederation ident 100
 bgp router-id 150.1.9.9
 neighbor 150.1.4.4 remote-as 65002
 neighbor 150.1.4.4 update-source loopback 0
 neighbor 150.1.5.5 remote-as 65002
 neighbor 150.1.5.5 update-source loopback 0
```

SW2:
```
router bgp 65001
 bgp confederation ident 100
 bgp confederation peers 65002
 bgp router-id 150.1.8.8
 neighbor 150.1.7.7 remote-as 65001
 neighbor 150.1.7.7 update-source loopback 0
 neighbor 150.1.6.6 remote-as 65001
 neighbor 150.1.6.6 update-source loopback 0
 neighbor 161.1.58.5 remote-as 65002
```

SW1:
```
router bgp 65001
 bgp confederation ident 100
 bgp router-id 150.1.7.7
 neighbor 150.1.8.8 remote-as 65001
 neighbor 150.1.8.8 update-source loopback 0
 neighbor 150.1.6.6 remote-as 65001
 neighbor 150.1.6.6 update-source loopback 0
```

R6:
```
router bgp 65001
 bgp confederation ident 100
 bgp router-id 150.1.6.6
 neighbor 150.1.8.8 remote-as 65001
 neighbor 150.1.8.8 update-source loopback 0
 neighbor 150.1.7.7 remote-as 65001
 neighbor 150.1.7.7 update-source loopback 0
 neighbor 54.1.1.254 remote-as 54
```


Task 5.1 Verification

```
Rack3R3#show ip bgp summary  | beg Nei
Neighbor     V AS MsgRcvd MsgSent TblVer InQ OutQ Up/Down  State/PfxRcd
150.1.2.2    4 200    4       7       14    0    0 00:01:27        0
161.1.34.4   4 100    9       7       14    0    0 00:01:16       10
192.10.1.254 4 254    6       8       14    0    0 00:01:26        3

Rack3R4#show ip bgp summary | beg Nei
Neighbor     V AS MsgRcvd MsgSent TblVer InQ OutQ Up/Down  State/PfxRcd
150.1.5.5    4 65002  5      10       14    0    0 00:02:31        0
150.1.9.9    4 65002  5      10       14    0    0 00:02:30        0
161.1.34.3   4   200  8      10       14    0    0 00:02:40        3
204.12.1.254 4    54 11      11       14    0    0 00:02:31       10

Rack3R5#show ip bgp summary  | beg Nei
Neighbor     V AS MsgRcvd MsgSent TblVer InQ OutQ Up/Down  State/PfxRcd
150.1.4.4    4 65002   11     6       14    0    0 00:03:41       13
150.1.9.9    4 65002    6     6       14    0    0 00:03:30        0
161.1.58.8   4 65001    8     9       14    0    0 00:03:28       10

Rack3SW1#show ip bgp summary  | beg Nei
Neighbor     V AS MsgRcvd MsgSent TblVer InQ OutQ Up/Down  State/PfxRcd
150.1.6.6    4 65001   11     7       24    0    0 00:04:18       10
150.1.8.8    4 65001   11     7       24    0    0 00:04:30        3

Rack3R6#show ip bgp summary  | beg Nei
Neighbor     V AS MsgRcvd MsgSent TblVer InQ OutQ Up/Down  State/PfxRcd
54.1.1.254   4 54      13    10       14    0    0 00:05:35       10
150.1.7.7    4 65001    8    12       14    0    0 00:05:48        0
150.1.8.8    4 65001   12    12       14    0    0 00:05:57        3
```

Task 5.2

R4:

```
route-map PREPEND
 set as-path prepend 100 100 100
!
ip prefix-list DENY_VLAN10 deny 161.1.10.0/24
ip prefix-list DENY_VLAN10 permit 0.0.0.0/0 le 32
!
router bgp 65002
 network 161.1.10.0 mask 255.255.255.0
 neighbor 204.12.1.254 route-map PREPEND out
 neighbor 161.1.34.3 prefix-list DENY_VLAN10 out
```

R6:

```
router bgp 65001
 network 161.1.10.0 mask 255.255.255.0
```


Task 5.2 Verification

```
BB3>sh ip bgp 161.1.10.0
BGP routing table entry for 161.1.10.0/24, version 3250
Paths: (2 available, best #2, table Default-IP-Routing-Table)
  Advertised to peer-groups:
     RACKS
  100 100 100 100
    204.12.1.4 from 204.12.1.4 (150.1.4.4)
      Origin IGP, metric 120, localpref 100, valid, external
  100
    172.16.4.1 from 172.16.4.1 (212.18.3.1)
      Origin IGP, metric 2560005632, localpref 100, valid, internal,
best

BB1>show ip bgp 161.1.10.1
BGP routing table entry for 161.1.10.0/24, version 3450
Paths: (1 available, best #1, table Default-IP-Routing-Table)
  Advertised to non peer-group peers:
  172.16.4.3
  100
    54.1.1.6 from 54.1.1.6 (150.1.6.6)
      Origin IGP, metric 2560005632, localpref 100, valid, external,
best
```

Task 5.3

R4:

```
router bgp 65002
 aggregate-address 161.1.0.0 255.255.128.0
```

Task 5.3 Verification

```
Rack3R4#show ip bgp
BGP table version is 16, local router ID is 150.1.4.4
Status codes: s suppressed, d damped, h history, * valid, > best, i -
internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
*> 28.119.16.0/24   204.12.1.254             0             0 54 i
*> 28.119.17.0/24   204.12.1.254             0             0 54 i
*> 112.0.0.0        204.12.1.254                           0 54 50 60 i
*> 113.0.0.0        204.12.1.254                           0 54 50 60 i
*> 114.0.0.0        204.12.1.254                           0 54 i
*> 115.0.0.0        204.12.1.254                           0 54 i
*> 116.0.0.0        204.12.1.254                           0 54 i
*> 117.0.0.0        204.12.1.254                           0 54 i
*> 118.0.0.0        204.12.1.254                           0 54 i
*> 119.0.0.0        204.12.1.254                           0 54 i
*> 161.1.0.0/17     0.0.0.0                            32768 i
*> 161.1.10.0/24    161.1.34.3               120       32768 i
*> 205.90.31.0      161.1.34.3                             0 200 254 ?
*> 220.20.3.0       161.1.34.3                             0 200 254 ?
*> 222.22.2.0       161.1.34.3                             0 200 254 ?
```


Task 5.3 Verification

Verify that only the aggregate prefix of AS100 routes (no specifics) is advertised to AS54:

```
Rack1R6#show ip bgp neighbors 54.1.2.254 advertised-routes | begin Ne
   Network          Next Hop            Metric LocPrf Weight Path
*> 28.119.16.0/24   54.1.2.254                             0 54 i
*> 28.119.17.0/24   54.1.2.254                             0 54 i
*> 112.0.0.0        54.1.2.254                0            0 54 50 60 i
*> 113.0.0.0        54.1.2.254                0            0 54 50 60 i
*> 114.0.0.0        54.1.2.254                0            0 54 i
*> 115.0.0.0        54.1.2.254                0            0 54 i
*> 116.0.0.0        54.1.2.254                0            0 54 i
*> 117.0.0.0        54.1.2.254                0            0 54 i
*> 118.0.0.0        54.1.2.254                0            0 54 i
*> 119.0.0.0        54.1.2.254                0            0 54 i
*> 140.1.0.0        0.0.0.0                              32768 i

Total number of prefixes 11

Rack1R6# show ip bgp | include Status|s>
Status codes: s suppressed, d damped, h history, * valid, > best, i -
internal,
s> 140.1.8.0/24     140.1.100.5


Rack1R3#show ip bgp neighbors 204.12.1.254 advertised-routes | begin Ne
   Network          Next Hop            Metric LocPrf Weight Path
*> 28.119.16.0/24   204.12.1.254              0            0 54 i
*> 28.119.17.0/24   204.12.1.254              0            0 54 i
*> 112.0.0.0        204.12.1.254                           0 54 50 60 i
*> 113.0.0.0        204.12.1.254                           0 54 50 60 i
*> 114.0.0.0        204.12.1.254                           0 54 i
*> 115.0.0.0        204.12.1.254                           0 54 i
*> 116.0.0.0        204.12.1.254                           0 54 i
*> 117.0.0.0        204.12.1.254                           0 54 i
*> 118.0.0.0        204.12.1.254                           0 54 i
*> 119.0.0.0        204.12.1.254                           0 54 i
*> 140.1.0.0        0.0.0.0                              32768 i

Total number of prefixes 11

Rack1R3#show ip bgp | include Status|s>
Status codes: s suppressed, d damped, h history, * valid, > best, i -
internal,
s> 140.1.8.0/24     140.1.100.5
```

Confirm that the aggregate is filtered in updates to AS200:

```
Rack1R5#show ip bgp 140.1.0.0
% Network not in table
```


Task 5.4

R6:

```
ip access-list standard EVEN_FIRST_OCTET
 permit 0.0.0.0 254.255.255.255
!
route-map LOCAL_PREFERENCE permit 10
 match ip address EVEN_FIRST_OCTET
 set local-preference 150
!
route-map LOCAL_PREFERENCE permit 1000
 set local-preference 50
!
router bgp 100
 neighbor 54.1.2.254 route-map LOCAL_PREFERENCE in
```

Task 5.4 Verification

Verify the BGP table on R6. Note the local-preference for odd/even first-octet prefixes:

```
Rack1R6#show ip bgp
BGP table version is 18, local router ID is 150.1.6.6
Status codes: s suppressed, d damped, h history, * valid, > best, i -
internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
*> 28.119.16.0/24   54.1.2.254                150      0 54 i
*> 28.119.17.0/24   54.1.2.254                150      0 54 i
*> 112.0.0.0        54.1.2.254             0  150      0 54 50 60 i
*>i113.0.0.0        204.12.1.254           0  100      0 54 50 60 i
*                   54.1.2.254             0   50      0 54 50 60 i
*> 114.0.0.0        54.1.2.254             0  150      0 54 i
*>i115.0.0.0        204.12.1.254           0  100      0 54 i
*                   54.1.2.254             0   50      0 54 i
*> 116.0.0.0        54.1.2.254             0  150      0 54 i
*>i117.0.0.0        204.12.1.254           0  100      0 54 i
*                   54.1.2.254             0   50      0 54 i
*> 118.0.0.0        54.1.2.254             0  150      0 54 i
*>i119.0.0.0        204.12.1.254           0  100      0 54 i
*                   54.1.2.254             0   50      0 54 i
* i140.1.0.0        140.1.0.3              0  100      0 i
*>                  0.0.0.0                         32768 i
s> 140.1.8.0/24     140.1.0.5                           0 200 400 i
```


Verify the paths that packets are taking to reach the odd/even first-octet prefixes learned from AS54:

```
Rack1R3#traceroute 116.0.0.1

Type escape sequence to abort.
Tracing the route to 116.0.0.1

  1 140.1.100.6 4 msec 0 msec 4 msec
  2 54.1.2.254 20 msec *  20 msec

Rack1R3#traceroute 117.0.0.1

Type escape sequence to abort.
Tracing the route to 117.0.0.1

  1 204.12.1.254 4 msec 4 msec 4 msec
  2 172.16.4.1 28 msec *  16 msec
```


Task 1.1

1) SW1 - IP address for interface Fa0/1 190.1.17.1 should be 190.1.17.7
2) SW3 - Interface VL2596 should be interface VL2569.

Task 2.1

SW1:

```
vtp domain IE
vtp mode transparent
vlan 32,2569
!
interface FastEthernet0/3
 switchport access vlan 32
!
interface FastEthernet0/5
 switchport access vlan 2569
```

SW2:

```
vtp domain IE
vtp mode transparent
!
vlan 32,43,2569
!
interface FastEthernet0/2
 switchport access vlan 2569
!
interface FastEthernet0/6
 switchport access vlan 2569
!
interface FastEthernet0/24
 switchport access vlan 32
```

SW3:

```
vtp domain IE
vtp mode transparent
!
vlan 3,5,43,2569
!
interface FastEthernet0/3
 switchport access vlan 3
!
interface FastEthernet0/5
 switchport access vlan 5
!
interface FastEthernet0/24
 switchport access vlan 43
```


SW4:

```
vtp domain IE
vtp mode transparent
!
vlan 3,5,43,2569
!
interface FastEthernet0/4
 switchport access vlan 4
```

Task 2.1 Verification

```
Rack1R3#ping 192.10.1.254

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.10.1.254, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 4/5/8 ms


Rack1R1#ping 190.1.17.7

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 190.1.17.7, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/4 ms

Rack1R4#ping 204.12.1.254

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 204.12.1.254, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 4/5/8 ms

Rack1R5#ping 190.1.0.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 190.1.0.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/3/4 ms

Rack1R5#ping 190.1.0.6

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 190.1.0.6, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/4 ms

Rack1R5#ping 190.1.0.9

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 190.1.0.9, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/4 ms
```


Task 2.2

SW1:

```
interface FastEthernet0/13
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet0/14
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet0/15
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
```

SW2:

```
interface FastEthernet0/13
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet0/14
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet0/15
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet0/19
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet0/20
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet0/21
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
```

SW3:

```
interface FastEthernet0/19
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
!
```



```
interface FastEthernet0/20
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet0/21
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
```

SW4:

```
interface FastEthernet0/16
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet0/17
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet0/18
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet0/19
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet0/20
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet0/21
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
```

Task 2.2 Verification

```
Rack1SW1#show interfaces trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/13      on           802.1q         trunking      1
Fa0/14      on           802.1q         trunking      1
Fa0/15      on           802.1q         trunking      1

Rack1SW2#show interfaces trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/13      on           802.1q         trunking      1
Fa0/14      on           802.1q         trunking      1
```



```
Fa0/15      on            802.1q         trunking      1
Fa0/19      on            802.1q         trunking      1
Fa0/20      on            802.1q         trunking      1
Fa0/21      on            802.1q         trunking      1

Rack1SW3#show interfaces trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/19      on           802.1q         trunking      1
Fa0/20      on           802.1q         trunking      1
Fa0/21      on           802.1q         trunking      1


Rack1SW4#show interfaces trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/16      on           802.1q         trunking      1
Fa0/17      on           802.1q         trunking      1
Fa0/18      on           802.1q         trunking      1
Fa0/19      on           802.1q         trunking      1
Fa0/20      on           802.1q         trunking      1
Fa0/21      on           802.1q         trunking      1
```

Task 2.3

SW1 and SW2:

```
interface FastEthernet0/13
 channel-group 1 mode active
!
interface FastEthernet0/14
 channel-group 1 mode active
!
interface FastEthernet0/15
 channel-group 1 mode active
```

SW2:

```
interface FastEthernet0/19
 channel-group 1 mode active
!
interface FastEthernet0/20
 channel-group 1 mode active
!
interface FastEthernet0/21
 channel-group 1 mode active
```

SW4:

```
interface FastEthernet0/16
 channel-group 1 mode active
!
interface FastEthernet0/17
 channel-group 1 mode active
!
interface FastEthernet0/18
 channel-group 1 mode active
```


Task 2.3 Verification

```
Rack1SW2#show etherchannel 1 summary
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 1
Number of aggregators:           1

Group  Port-channel  Protocol    Ports
------------------------------------------------
1      Po1(SU)         LACP      Fa0/13(P)   Fa0/14(P)   Fa0/15(P)

Rack1SW2#show interface trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/13      on           802.1q         trunking      1
Fa0/14      on           802.1q         trunking      1
Fa0/15      on           802.1q         trunking      1
Po1         on           802.1q         trunking      1

Rack1SW4#show etherchannel 2 summary
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 1
Number of aggregators:           1

Group  Port-channel  Protocol    Ports
------------------------------------------------
2      Po2(SU)         LACP      Fa0/16(P)   Fa0/17(P)   Fa0/18(P)

Rack1SW4#show interface trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/19      on           802.1q         trunking      1
Fa0/20      on           802.1q         trunking      1
Fa0/21      on           802.1q         trunking      1
Po2         on           802.1q         trunking      1
```


Task 3.1

R3:

```
interface Serial1/1
 encapsulation frame-relay
 no frame-relay inverse-arp ip 311
 no frame-relay inverse-arp ip 312
 no frame-relay inverse-arp ip 315
```

R4:

```
interface Serial0/0
 encapsulation frame-relay
 no frame-relay inverse-arp ip 401
 no frame-relay inverse-arp ip 402
 no frame-relay inverse-arp ip 403
 no frame-relay inverse-arp ip 405
```

Task 3.1 Verification

Confirm that dynamic mapping works only over desired PVC:

```
Rack1R3#show frame-relay map
Serial1/1 (up): ip 190.1.34.4 dlci 314(0x13A,0x4CA0), dynamic,
              broadcast,, status defined, active

Rack1R4#show frame-relay map
Serial0/0 (up): ip 190.1.34.3 dlci 413(0x19D,0x64D0), dynamic,
              broadcast,, status defined, active
```

Verify connectivity:

```
Rack1R4#ping 190.1.34.3

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 190.1.34.3, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 60/60/60 ms
```


Task 3.2

R1:
```
interface Serial0/0
 encapsulation frame-relay
!
interface Serial0/0.1 multipoint
 ip address 190.1.135.1 255.255.255.0
 frame-relay map ip 190.1.135.3 103 broadcast
 frame-relay map ip 190.1.135.5 105 broadcast
```

R3:
```
interface Serial1/0
 encapsulation frame-relay
!
interface Serial1/0.1 multipoint
 ip address 190.1.135.3 255.255.255.0
 frame-relay map ip 190.1.135.1 301 broadcast
 frame-relay map ip 190.1.135.5 305 broadcast
```

R5:
```
interface Serial0/0
 encapsulation frame-relay
!
interface Serial0/0.1 multipoint
 ip address 190.1.135.5 255.255.255.0
 frame-relay map ip 190.1.135.1 501 broadcast
 frame-relay map ip 190.1.135.3 503 broadcast
```

Task 3.2 Verification

Verify L3 to L2 mappings:

```
Rack1R1#show frame-relay map
Serial0/0.1 (up): ip 190.1.135.3 dlci 103(0x67,0x1870), static,
              broadcast,
              CISCO, status defined, active
Serial0/0.1 (up): ip 190.1.135.5 dlci 105(0x69,0x1890), static,
              broadcast,
              CISCO, status defined, active

Rack1R3#show frame-relay map
Serial1/0.1 (up): ip 190.1.135.1 dlci 301(0x12D,0x48D0), static,
              broadcast,
              CISCO, status defined, active
Serial1/0.1 (up): ip 190.1.135.5 dlci 305(0x131,0x4C10), static,
              broadcast,
              CISCO, status defined, active
Serial1/1 (up): ip 190.1.34.4 dlci 314(0x13A,0x4CA0), dynamic,
              broadcast,, status defined, active
```



```
Rack1R5#show frame-relay map
Serial0/0.1 (up): ip 190.1.135.1 dlci 501(0x1F5,0x7C50), static,
              broadcast,
              CISCO, status defined, active
Serial0/0.1 (up): ip 190.1.135.3 dlci 503(0x1F7,0x7C70), static,
              broadcast,
              CISCO, status defined, active
```

Test connectivity:

```
Rack1R1#ping 190.1.135.5

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 190.1.135.5, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 32/32/32 ms

Rack1R1#ping 190.1.135.3

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 190.1.135.3, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 28/31/32 ms

Rack1R3#ping 190.1.135.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 190.1.135.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 32/32/32 ms

Rack1R3#ping 190.1.135.5

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 190.1.135.5, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 56/59/60 ms
```

Task 3.3

R6:

```
interface Serial0/0/0
 encapsulation frame-relay
!
interface Serial0/0/0.1 point-to-point
 ip address 54.1.1.6 255.255.255.0
 frame-relay interface-dlci 101
```


Task 3.3 Verification

Verify L3 to L2 mapping and test connectivity:

```
Rack1R6#show frame-relay map
Serial0/0/0.1 (up): point-to-point dlci, dlci 101(0x65,0x1850),
broadcast status defined, active

Rack1R6#ping 54.1.1.254

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 54.1.1.254, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 32/32/32 ms
```

Task 3.4

R4:

```
interface Serial0/1
 encapsulation ppp
```

R5:

```
interface Serial0/1
 clock rate 64000
 encapsulation ppp
```

Task 3.4 Verification

Verify peer neighbor routes:

```
Rack1R4#show ip route | include /32
C       10.5.5.5/32 is directly connected, Serial0/1

Rack1R5#show ip route | include /32
C       10.4.4.4/32 is directly connected, Serial0/1
```


Task 3.5

R4:

```
username ROUTER5 password CISCO
!
interface Serial0/1
 ppp authentication pap
```

R5:

```
interface Serial0/1
 ppp pap sent-username ROUTER5 password CISCO
```

Task 3.5 Verification

Verify PPP PAP authentication:

```
Rack1R5#debug ppp authentication
PPP authentication debugging is on
Rack1R5#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Rack1R5(config)#interface s0/1
Rack1R5(config-if)#shutdown
%LINK-5-CHANGED: Interface Serial0/1, changed state to administratively
down
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1, changed
state to down
Rack1R5(config-if)#no shutdown
%LINK-3-UPDOWN: Interface Serial0/1, changed state to up
Se0/1 PPP: Using default call direction
Se0/1 PPP: Treating connection as a dedicated line
Se0/1 PPP: Session handle[C000003] Session id[3]
Se0/1 PPP: Authorization required
Se0/1 PPP: No authorization without authentication
Se0/1 PAP: Using hostname from interface PAP
Se0/1 PAP: Using password from interface PAP
Se0/1 PAP: O AUTH-REQ id 2 len 18 from "ROUTER5"
Se0/1 PAP: I AUTH-ACK id 2 len 5
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1, changed
state to up
```


Task 4.1

R3:

```
key chain RIP
 key 1
  key-string CISCO
!
interface Ethernet0/0
 ip rip authentication mode md5
 ip rip authentication key-chain RIP
!
router rip
 version 2
 no auto-summary
 network 190.1.0.0
 network 192.10.1.0
 passive-interface default
 no passive-interface Ethernet0/0
 no passive-interface Ethernet0/1
```

R4:

```
router rip
 version 2
 no auto-summary
 network 10.0.0.0
 network 190.1.0.0
 network 204.12.1.0
 passive-interface Serial0/0
```

R5:

```
router rip
 version 2
 no auto-summary
 network 10.0.0.0
 passive-interface default
 no passive-interface Serial0/1
```

Task 4.2

R4:

```
router rip
 no validate-update-source
```

R5:

```
router rip
 no validate-update-source
```


Tasks 4.1 – 4.2 Verification

Confirm RIP md5 authentication at R3:

```
Rack1R3#debug ip rip
RIP protocol debugging is on
 RIP: received packet with MD5 authentication
 RIP: received v2 update from 192.10.1.254 on Ethernet0/0
      205.90.31.0/24 via 0.0.0.0 in 7 hops
      220.20.3.0/24 via 0.0.0.0 in 7 hops
      222.22.2.0/24 via 0.0.0.0 in 7 hops
```

Verify RIP routes at R3, R4, R5:

```
Rack1R3#show  ip route rip
R    222.22.2.0/24 [120/7] via 192.10.1.254, 00:00:18, Ethernet0/0
R    220.20.3.0/24 [120/7] via 192.10.1.254, 00:00:18, Ethernet0/0
R    205.90.31.0/24 [120/7] via 192.10.1.254, 00:00:18, Ethernet0/0

Rack1R4#show ip route rip
     31.0.0.0/16 is subnetted, 4 subnets
R       31.3.0.0 [120/1] via 204.12.1.254, 00:00:28, Ethernet0/0
R       31.2.0.0 [120/1] via 204.12.1.254, 00:00:28, Ethernet0/0
R       31.1.0.0 [120/1] via 204.12.1.254, 00:00:28, Ethernet0/0
R       31.0.0.0 [120/1] via 204.12.1.254, 00:00:28, Ethernet0/0
     30.0.0.0/16 is subnetted, 4 subnets
R       30.2.0.0 [120/1] via 204.12.1.254, 00:00:28, Ethernet0/0
R       30.3.0.0 [120/1] via 204.12.1.254, 00:00:28, Ethernet0/0
R       30.0.0.0 [120/1] via 204.12.1.254, 00:00:28, Ethernet0/0
R       30.1.0.0 [120/1] via 204.12.1.254, 00:00:28, Ethernet0/0

Rack1R5#show ip route rip
R    204.12.1.0/24 [120/1] via 10.4.4.4, 00:00:05
     190.1.0.0/24 is subnetted, 5 subnets
R       190.1.34.0 [120/1] via 10.4.4.4, 00:00:05
R       190.1.4.0 [120/1] via 10.4.4.4, 00:00:05
     31.0.0.0/16 is subnetted, 4 subnets
R       31.3.0.0 [120/2] via 10.4.4.4, 00:00:05
R       31.2.0.0 [120/2] via 10.4.4.4, 00:00:05
R       31.1.0.0 [120/2] via 10.4.4.4, 00:00:05
R       31.0.0.0 [120/2] via 10.4.4.4, 00:00:05
     30.0.0.0/16 is subnetted, 4 subnets
R       30.2.0.0 [120/2] via 10.4.4.4, 00:00:05
R       30.3.0.0 [120/2] via 10.4.4.4, 00:00:05
R       30.0.0.0 [120/2] via 10.4.4.4, 00:00:05
R       30.1.0.0 [120/2] via 10.4.4.4, 00:00:05
```


Task 4.3

R4:
```
router rip
 offset-list 0 in 13 Ethernet0/0
```

Task 4.3 Verification

Verify RIP routes metric at R5:

```
Rack1R5#show ip route 30.0.0.0
Routing entry for 30.0.0.0/16, 4 known subnets
  Redistributing via rip

R       30.2.0.0 [120/15] via 10.4.4.4, 00:00:06
R       30.3.0.0 [120/15] via 10.4.4.4, 00:00:06
R       30.0.0.0 [120/15] via 10.4.4.4, 00:00:06
R       30.1.0.0 [120/15] via 10.4.4.4, 00:00:06

Rack1R5#show ip route 31.0.0.0
Routing entry for 31.0.0.0/16, 4 known subnets
  Redistributing via rip

R       31.3.0.0 [120/15] via 10.4.4.4, 00:00:11
R       31.2.0.0 [120/15] via 10.4.4.4, 00:00:11
R       31.1.0.0 [120/15] via 10.4.4.4, 00:00:11
R       31.0.0.0 [120/15] via 10.4.4.4, 00:00:11
```

Task 4.4

R1:
```
interface Serial0/0.1
 ip ospf priority 0
!
router ospf 1
 network 190.1.135.1 0.0.0.0 area 135
```

R3:
```
interface Serial1/0.1
 ip ospf priority 0
!
router ospf 1
 network 190.1.135.3 0.0.0.0 area 135
```

R5:
```
router ospf 1
 network 190.1.135.5 0.0.0.0 area 135
 neighbor 190.1.135.1
 neighbor 190.1.135.3
```


Task 4.4 Verification

Verify OSPF network type:

```
Rack1R5#show ip ospf interface s0/0.1
Serial0/0.1 is up, line protocol is up
  Internet Address 190.1.135.5/24, Area 135
  Process ID 1, Router ID 150.1.5.5, Network Type NON_BROADCAST,Cost:64
<output omitted>
```

Verify OSPF neighbors and confirm that R5 is the DR:

```
Rack1R5#
%OSPF-5-ADJCHG: Process 1, Nbr 150.1.1.1 on Serial0/0.1 from LOADING to
FULL, Loading Done
%OSPF-5-ADJCHG: Process 1, Nbr 150.1.3.3 on Serial0/0.1 from LOADING to
FULL, Loading Done

Rack1R5#show ip ospf neighbor

Neighbor ID     Pri State           Dead Time   Address         Interface
150.1.1.1         0 FULL/DROTHER    00:01:54    190.1.135.1     Serial0/0.1
150.1.3.3         0 FULL/DROTHER    00:01:52    190.1.135.3     Serial0/0.1
```

Task 4.5

R1:

```
router ospf 1
 router-id 150.1.1.1
 network 190.1.17.1 0.0.0.0 area 17
 network 150.1.1.1 0.0.0.0 area 0
 area 135 virtual-link 150.1.3.3
```

R3:

```
router ospf 1
 router-id 150.1.3.3
 network 190.1.34.3 0.0.0.0 area 34
 neighbor 190.1.34.4
 area 135 virtual-link 150.1.1.1
```

R4:

```
router ospf 1
 network 190.1.34.4 0.0.0.0 area 34
```

SW1:

```
ip routing
!
router ospf 1
 network 190.1.17.7 0.0.0.0 area 17
```


Pitfall

A virtual-link can be created between any two backbone routers that have an interface to a common non-backbone area. This means that before this link will come up, you will need to complete the first bullet point in Task 4.6. This is an example of why you want to read the entire lab prior to starting.

Further Reading

RFC 2328

Task 4.5 Verification

Verify OSPF neighbors at R4 and SW1:

```
Rack1R4#show ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
150.1.3.3         1   FULL/BDR        00:01:36    190.1.34.3      Serial0/0

Rack1SW1#show ip ospf neighbor

Neighbor ID     Pri   State   Dead Time   Address       Interface
150.1.1.1         1   FULL/DR 00:00:31    190.1.17.1    FastEthernet0/1
```

Confirm that Area 0 is healthy:

```
Rack1R3#show ip ospf | begin BACKBONE
    Area BACKBONE(0)
        Number of interfaces in this area is 1
        Area has no authentication
        SPF algorithm last executed 00:06:47.188 ago
        SPF algorithm executed 3 times
        Area ranges are
        Number of LSA 6. Checksum Sum 0x027C39
        Number of opaque link LSA 0. Checksum Sum 0x000000
        Number of DCbitless LSA 0
        Number of indication LSA 0
        Number of DoNotAge LSA 3
        Flood list length 0
<output omitted>

Rack1R3#show ip ospf virtual-links
Virtual Link OSPF_VL0 to router 150.1.1.1 is up
  Run as demand circuit
  DoNotAge LSA allowed.
  Transit area 135, via interface Serial1/0.1, Cost of using 781
  Transmit Delay is 1 sec, State POINT_TO_POINT,
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    Hello due in 00:00:02
    Adjacency State FULL (Hello suppressed)
    Index 1/2, retransmission queue length 0,number of retransmission 1
    First 0x0(0)/0x0(0) Next 0x0(0)/0x0(0)
    Last retransmission scan length is 1, maximum is 1
    Last retransmission scan time is 0 msec, maximum is 0 msec
```

Confirm that inter-area routes are propagated:

```
Rack1R4#show ip route ospf
     190.1.0.0/24 is subnetted, 4 subnets
O IA    190.1.135.0 [110/845] via 190.1.34.3, 00:05:58, Serial0/0
O IA    190.1.17.0 [110/846] via 190.1.34.3, 00:05:58, Serial0/0
```


Task 4.6

R1:
```
interface Loopback0
 ip ospf network point-to-point
!
router ospf 1
 network 150.1.1.1 0.0.0.0 area 0
```

Quick Note
This was added in task 4.5 but shown here for clarity.

SW1:
```
interface Loopback0
 ip ospf network point-to-point
!
router ospf 1
 network 150.1.7.7 0.0.0.0 area 17
```

Task 4.6 Verification

Confirm that Loopback0 prefixes of R1 and SW1 have desired prefix length:

```
Rack1R5#show ip route ospf | inc 150
     150.1.0.0/24 is subnetted, 3 subnets
O IA    150.1.7.0 [110/66] via 190.1.135.1, 00:00:04, Serial0/0.1
O IA    150.1.1.0 [110/65] via 190.1.135.1, 00:00:14, Serial0/0.1
```

Task 4.7

R4:
```
router ospf 1
 redistribute connected subnets route-map CONNECTED->OSPF
!
route-map CONNECTED->OSPF
 match interface loopback0
```

Task 4.8

R3:
```
router ospf 1
 network 150.1.3.3 0.0.0.0 area 3
 area 3 range 150.1.3.0 255.255.255.0
```


Tasks 4.7 – 4.8 Verification

Confirm that Loopback0 prefixes of R3 and R4 has desired prefix length and route-type:

```
Rack1R5#show ip route ospf | inc 150
     150.1.0.0/24 is subnetted, 5 subnets
O IA    150.1.7.0 [110/66] via 190.1.135.1, 00:02:57, Serial0/0.1
O E2    150.1.4.0 [110/20] via 190.1.135.3, 00:01:25, Serial0/0.1
O IA    150.1.3.0 [110/65] via 190.1.135.3, 00:01:25, Serial0/0.1
O IA    150.1.1.0 [110/65] via 190.1.135.1, 00:03:07, Serial0/0.1
```

Verify summary for Loopback interface at router R3:

```
Rack1R3#show ip ospf database summary 150.1.3.0

            OSPF Router with ID (150.1.3.3) (Process ID 1)

                Summary Net Link States (Area 0)

  LS age: 124
  Options: (No TOS-capability, DC, Upward)
  LS Type: Summary Links(Network)
  Link State ID: 150.1.3.0 (summary Network Number)
  Advertising Router: 150.1.3.3
  LS Seq Number: 80000001
  Checksum: 0x46BD
  Length: 28
  Network Mask: /24
        TOS: 0  Metric: 1
<output omitted>
```

Task 4.9

R5:

```
router rip
 network 150.1.0.0
!
router ospf 1
 redistribute rip subnets route-map RIP->OSPF
!
route-map RIP->OSPF permit 10
 match interface loopback0
```


Task 4.9 Verification

Confirm that Loopback0 prefix at R5 is originated into RIP:

```
Rack1R5#show ip rip database 150.1.5.0 255.255.255.0
150.1.5.0/24    directly connected, Loopback0
```

Confirm that Loopback network has been redistributed into OSPF:

```
Rack1R3#show ip route ospf | inc 150.1.5.
O E2    150.1.5.0 [110/20] via 190.1.135.5, 00:01:39, Serial1/0.1
```

Task 4.10

R2:

```
router eigrp 10
 no auto-summary
 network 190.1.0.2 0.0.0.0
```

R5:

```
router eigrp 10
 no auto-summary
 network 190.1.0.5 0.0.0.0
 network 190.1.5.5 0.0.0.0
```

R6:

```
router eigrp 10
 no auto-summary
 network 190.1.0.6 0.0.0.0
```

Task 4.10 Verification

Verify EIGRP neighbors at R6:

```
Rack1R6#show ip eigrp neighbors
IP-EIGRP neighbors for process 10
H   Address                 Interface       Hold Uptime   SRTT   RTO  Q  Seq
                                            (sec)         (ms)       Cnt Num
1   190.1.0.2               Gi0/0             14 00:00:55 1172   5000  0  3
0   190.1.0.5               Gi0/0             14 00:00:55 1277   5000  0  5
```

Verify EIGRP routes at R6:

```
Rack1R6#show ip route eigrp
     190.1.0.0/24 is subnetted, 2 subnets
D       190.1.5.0 [90/284160] via 190.1.0.5, 00:01:26,
GigabitEthernet0/0
```


Task 4.11

R6:

```
key chain EIGRP
 key 1
  key-string CISCO
!
interface Serial0/0/0.1
 ip authentication mode eigrp 10 md5
 ip authentication key-chain eigrp 10 EIGRP
!
router eigrp 10
 network 54.1.1.6 0.0.0.0
```

Task 4.11 Verification

Confirm that R6 has EIGRP adjacency with BB1:

```
Rack1R6#show ip eigrp neighbors serial 0/0/0.1
IP-EIGRP neighbors for process 10
H   Address                 Interface       Hold Uptime   SRTT   RTO  Q  Seq
                                            (sec)         (ms)       Cnt Num
2   54.1.1.254              Se0/0/0.1         14 00:00:18   45   270  0  130
```

Confirm that EIGRP adjacency with BB1 is authenticated:

```
Rack1R6#debug eigrp packets hello
EIGRP Packets debugging is on
    (HELLO)
EIGRP: received packet with MD5 authentication, key id = 1
EIGRP: Received HELLO on Serial0/0/0.1 nbr 54.1.1.254
       AS 10, Flags 0x0, Seq 0/0 idbQ 0/0 iidbQ un/rely 0/0 peerQ
un/rely 0/0
```

Check for received routes:

```
Rack1R6#show ip route eigrp
D    200.0.0.0/24 [90/2297856] via 54.1.1.254, 00:02:02, Serial0/0/0.1
D    200.0.1.0/24 [90/2297856] via 54.1.1.254, 00:02:02, Serial0/0/0.1
     190.1.0.0/24 is subnetted, 2 subnets
D       190.1.5.0 [90/284160] via 190.1.0.5, 00:04:13,
GigabitEthernet0/0
D    200.0.2.0/24 [90/2297856] via 54.1.1.254, 00:02:02, Serial0/0/0.1
D    200.0.3.0/24 [90/2297856] via 54.1.1.254, 00:02:02, Serial0/0/0.1
```


Task 4.12

R2:
```
router eigrp 10
 network 150.1.2.2 0.0.0.0
!
interface FastEthernet0/0
 ip summary-address eigrp 10 150.1.2.0 255.255.254.0
```

R6:
```
router eigrp 10
 network 150.1.6.6 0.0.0.0
!
interface GigabitEthernet0/0
 ip summary-address eigrp 10 150.1.6.0 255.255.254.0
!
interface Serial0/0/0.1
 ip summary-address eigrp 10 150.1.6.0 255.255.254.0
```

SW3:
```
router eigrp 10
 network 150.1.9.9 0.0.0.0
!
interface Vlan2569
 ip summary-address eigrp 10 150.1.8.0 255.255.255.0
```

Task 4.12 Verification

Confirm that SW3, R2 and R6 advertise summaries with desired prefix lengths:

```
Rack1R5#show ip route eigrp | inc 150.1
     150.1.0.0/16 is variably subnetted, 7 subnets, 2 masks
D       150.1.6.0/23 [90/409600] via 190.1.0.6, 00:00:33, Ethernet0/0
D       150.1.2.0/23 [90/409600] via 190.1.0.2, 00:00:35, Ethernet0/0
D       150.1.8.0/23 [90/409600] via 190.1.0.9, 00:00:15, Ethernet0/0
```

Task 4.13

R3:
```
router rip
 redistribute ospf 1 metric 1
!
router ospf 1
 redistribute rip subnets
```

R4:
```
router ospf 1
 redistribute rip subnets
!
route-map CONNECTED->OSPF permit 20
```



```
router rip
 redistribute ospf 1 metric 1
```

R5:

```
router eigrp 10
 redistribute ospf 1 metric 1 1 1 1 1
 redistribute rip metric 1 1 1 1 1
!
router ospf 1
 redistribute eigrp 10 subnets
!
router rip
 redistribute ospf 1 metric 1
```


Task 4.14

R4:

```
router ospf 1
 redistribute rip subnets route-map RIP->OSPF
!
route-map RIP->OSPF permit 10
 set tag 1
```

R5:

```
router rip
 redistribute ospf 1 metric 1 route-map OSPF->RIP
!
route-map OSPF->RIP deny 10
 match tag 1
!
route-map OSPF->RIP permit 20
```

Task 4.13 – 4.14 Verification

To verify connectivity, ping every internal prefix and sample backbone IGP prefixes with the following Tcl script:

```
foreach i {
190.1.135.1
150.1.1.1
190.1.17.1
150.1.2.2
190.1.0.2
190.1.135.3
150.1.3.3
190.1.34.3
190.1.3.3
192.10.1.3
10.4.4.4
150.1.4.4
190.1.34.4
190.1.4.4
204.12.1.4
10.5.5.5
190.1.135.5
150.1.5.5
190.1.0.5
190.1.5.5
54.1.1.6
150.1.6.6
190.1.0.6
150.1.7.7
190.1.17.7
31.3.0.1
30.2.0.1
200.0.0.1
222.22.2.1
} { puts [ exec "ping $i"] }
```


Task 5.1

R1:

```
router bgp 100
 neighbor 190.1.0.2 remote-as 100
 neighbor 190.1.0.6 remote-as 100
 neighbor 190.1.135.3 remote-as 200
```

R2:

```
router bgp 100
 neighbor 190.1.135.1 remote-as 100
 neighbor 190.1.0.6 remote-as 100
```

R3:

```
router bgp 200
 neighbor 190.1.135.1 remote-as 100
 neighbor 192.10.1.254 remote-as 254
 neighbor 192.10.1.254 password CISCO
!
router ospf 1
 redistribute bgp 200 subnets route-map BGP->OSPF
!
route-map BGP->OSPF permit 10
 match as-path 1
!
ip as-path access-list 1 permit ^254_
```

R6:

```
router bgp 100
 network 190.1.0.0 mask 255.255.255.0
 aggregate-address 190.1.0.0 255.255.0.0 summary-only
 neighbor 190.1.135.1 remote-as 100
 neighbor 190.1.0.2 remote-as 100
 neighbor 54.1.1.254 remote-as 54
!
router eigrp 10
 redistribute bgp 100 metric 1 1 1 1 1 route-map BGP->EIGRP
 distribute-list prefix BGP out Serial0/0/0.1
!
route-map BGP->EIGRP permit 10
 match as-path 1
!
ip as-path access-list 1 permit ^54_
!
ip prefix-list BGP seq 5 deny 28.119.16.0/24
ip prefix-list BGP seq 10 deny 28.119.17.0/24
ip prefix-list BGP seq 15 deny 112.0.0.0/8
ip prefix-list BGP seq 20 deny 113.0.0.0/8
ip prefix-list BGP seq 25 deny 114.0.0.0/8
ip prefix-list BGP seq 30 deny 115.0.0.0/8
ip prefix-list BGP seq 35 deny 116.0.0.0/8
ip prefix-list BGP seq 40 deny 117.0.0.0/8
ip prefix-list BGP seq 45 deny 118.0.0.0/8
ip prefix-list BGP seq 50 deny 119.0.0.0/8
ip prefix-list BGP seq 55 permit 0.0.0.0/0 le 32
```


Task 5.1 Breakdown

When redistributing from BGP into IGP care needs to be taken to ensure that only the BGP routes learned at the edge are redistributed. If all routes were redistributed from BGP into IGP, traffic could be blackholed. This can ocurr by follwing the lower administrative distance IGP over iBGP routes toward the wrong edge of the network.

On R6, if the routes redistributed from BGP into EIGRP are not filtered from being advertised back to BB1, a routing loop will result. This will happen because BB1 would prefer the EIGRP routes rather than the BGP routes to BB2 where the routes are originated.

Finally, the task states that all device running BGP need reachability to the advertised routes which necessitates advertising the internal network space to AS 54. This is done using an aggregate route on R6.

Task 5.1 Verification

Verify BGP neighbors:

```
Rack1R3#show ip bgp summary  | beg Nei
Neighbor        V AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd
190.1.135.1     4 100       3        5        4    0    0   00:00:12        0
192.10.1.254    4 254       5        5        4    0    0   00:00:13        3

Rack1R1#show ip bgp summary | beg Nei
Neighbor        V AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd
190.1.0.2       4 100       5        6       28    0    0  00:01:32        0
190.1.0.6       4 100       7        5       28    0    0  00:00:12        8
190.1.135.3     4 200       7        6       20    0    0  00:00:39        3

Rack1R6#show ip bgp summary  | beg Nei
Neighbor        V AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd
54.1.1.254      4 54        7        5       15    0    0 00:00:39        8
190.1.0.2       4 100       4        7       15    0    0 00:00:32        0
190.1.135.1     4 100       5        7       15    0    0 00:00:32        3
```

Confirm that R5 has AS 254 BGP prefixes installed into RIB via OSPF:

```
Rack1R5#show ip route  205.90.31.0
Routing entry for 205.90.31.0/24
  Known via "ospf 1", distance 110, metric 1
  Tag 254, type extern 2, forward metric 64
  Redistributing via rip, eigrp 10
  Advertised by rip metric 1 route-map OSPF->RIP
                eigrp 10 metric 1 1 1 1 1
  Last update from 190.1.135.3 on Serial0/0.1, 00:03:52 ago
  Routing Descriptor Blocks:
  * 190.1.135.3, from 150.1.3.3, 00:03:52 ago, via Serial0/0.1
      Route metric is 1, traffic share count is 1
```



```
      Route tag 254

Rack1R5#show ip route 220.20.3.0
Routing entry for 220.20.3.0/24
  Known via "ospf 1", distance 110, metric 1
  Tag 254, type extern 2, forward metric 64
  Redistributing via rip, eigrp 10
  Advertised by rip metric 1 route-map OSPF->RIP
                eigrp 10 metric 1 1 1 1 1
  Last update from 190.1.135.3 on Serial0/0.1, 00:04:16 ago
  Routing Descriptor Blocks:
  * 190.1.135.3, from 150.1.3.3, 00:04:16 ago, via Serial0/0.1
      Route metric is 1, traffic share count is 1
      Route tag 254
```



```
Rack1R5#show ip route 222.22.2.0
Routing entry for 222.22.2.0/24
  Known via "ospf 1", distance 110, metric 1
  Tag 254, type extern 2, forward metric 64
  Redistributing via rip, eigrp 10
  Advertised by rip metric 1 route-map OSPF->RIP
                eigrp 10 metric 1 1 1 1 1
  Last update from 190.1.135.3 on Serial0/0.1, 00:04:35 ago
  Routing Descriptor Blocks:
  * 190.1.135.3, from 150.1.3.3, 00:04:35 ago, via Serial0/0.1
      Route metric is 1, traffic share count is 1
      Route tag 254
```

Confirm that R5 has AS54 prefixes installed into RIB via EIGRP. For instance, check prefix 112.0.0.0:

```
Rack1R5#show ip route 112.0.0.0
Routing entry for 112.0.0.0/8
  Known via "eigrp 10", distance 170, metric 2560025856
  Tag 54, type external
  Redistributing via ospf 1, eigrp 10
  Advertised by ospf 1 subnets
  Last update from 190.1.0.6 on Ethernet0/0, 00:00:02 ago
  Routing Descriptor Blocks:
  * 190.1.0.6, from 190.1.0.6, 00:00:02 ago, via Ethernet0/0
      Route metric is 2560025856, traffic share count is 1
      Total delay is 1010 microseconds, minimum bandwidth is 1 Kbit
      Reliability 1/255, minimum MTU 1 bytes
      Loading 1/255, Hops 1
      Route tag 54
```

Task 5.2

R6:

```
router bgp 100
 aggregate-address 112.0.0.0 248.0.0.0
```

Task 5.2 Verification

Confirm that summary has been generated:

```
Rack1R6#show ip bgp cidr-only
BGP table version is 16, local router ID is 150.1.6.6
Status codes: s suppressed, d damped, h history, * valid, > best, i -
internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
*> 112.0.0.0/5      0.0.0.0                              32768 i
```


Task 1.1

1) Wrong VLAN and subnet between R3 and SW3.
2) Wrong VLAN and subnet between R5 and SW4.

Task 2.1

SW1:

```
interface FastEthernet0/16
 switchport trunk encapsulation dot1q
 switchport trunk native vlan 125
 switchport mode trunk
 switchport nonegotiate
```

SW2:

```
interface FastEthernet0/16
 switchport trunk encapsulation dot1q
 switchport trunk native vlan 125
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet0/17
 switchport trunk encapsulation dot1q
 switchport trunk native vlan 125
 switchport mode trunk
 switchport nonegotiate
```

SW3:

```
interface FastEthernet0/13
 switchport trunk encapsulation dot1q
 switchport trunk native vlan 125
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet0/16
 switchport trunk encapsulation dot1q
 switchport trunk native vlan 125
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet0/17
 switchport trunk encapsulation dot1q
 switchport trunk native vlan 125
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet0/19
 switchport trunk encapsulation dot1q
 switchport trunk native vlan 125
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet0/21
 switchport trunk encapsulation dot1q
 switchport trunk native vlan 125
```



```
 switchport mode trunk
 switchport nonegotiate
```

SW4:

```
interface FastEthernet0/19
 switchport trunk encapsulation dot1q
 switchport trunk native vlan 125
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet0/21
 switchport trunk encapsulation dot1q
 switchport trunk native vlan 125
 switchport mode trunk
 switchport nonegotiate
```

Task 2.1 Verification

```
Rack1SW1#show interfaces trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/16      on           802.1q         trunking      125

Rack1SW2#show interfaces trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/16      on           802.1q         trunking      125
Fa0/17      on           802.1q         trunking      125

Rack1SW3#show interfaces trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/13      on           802.1q         trunking      125
Fa0/16      on           802.1q         trunking      125
Fa0/17      on           802.1q         trunking      125
Fa0/19      on           802.1q         trunking      125
Fa0/21      on           802.1q         trunking      125

Rack1SW4#show interfaces trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/19      on           802.1q         trunking      125
Fa0/21      on           802.1q         trunking      125
```


Task 2.2

SW2:

```
interface FastEthernet0/16
 channel-group 1 mode active
!
interface FastEthernet0/17
 channel-group 1 mode active
```

SW3:

```
interface FastEthernet0/16
 channel-group 1 mode active
!
interface FastEthernet0/17
 channel-group 1 mode active
!
interface FastEthernet0/19
 channel-group 2 mode active
!
interface FastEthernet0/21
 channel-group 2 mode active
```

SW4:

```
interface FastEthernet0/19
 channel-group 1 mode active
!
interface FastEthernet0/21
 channel-group 1 mode active
```

Task 2.2 Verification

```
Rack1SW3#show etherchannel summary
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 2
Number of aggregators:           2

Group  Port-channel  Protocol    Ports
------------------------------------------
1      Po1(SU)         LACP      Fa0/16(P)   Fa0/17(P)
2      Po2(SU)         LACP      Fa0/19(P)   Fa0/21(P)

Rack1SW3#show interfaces trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/13      on           802.1q         trunking      125
Po1         on           802.1q         trunking      125
Po2         on           802.1q         trunking      125
```


Task 2.3

SW1:

```
vtp domain CCIE
!
interface FastEthernet0/1
 switchport access vlan 125
!
interface FastEthernet0/3
 switchport access vlan 37
!
interface FastEthernet0/5
 switchport access vlan 125

interface FastEthernet0/16
 switchport trunk allowed vlan 72,73,125
```

SW2:

```
vtp domain CCIE
!
interface FastEthernet0/2
 switchport access vlan 125
!
interface FastEthernet0/4
 switchport access vlan 46
!
interface FastEthernet0/6
 switchport access vlan 46
!
interface FastEthernet0/24
 switchport access vlan 72

interface Port-channel1
 switchport trunk allowed vlan 72,125
```

SW3:

```
vtp domain CCIE
!
interface FastEthernet0/3
 switchport access vlan 3
!
interface FastEthernet0/4
!
interface FastEthernet0/5
 switchport access vlan 5
!
interface FastEthernet0/24
 switchport access vlan 73

interface FastEthernet0/13
 switchport trunk allowed vlan 72,73,125

interface Port-channel1
 switchport trunk allowed vlan 72,125
```



```
interface Port-channel2
 switchport trunk allowed vlan 5
```

SW4:

```
vtp domain CCIE
!
interface FastEthernet0/4
 switchport access vlan 4

interface Port-channel1
 switchport trunk allowed vlan 5
```

Task 2.3 Verification

```
Rack1SW1#show vtp status
VTP Version                     : 2
Configuration Revision          : 10
Maximum VLANs supported locally : 1005
Number of existing VLANs        : 13
VTP Operating Mode              : Server
VTP Domain Name                 : CCIE
VTP Pruning Mode                : Disabled
VTP V2 Mode                     : Disabled
VTP Traps Generation            : Disabled
MD5 digest                      : 0xB8 0x30 0x5F 0xDE 0x37 0x2A 0x39
0xD0
Configuration last modified by 152.1.37.7 at 3-1-93 01:26:38
Local updater ID is 152.1.37.7 on interface Vl37 (lowest numbered VLAN
interface found)

Rack1SW2#show vtp status
VTP Version                     : 2
Configuration Revision          : 10
Maximum VLANs supported locally : 1005
Number of existing VLANs        : 13
VTP Operating Mode              : Server
VTP Domain Name                 : CCIE
VTP Pruning Mode                : Disabled
VTP V2 Mode                     : Disabled
VTP Traps Generation            : Disabled
MD5 digest                      : 0xB8 0x30 0x5F 0xDE 0x37 0x2A 0x39
0xD0
Configuration last modified by 152.1.37.7 at 3-1-93 01:26:38
Local updater ID is 0.0.0.0 (no valid interface found)

Rack1SW3#show vtp status
VTP Version                     : 2
Configuration Revision          : 10
Maximum VLANs supported locally : 1005
Number of existing VLANs        : 13
VTP Operating Mode              : Server
VTP Domain Name                 : CCIE
VTP Pruning Mode                : Disabled
VTP V2 Mode                     : Disabled
VTP Traps Generation            : Disabled
```



```
MD5 digest                      : 0xB8 0x30 0x5F 0xDE 0x37 0x2A 0x39
0xD0
Configuration last modified by 152.1.37.7 at 3-1-93 01:26:38
Local updater ID is 152.1.3.9 on interface Vl3 (lowest numbered VLAN
interface found)

Rack1SW4#show vtp status
VTP Version                     : 2
Configuration Revision          : 10
Maximum VLANs supported locally : 1005
Number of existing VLANs        : 13
VTP Operating Mode              : Server
VTP Domain Name                 : CCIE
VTP Pruning Mode                : Disabled
VTP V2 Mode                     : Disabled
VTP Traps Generation            : Disabled
MD5 digest                      : 0xB8 0x30 0x5F 0xDE 0x37 0x2A 0x39
0xD0
Configuration last modified by 152.1.37.7 at 3-1-93 01:26:38
Local updater ID is 152.1.5.10 on interface Vl5 (lowest numbered VLAN
interface found)

Rack1SW1#show vlan brief | exclude unsup

VLAN Name                            Status    Ports
---- ----------------------------- --------- -------------------------------
1    default                         active    Fa0/2, Fa0/4, Fa0/6, Fa0/7
                                               Fa0/8, Fa0/9, Fa0/10, Fa0/11
                                               Fa0/12, Fa0/13, Fa0/14, Fa0/15
                                               Fa0/17, Fa0/18, Fa0/19, Fa0/20
                                               Fa0/21, Fa0/22, Fa0/23, Fa0/24
                                               Gi0/1, Gi0/2
3    VLAN0003                        active
4    VLAN0004                        active
5    VLAN0005                        active
37   VLAN0037                        active    Fa0/3
46   VLAN0046                        active
72   VLAN0072                        active
73   VLAN0073                        active
125  VLAN0125                        active    Fa0/1, Fa0/5


Rack1SW2#show vlan brief | exclude unsup

VLAN Name                            Status    Ports
---- ----------------------------- --------- -------------------------------
1    default                         active    Fa0/1, Fa0/3, Fa0/5, Fa0/7
                                               Fa0/8, Fa0/9, Fa0/10, Fa0/11
                                               Fa0/12, Fa0/13, Fa0/14, Fa0/15
                                               Fa0/18, Fa0/19, Fa0/20, Fa0/21
                                               Fa0/22, Fa0/23, Gi0/1, Gi0/2
3    VLAN0003                        active
4    VLAN0004                        active
5    VLAN0005                        active
37   VLAN0037                        active
46   VLAN0046                        active    Fa0/4, Fa0/6
72   VLAN0072                        active    Fa0/24
```



```
73   VLAN0073                         active
125  VLAN0125                         active    Fa0/2
```

```
Rack1SW3#show vlan brief | exclude unsup

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa0/1, Fa0/2, Fa0/4, Fa0/6
                                                Fa0/7, Fa0/8, Fa0/9, Fa0/10
                                                Fa0/11, Fa0/12, Fa0/14, Fa0/15
                                                Fa0/18, Fa0/20, Fa0/22, Fa0/23
                                                Gi0/1, Gi0/2
3    VLAN0003                         active    Fa0/3
4    VLAN0004                         active
5    VLAN0005                         active    Fa0/5
37   VLAN0037                         active
46   VLAN0046                         active
72   VLAN0072                         active
73   VLAN0073                         active    Fa0/24
125  VLAN0125                         active
```

```
Rack1SW4#show vlan brief | exclude unsup

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa0/1, Fa0/2, Fa0/3, Fa0/5
                                                Fa0/6, Fa0/7, Fa0/8, Fa0/9
                                                Fa0/10, Fa0/11, Fa0/12, Fa0/13
                                                Fa0/14, Fa0/15, Fa0/16, Fa0/17
                                                Fa0/18, Fa0/20, Fa0/22, Fa0/23
                                                Fa0/24, Gi0/1, Gi0/2
3    VLAN0003                         active
4    VLAN0004                         active    Fa0/4
5    VLAN0005                         active
37   VLAN0037                         active
46   VLAN0046                         active
72   VLAN0072                         active
73   VLAN0073                         active
125  VLAN0125                         active
```

```
Rack1SW1#show interfaces trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/16      on           802.1q         trunking      125

Port        Vlans allowed on trunk
Fa0/16      72-73,125

Port        Vlans allowed and active in management domain
Fa0/16      72-73,125

Port        Vlans in spanning tree forwarding state and not pruned
Fa0/16      72-73,125
```



```
Rack1SW2#show interfaces trunk

Port        Mode         Encapsulation  Status        Native vlan
Po1         on           802.1q         trunking      125

Port        Vlans allowed on trunk
Po1         72,125

Port        Vlans allowed and active in management domain
Po1         72,125

Port        Vlans in spanning tree forwarding state and not pruned
Po1         72,125


Rack1SW3#show interfaces trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/13      on           802.1q         trunking      125
Po1         on           802.1q         trunking      125
Po2         on           802.1q         trunking      125

Port        Vlans allowed on trunk
Fa0/13      72-73,125
Po1         72,125
Po2         5

Port        Vlans allowed and active in management domain
Fa0/13      72-73,125
Po1         72,125
Po2         5

Port        Vlans in spanning tree forwarding state and not pruned
Fa0/13      72-73,125
Po1         72,125
Po2         5


Rack1SW4#show interfaces trunk

Port        Mode         Encapsulation  Status        Native vlan
Po1         on           802.1q         trunking      125

Port        Vlans allowed on trunk
Po1         5

Port        Vlans allowed and active in management domain
Po1         5

Port        Vlans in spanning tree forwarding state and not pruned
Po1         5
```


Task 3.1

R1:
```
interface Serial0/0
 encapsulation frame-relay
!
interface Serial0/0.1 point-to-point
 ip address 152.1.123.1 255.255.255.0
 frame-relay interface-dlci 103
```

R2:
```
interface Serial0/0
 encapsulation frame-relay
!
interface Serial0/0.1 point-to-point
 ip address 152.1.123.2 255.255.255.0
 frame-relay interface-dlci 203
```

R3:
```
interface Serial0/0
 encapsulation frame-relay
!
interface Serial0/0.1 multipoint
 ip address 152.1.123.3 255.255.255.0
 frame-relay map ip 152.1.123.1 301 broadcast
 frame-relay map ip 152.1.123.2 302 broadcast
```

Task 3.1 Verification

Verify L3 to L2 mappings and check connectivity:

```
Rack1R3#show frame-relay map
Serial1/0.1 (up): ip 152.1.123.1 dlci 301(0x12D,0x48D0), static,
              broadcast,
              CISCO, status defined, active
Serial1/0.1 (up): ip 152.1.123.2 dlci 302(0x12E,0x48E0), static,
              broadcast,
              CISCO, status defined, active

Rack1R3#ping 152.1.123.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 152.1.123.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 32/32/32 ms
Rack1R3#ping 152.1.123.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 152.1.123.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 32/32/32 ms
```


Task 3.2

R4:

```
interface virtual-template1
 ip address 152.1.45.4 255.255.255.0
!
interface Serial0/0
 encapsulation frame-relay
!
interface Serial0/0.1 point-to-point
 frame-relay interface-dlci 405 ppp virtual-template 1
```

R5:

```
interface virtual-template1
 ip address 152.1.45.5 255.255.255.0
!
interface Serial0/0
 encapsulation frame-relay
 frame-relay interface-dlci 504 ppp virtual-template 1
```

Task 3.2 Verification

Confirm connectivity:

```
Rack1R5#ping 152.1.45.4

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 152.1.45.4, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 60/60/60 ms
```

Task 3.3

R6:

```
interface Serial0/0/0
 encapsulation frame-relay
!
interface Serial0/0/0.1 point-to-point
 frame-relay interface-dlci 401
```

Task 3.3 Verification

Confirm that PVC is active:

```
Rack1R6#show frame-relay pvc | inc 401
DLCI = 401, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE =
Serial0/0/0.1
```


Task 3.4

R4:

```
interface Serial0/1
 encapsulation ppp
```

R5:

```
interface Serial0/1
 clock rate 64000
 encapsulation ppp
```

Task 3.5

R4:

```
username Rack1R5 password CISCO
!
interface Serial0/1
 ppp authentication chap
```

R5:

```
username Rack1R4 password CISCO
!
interface Serial0/1
 ppp authentication chap
```

Tasks 3.4 – 3.5 Verification

Verify PPP authentication:

```
Rack1R5#debug ppp authentication
PPP authentication debugging is on
Rack1R5#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Rack1R5(config)#interface s/1
Rack1R5(config-if)#shutdown
%LINK-5-CHANGED: Interface Serial0/1, changed state to administratively
down
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1, changed
state to down
Rack1R5(config-if)#no shutdown

%LINK-3-UPDOWN: Interface Serial0/1, changed state to up
Se0/1 PPP: Using default call direction
Se0/1 PPP: Treating connection as a dedicated line
Se0/1 PPP: Session handle[A900000D] Session id[8]
Se0/1 PPP: Authorization required
Se0/1 CHAP: O CHALLENGE id 2 len 28 from "Rack1R5"
Se0/1 CHAP: I CHALLENGE id 6 len 28 from "Rack1R4"
Se0/1 CHAP: Using hostname from unknown source
Se0/1 CHAP: Using password from AAA
Se0/1 CHAP: O RESPONSE id 6 len 28 from "Rack1R5"
Se0/1 CHAP: I RESPONSE id 2 len 28 from "Rack1R4"
Se0/1 PPP: Sent CHAP LOGIN Request
Se0/1 PPP: Received LOGIN Response PASS
Se0/1 PPP: Sent LCP AUTHOR Request
```



```
Se0/1 PPP: Sent IPCP AUTHOR Request
Se0/1 CHAP: I SUCCESS id 6 len 4
Se0/1 LCP: Received AAA AUTHOR Response PASS
Se0/1 IPCP: Received AAA AUTHOR Response PASS
Se0/1 CHAP: O SUCCESS id 2 len 4
Se0/1 PPP: Sent CDPCP AUTHOR Request
Se0/1 CDPCP: Received AAA AUTHOR Response PASS
Se0/1 PPP: Sent IPCP AUTHOR Request
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1, changed
state to up
```

Confirm connectivity:

```
Rack1R4#ping 152.1.54.5

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 152.1.54.5, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 28/30/32 ms
```


Task 4.1

R6:

```
no ip routing
bridge 1 protocol ieee
!
interface GigabitEthernet0/0
 bridge-group 1
!
interface Serial0/0/0.1
 bridge-group 1
```

Task 4.1 Verification

Verify bridging configuration:

```
Rack1R6#show bridge 1 verbose

Total of 300 station blocks, 299 free
Codes: P - permanent, S - self

BG Hash      Address      Action  Interface      VC     Age   RX count
TX count
 1 33/0   000f.8fe0.3506 forward  Gi0/0           -      0     2   0

Flood ports (BG 1)           RX count    TX count
GigabitEthernet0/0                  2           0
Serial0/0/0.1                       0           2

Rack1R6#show spanning-tree 1

 Bridge group 1 is executing the ieee compatible Spanning Tree protocol
  Bridge Identifier has priority 32768, address 0015.62d0.4830
  Configured hello time 2, max age 20, forward delay 15
  Current root has priority 32768, address 0000.0cbc.5888
  Root port is 12 (Serial0/0/0.1), cost of root path is 647
  Topology change flag not set, detected flag not set
  Number of topology changes 5 last change occurred 00:00:57 ago
          from GigabitEthernet0/0
  Times:  hold 1, topology change 35, notification 2
          hello 2, max age 20, forward delay 15
  Timers: hello 0, topology change 0, notification 0, aging 300

 Port 4 (GigabitEthernet0/0) of Bridge group 1 is forwarding
   Port path cost 19, Port priority 128, Port Identifier 128.4.
   Designated root has priority 32768, address 0000.0cbc.5888
   Designated bridge has priority 32768, address 0015.62d0.4830
   Designated port id is 128.4, designated path cost 647
   Timers: message age 0, forward delay 0, hold 0
   Number of transitions to forwarding state: 1
   BPDU: sent 42, received 4
```



```
Port 12 (Serial0/0/0.1) of Bridge group 1 is forwarding
   Port path cost 647, Port priority 128, Port Identifier 128.12.
   Designated root has priority 32768, address 0000.0cbc.5888
   Designated bridge has priority 32768, address 0000.0cbc.5888
   Designated port id is 128.60, designated path cost 0
   Timers: message age 1, forward delay 0, hold 0
   Number of transitions to forwarding state: 1
   BPDU: sent 5, received 91
```

Task 4.2

R6:

```
interface GigabitEthernet0/0
 ip address 54.1.10.6 255.255.255.0
!
interface Serial0/0/0.1
 ip address 54.1.10.6 255.255.255.0
```

Task 4.2 Verification

Confirm that R6 can ping R4:

```
Rack1R6#ping 54.1.10.100

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 54.1.10.100, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/4 ms
```

Confirm that R4 can reach BB1:

```
Rack1R4#ping 54.1.10.254

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 54.1.10.254, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 40/40/40 ms
```


Task 4.3

R4:
```
router rip
 version 2
 no auto-summary
 network 152.1.0.0
 network 150.1.0.0
 network 54.0.0.0
```

R5:
```
router rip
 version 2
 no auto-summary
 network 152.1.0.0
 passive-interface Ethernet0/0
```

SW1:
```
ip routing
!
router rip
 version 2
 no auto-summary
 network 204.12.1.0
```

SW4:
```
ip routing
!
router rip
 version 2
 no auto-summary
 network 150.1.0.0
 network 152.1.0.0
```

Task 4.3 Verification

```
Rack1R4#show ip protocols
Routing Protocol is "rip"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Sending updates every 30 seconds, next due in 18 seconds
  Invalid after 180 seconds, hold down 180, flushed after 240
  Redistributing: rip
  Default version control: send version 2, receive version 2
    Interface             Send  Recv  Triggered RIP  Key-chain
    Ethernet0/0           2     2
    Ethernet0/1           2     2
    Serial0/1             2     2
    Virtual-Access1       2     2
    Virtual-Template1     2     2
    Loopback0             2     2
  Automatic network summarization is not in effect
  Maximum path: 4
  Routing for Networks:
    0.0.0.0
  Routing Information Sources:
```



```
    Gateway         Distance      Last Update
    152.1.54.5           120      00:00:21
    152.1.45.5           120      00:00:25
    54.1.10.254          120      00:00:00
  Distance: (default is 120)

Rack1R4#show ip route rip
     152.1.0.0/16 is variably subnetted, 7 subnets, 2 masks
R       152.1.5.0/24 [120/1] via 152.1.54.5, 00:00:05, Serial0/1
                     [120/1] via 152.1.45.5, 00:00:13, Virtual-Access1
R       152.1.125.0/24 [120/1] via 152.1.54.5, 00:00:05, Serial0/1
                       [120/1] via 152.1.45.5, 00:00:13, Virtual-
Access1
R    212.18.1.0/24 [120/1] via 54.1.10.254, 00:00:14, Ethernet0/0
R    212.18.0.0/24 [120/1] via 54.1.10.254, 00:00:14, Ethernet0/0
R    212.18.3.0/24 [120/1] via 54.1.10.254, 00:00:14, Ethernet0/0
R    212.18.2.0/24 [120/1] via 54.1.10.254, 00:00:14, Ethernet0/0
     150.1.0.0/24 is subnetted, 2 subnets
R       150.1.10.0 [120/2] via 152.1.54.5, 00:00:05, Serial0/1
                   [120/2] via 152.1.45.5, 00:00:13, Virtual-Access1

Rack1R5#show ip protocols
Routing Protocol is "rip"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Sending updates every 30 seconds, next due in 18 seconds
  Invalid after 180 seconds, hold down 180, flushed after 240
  Redistributing: rip
  Default version control: send version 2, receive version 2
    Interface             Send  Recv  Triggered RIP  Key-chain
    Ethernet0/1           2     2
    Serial0/1             2     2
    Virtual-Access1       2     2
    Virtual-Template1     2     2
  Automatic network summarization is not in effect
  Maximum path: 4
  Routing for Networks:
    152.1.0.0
  Passive Interface(s):
    Ethernet0/0
  Routing Information Sources:
    Gateway         Distance      Last Update
    152.1.5.10           120      00:00:05
    152.1.54.4           120      00:00:26
    152.1.45.4           120      00:00:13
  Distance: (default is 120)

Rack1R5#show ip route rip
     152.1.0.0/16 is variably subnetted, 7 subnets, 2 masks
R       152.1.4.0/24 [120/1] via 152.1.54.4, 00:00:14, Serial0/1
                     [120/1] via 152.1.45.4, 00:00:01, Virtual-Access1
     54.0.0.0/24 is subnetted, 1 subnets
R       54.1.10.0 [120/1] via 152.1.54.4, 00:00:14, Serial0/1
                  [120/1] via 152.1.45.4, 00:00:01, Virtual-Access1
R    212.18.1.0/24 [120/2] via 152.1.54.4, 00:00:14, Serial0/1
                   [120/2] via 152.1.45.4, 00:00:01, Virtual-Access1
R    212.18.0.0/24 [120/2] via 152.1.54.4, 00:00:14, Serial0/1
```



```
                    [120/2] via 152.1.45.4, 00:00:01, Virtual-Access1
R    212.18.3.0/24 [120/2] via 152.1.54.4, 00:00:14, Serial0/1
                    [120/2] via 152.1.45.4, 00:00:01, Virtual-Access1
R    212.18.2.0/24 [120/2] via 152.1.54.4, 00:00:14, Serial0/1
                    [120/2] via 152.1.45.4, 00:00:01, Virtual-Access1
     150.1.0.0/24 is subnetted, 3 subnets
R       150.1.4.0 [120/1] via 152.1.54.4, 00:00:14, Serial0/1
                  [120/1] via 152.1.45.4, 00:00:02, Virtual-Access1
R       150.1.10.0 [120/1] via 152.1.5.10, 00:00:24, Ethernet0/1

Rack1SW4#show ip protocols
*** IP Routing is NSF aware ***

Routing Protocol is "rip"
  Sending updates every 30 seconds, next due in 24 seconds
  Invalid after 180 seconds, hold down 180, flushed after 240
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Redistributing: rip
  Default version control: send version 2, receive version 2
    Interface                Send  Recv  Triggered RIP  Key-chain
    Vlan5                    2     2
    Loopback0                2     2
  Automatic network summarization is not in effect
  Maximum path: 4
  Routing for Networks:
    150.1.0.0
    152.1.0.0
  Routing Information Sources:
    Gateway         Distance      Last Update
    152.1.5.5            120      00:00:01
  Distance: (default is 120)

Rack1SW4#show ip route rip
     152.1.0.0/16 is variably subnetted, 7 subnets, 2 masks
R       152.1.4.0/24 [120/2] via 152.1.5.5, 00:00:12, Vlan5
R       152.1.54.4/32 [120/1] via 152.1.5.5, 00:00:12, Vlan5
R       152.1.54.0/24 [120/1] via 152.1.5.5, 00:00:12, Vlan5
R       152.1.45.4/32 [120/1] via 152.1.5.5, 00:00:12, Vlan5
R       152.1.45.0/24 [120/1] via 152.1.5.5, 00:00:12, Vlan5
R       152.1.125.0/24 [120/1] via 152.1.5.5, 00:00:12, Vlan5
     54.0.0.0/24 is subnetted, 1 subnets
R       54.1.10.0 [120/2] via 152.1.5.5, 00:00:12, Vlan5
R    212.18.1.0/24 [120/3] via 152.1.5.5, 00:00:12, Vlan5
R    212.18.0.0/24 [120/3] via 152.1.5.5, 00:00:12, Vlan5
R    212.18.3.0/24 [120/3] via 152.1.5.5, 00:00:12, Vlan5
R    212.18.2.0/24 [120/3] via 152.1.5.5, 00:00:12, Vlan5
     150.1.0.0/24 is subnetted, 2 subnets
R       150.1.4.0 [120/2] via 152.1.5.5, 00:00:12, Vlan5
```


Task 4.4

R4:

```
interface Serial0/0.1
 backup interface Serial0/1
```

Task 4.4 Verification

Verify backup configuration:

```
Rack1R4#show backup
Primary Interface   Secondary Interface   Status
-----------------   -------------------   ------
Serial0/0.1         Serial0/1             normal operation
```

Verify backup link in case of primary's fault:

```
Rack1R4#debug backup
Backup events debugging is on
Rack1R5#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Rack1R5(config)#interface serial 0/0
Rack1R5(config-if)#shutdown

Rack1R4#
%LINK-3-UPDOWN: Interface Virtual-Access2, changed state to down
BACKUP(Serial0/0.1): event = primary interface went down
BACKUP(Serial0/0.1): changed state to "waiting to backup"
BACKUP(Serial0/0.1): event = timer expired on primary
BACKUP(Serial0/0.1): secondary interface (Serial0/1) made active
BACKUP(Serial0/0.1): changed state to "backup mode"
%LINEPROTO-5-UPDOWN: Line protocol on Interface Virtual-Access2,
changed state to down
%LINK-3-UPDOWN: Interface Serial0/1, changed state to up
BACKUP(Serial0/1): event = secondary interface came up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1, changed
state to up
BACKUP(Serial0/1): event = secondary interface came up
```

Task 4.5

R1:

```
router eigrp 10
 no auto-summary
 network 152.1.125.1 0.0.0.0
```

R2:

```
router eigrp 10
 no auto-summary
 network 152.1.125.2 0.0.0.0
```

R5:

```
router eigrp 10
 no auto-summary
 network 152.1.125.5 0.0.0.0
 network 150.1.5.5 0.0.0.0
```


Task 4.5 Verification

Verify EIGRP neighbors:

```
Rack1R5#show ip eigrp neighbors
IP-EIGRP neighbors for process 10
H   Address                 Interface       Hold Uptime   SRTT   RTO  Q  Seq
                                            (sec)         (ms)       Cnt Num
1   152.1.125.2             Et0/0             12 00:01:06   64   384  0  3
0   152.1.125.1             Et0/0             13 00:01:06   83   498  0  3
```

Verify EIGRP routes:

```
Rack1R1#show ip route eigrp
     150.1.0.0/24 is subnetted, 2 subnets
D       150.1.5.0 [90/156160] via 152.1.125.5, 00:01:43,
FastEthernet0/0
```

Task 4.6

R1:

```
interface Serial0/0.1
 ip ospf network point-to-multipoint
!
router ospf 1
 network 152.1.123.1 0.0.0.0 area 123
```

R2:

```
interface Serial0/0.1
 ip ospf network point-to-multipoint
!
router ospf 1
 network 152.1.123.2 0.0.0.0 area 123
```

R3:

```
interface Serial0/0.1
 ip ospf network point-to-multipoint
!
router ospf 1
 network 152.1.123.3 0.0.0.0 area 123
```


Task 4.6 Verification

Verify OSPF network type:

```
Rack1R3#show ip ospf interface s1/0.1
Serial1/0.1 is up, line protocol is up
  Internet Address 152.1.123.3/24, Area 123
  Process ID 1, Router ID 150.1.3.3, Network Type POINT_TO_MULTIPOINT,
Cost: 781
<output omitted>
```

Verify OSPF neighbors:

```
Rack1R3#show ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
150.1.1.1         0   FULL/  -        00:01:41    152.1.123.1     Serial1/0.1
150.1.2.2         0   FULL/  -        00:01:52    152.1.123.2     Serial1/0.1
```

Task 4.7

R3:

```
interface Ethernet0/0
 ip ospf mtu-ignore
!
interface Ethernet0/1
 ip ospf mtu-ignore
!
router ospf 1
 network 152.1.3.3 0.0.0.0 area 0
 network 152.1.37.3 0.0.0.0 area 37
```

```
SW1:
interface Vlan37
 ip ospf mtu-ignore
!
router ospf 1
 network 152.1.37.7 0.0.0.0 area 37
```

```
SW3:
ip routing
!
interface Vlan3
 ip ospf mtu-ignore
!
router ospf 1
 network 152.1.3.9 0.0.0.0 area 0
```


Task 4.7 Verification

```
Rack1R3#show ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address
Interface
150.1.9.9         1   FULL/BDR        00:00:34    152.1.3.9
Ethernet0/1
150.1.7.7         1   FULL/DR         00:00:34    152.1.37.7
Ethernet0/0
150.1.1.1         0   FULL/  -        00:01:41    152.1.123.1
Serial1/0.1
150.1.2.2         0   FULL/  -        00:01:39    152.1.123.2
Serial1/0.1


Rack1R3#show ip ospf interface e0/0
Ethernet0/0 is up, line protocol is up
  Internet Address 152.1.37.3/24, Area 37
  Process ID 1, Router ID 150.1.3.3, Network Type BROADCAST, Cost: 10

Rack1R3#show ip ospf interface e0/1
Ethernet0/1 is up, line protocol is up
  Internet Address 152.1.3.3/24, Area 0
  Process ID 1, Router ID 150.1.3.3, Network Type BROADCAST, Cost: 10
```

Task 4.8

R1:

```
interface Loopback0
 ip ospf network point-to-point
!
router ospf 1
 router-id 150.1.1.1
 network 150.1.1.1 0.0.0.0 area 0
 area 123 virtual-link 150.1.3.3
```

R2:

```
interface Loopback0
 ip ospf network point-to-point
!
router ospf 1
 router-id 150.1.2.2
 network 150.1.2.2 0.0.0.0 area 0
 area 123 virtual-link 150.1.3.3
```

R3:

```
router ospf 1
 router-id 150.1.3.3
 area 123 virtual-link 150.1.1.1
 area 123 virtual-link 150.1.2.2
```

SW3:

```
router ospf 1
 network 150.1.9.9 0.0.0.0 area 0
```


Task 4.8 Verification

```
Rack1R3#show ip ospf virtual-links
Virtual Link OSPF_VL1 to router 150.1.2.2 is up
  Run as demand circuit
  DoNotAge LSA allowed.
  Transit area 123, via interface Serial1/0.1, Cost of using 781
  Transmit Delay is 1 sec, State POINT_TO_POINT,
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    Hello due in 00:00:05
    Adjacency State FULL (Hello suppressed)
    Index 3/6, retransmission queue length 0, number of retransmission
0
    First 0x0(0)/0x0(0) Next 0x0(0)/0x0(0)
    Last retransmission scan length is 0, maximum is 0
    Last retransmission scan time is 0 msec, maximum is 0 msec
Virtual Link OSPF_VL0 to router 150.1.1.1 is up
  Run as demand circuit
  DoNotAge LSA allowed.
  Transit area 123, via interface Serial1/0.1, Cost of using 781
  Transmit Delay is 1 sec, State POINT_TO_POINT,
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    Hello due in 00:00:09
    Adjacency State FULL (Hello suppressed)
    Index 2/5, retransmission queue length 0, number of retransmission
1
    First 0x0(0)/0x0(0) Next 0x0(0)/0x0(0)
    Last retransmission scan length is 1, maximum is 1
    Last retransmission scan time is 0 msec, maximum is 0 msec


Rack1R3#show ip ospf database | begin Area 0
                Router Link States (Area 0)

Link ID         ADV Router      Age         Seq#       Checksum Link
count
150.1.1.1       150.1.1.1       1     (DNA) 0x80000002 0x0087D7 2
150.1.2.2       150.1.2.2       1     (DNA) 0x80000002 0x0088D0 2
150.1.3.3       150.1.3.3       403         0x80000004 0x0058AB 3
150.1.9.9       150.1.9.9       509         0x80000003 0x009551 2


Rack1R3#show ip ospf database router adv-router 150.1.1.1

            OSPF Router with ID (150.1.3.3) (Process ID 1)

                Router Link States (Area 0)

  Routing Bit Set on this LSA
  LS age: 1 (DoNotAge)
  Options: (No TOS-capability, DC)
  LS Type: Router Links
  Link State ID: 150.1.1.1
  Advertising Router: 150.1.1.1
  LS Seq Number: 80000002
  Checksum: 0x87D7
```



```
  Length: 48
  Area Border Router
  Number of Links: 2

    Link connected to: a Virtual Link
     (Link ID) Neighboring Router ID: 150.1.3.3
     (Link Data) Router Interface address: 152.1.123.1
      Number of TOS metrics: 0
       TOS 0 Metrics: 64

    Link connected to: a Stub Network
     (Link ID) Network/subnet number: 150.1.1.0
     (Link Data) Network Mask: 255.255.255.0
      Number of TOS metrics: 0
       TOS 0 Metrics: 1


Rack1R3#show ip ospf database router adv-router 150.1.2.2

            OSPF Router with ID (150.1.3.3) (Process ID 1)

                Router Link States (Area 0)

  Routing Bit Set on this LSA
  LS age: 1 (DoNotAge)
  Options: (No TOS-capability, DC)
  LS Type: Router Links
  Link State ID: 150.1.2.2
  Advertising Router: 150.1.2.2
  LS Seq Number: 80000002
  Checksum: 0x88D0
  Length: 48
  Area Border Router
  Number of Links: 2

    Link connected to: a Virtual Link
     (Link ID) Neighboring Router ID: 150.1.3.3
     (Link Data) Router Interface address: 152.1.123.2
      Number of TOS metrics: 0
       TOS 0 Metrics: 64

    Link connected to: a Stub Network
     (Link ID) Network/subnet number: 150.1.2.0
     (Link Data) Network Mask: 255.255.255.0
      Number of TOS metrics: 0
       TOS 0 Metrics: 1


Rack1R3#show ip ospf database router adv-router 150.1.9.9

            OSPF Router with ID (150.1.3.3) (Process ID 1)

                Router Link States (Area 0)

  LS age: 684
  Options: (No TOS-capability, DC)
  LS Type: Router Links
```

```
  Link State ID: 150.1.9.9
  Advertising Router: 150.1.9.9
  LS Seq Number: 80000003
  Checksum: 0x9551
  Length: 48
  Number of Links: 2

    Link connected to: a Stub Network
     (Link ID) Network/subnet number: 150.1.9.0
     (Link Data) Network Mask: 255.255.255.0
      Number of TOS metrics: 0
       TOS 0 Metrics: 1

    Link connected to: a Transit Network
     (Link ID) Designated Router address: 152.1.3.3
     (Link Data) Router Interface address: 152.1.3.9
      Number of TOS metrics: 0
       TOS 0 Metrics: 1


Rack1R3#show ip route ospf | include 150.1
     150.1.0.0/24 is subnetted, 4 subnets
O       150.1.2.0 [110/782] via 152.1.123.2, 00:10:10, Serial1/0.1
O       150.1.1.0 [110/782] via 152.1.123.1, 00:10:10, Serial1/0.1
O       150.1.9.0 [110/11] via 152.1.3.9, 00:10:10, Ethernet0/1
```

Task 4.9

R3:

```
router ospf 1
 network 150.1.3.3 0.0.0.0 area 37
```

SW1:

```
router ospf 1
 network 150.1.7.7 0.0.0.0 area 37
```

Task 4.9 Verification

Confirm that R3 and SW1 see each other's Loopback0 network as intra-area route:

```
Rack1R3#show ip route ospf | include 150.1.7.7
O       150.1.7.7/32 [110/11] via 152.1.37.7, 00:10:28, Ethernet0/0

Rack1SW1#show ip route ospf | include 150.1.3.3
O       150.1.3.3/32 [110/2] via 152.1.37.3, 00:12:24, Vlan37
```


Task 4.10

R1:
```
router ospf 1
 redistribute eigrp 10 subnets
!
router eigrp 10
 redistribute ospf 1 metric 1 1 1 1 1
```

R2:
```
router ospf 1
 redistribute eigrp 10 subnets
!
router eigrp 10
 redistribute ospf 1 metric 1 1 1 1 1
```

R5:
```
router rip
 redistribute eigrp 10 metric 1
!
router eigrp 10
 redistribute rip metric 1 1 1 1 1
```

SW1:
```
router rip
 redistribute ospf 1 metric 1
!
router ospf 1
 redistribute rip subnets
```

Task 4.11

R1:
```
router ospf 1
 distance ospf external 171
```

R2:
```
router ospf 1
 distance ospf external 171
```

SW1:
```
router rip
  distance 109
```


Tasks 4.10 – 4.11 Verification

Verify full connectivity with the following TCL script:

```
foreach i {
150.1.1.1
152.1.123.1
152.1.125.1
150.1.2.2
152.1.123.2
152.1.125.2
150.1.3.3
152.1.3.3
152.1.37.3
152.1.123.3
54.1.10.100
150.1.4.4
152.1.4.4
152.1.54.4
152.1.45.4
150.1.5.5
152.1.5.5
152.1.54.5
152.1.45.5
152.1.125.5
150.1.7.7
152.1.37.7
204.12.1.7
150.1.9.9
152.1.3.9
} { puts [ exec "ping $i" ] }
```

Note that backup link between R4 and R5 is reachable only when primary link fails. Also, VLAN72 network is excluded from connectivity test.

Task 5.1

R1:
```
router bgp 1000
 no synchronization
 bgp log-neighbor-changes
 bgp confederation identifier 200
 bgp confederation peers 3000
 neighbor 152.1.123.3 remote-as 3000
 neighbor 152.1.125.5 remote-as 100
 no auto-summary
```

R2:
```
router bgp 2000
 no synchronization
 bgp log-neighbor-changes
 bgp confederation identifier 200
 bgp confederation peers 3000
 neighbor 152.1.123.3 remote-as 3000
 neighbor 152.1.125.5 remote-as 100
```

R3:
```
router bgp 3000
 no synchronization
 bgp log-neighbor-changes
 bgp confederation identifier 200
 bgp confederation peers 1000 2000 7000
 neighbor 152.1.37.7 remote-as 7000
 neighbor 152.1.123.1 remote-as 1000
 neighbor 152.1.123.2 remote-as 2000
```

R4:
```
router bgp 100
 neighbor 150.1.5.5 remote-as 100
 neighbor 150.1.5.5 update-source loopback0
 neighbor 54.1.10.254 remote-as 54
```

R5:
```
router bgp 100
 neighbor 152.1.125.1 remote-as 200
 neighbor 152.1.125.2 remote-as 200
 neighbor 150.1.4.4 remote-as 100
 neighbor 150.1.4.4 update-source loopback0
```

SW1:
```
router bgp 7000
 no synchronization
 bgp log-neighbor-changes
 bgp confederation identifier 200
 bgp confederation peers 3000
 neighbor 152.1.37.3 remote-as 3000
 neighbor 152.1.37.3 next-hop-self
 neighbor 192.10.1.254 remote-as 254
 neighbor 192.10.1.254 password CISCO
 no auto-summary
```


Task 5.1 Verification

Verify BGP neighbors:

```
Rack1R5#show ip bgp summary | beg Nei
Neighbor        V AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd
150.1.4.4       4 100      11      11        1    0    0 00:08:44        0
152.1.125.1     4 200      12      11        1    0    0 00:08:57        0
152.1.125.2     4 200      12      12        1    0    0 00:08:43        0

Rack1R3#show ip bgp summary | beg Nei
Neighbor        V AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd
152.1.37.7      4 7000     19      21        1    0    0 00:00:06        0
152.1.123.1     4 1000     10      12        1    0    0 00:03:08        0
152.1.123.2     4 2000     11      16        1    0    0 00:01:50        0

Rack1SW1#show ip bgp summary | beg Nei
Neighbor        V AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd
152.1.37.3      4 3000      4       4        4    0    0 00:00:42        0
192.10.1.254    4 254       5       4        4    0    0 00:00:08        3
```

Task 5.2

R1:

```
route-map SET_MED permit 10
 set metric 1000
!
router bgp 1000
neighbor 152.1.125.5 route-map SET_MED out
```

R2:

```
route-map SET_MED permit 10
 set metric 2000
!
router bgp 2000
neighbor 152.1.125.5 route-map SET_MED out
```

SW1:

```
router bgp 7000
 network 152.1.37.0 mask 255.255.255.0
 aggregate-address 152.1.0.0 255.255.0.0 summary-only
```

Task 5.2 Breakdown

Although not explicitly required in the task, reachability to all networks advertised by the backbone routers is listed as a requirement in the lab instructions. Therefore, an aggregate is advertised on SW1 in order for routers in the BGP domain to be able to reach routes advertised by BB2. Remember that a network from the aggregation must be present in the BGP route table before the aggregate becomes active. Here, the 152.1.37.0/24 was advertised to activate the aggregate.

Task 5.2 Verification

Verify best-paths at R5:

```
Rack1R5#show ip bgp
BGP table version is 4, local router ID is 150.1.5.5
Status codes: s suppressed, d damped, h history, * valid, > best, i -
internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
*  205.90.31.0      152.1.125.2           2000             0 200 254 ?
*>                  152.1.125.1           1000             0 200 254 ?
*  220.20.3.0       152.1.125.2           2000             0 200 254 ?
*>                  152.1.125.1           1000             0 200 254 ?
*  222.22.2.0       152.1.125.2           2000             0 200 254 ?
*>                  152.1.125.1           1000             0 200 254 ?
```


Task 1.1

1) Wrong IP addresses on SW1's VLAN interfaces should be swapped
2) The 'no switchport' command is needed on SW3 and SW4 F0/16

Task 2.1

SW1:

```
interface FastEthernet0/14
 switchport mode dynamic desirable
```

Task 2.1 Verification

```
Rack1SW1#show interfaces trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/14      desirable    n-isl          trunking      1

Port        Vlans allowed on trunk
Fa0/14      1-4094

Port        Vlans allowed and active in management domain
Fa0/14      1

Port        Vlans in spanning tree forwarding state and not pruned
Fa0/14      none


Rack1SW3#show interfaces trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/17      desirable    n-isl          trunking      1
Fa0/18      desirable    n-isl          trunking      1

Port        Vlans allowed on trunk
Fa0/17      1-4094
Fa0/18      1-4094

Port        Vlans allowed and active in management domain
Fa0/17      1
Fa0/18      1

Port        Vlans in spanning tree forwarding state and not pruned
Fa0/17      1
Fa0/18      1


Rack1SW4#show interfaces trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/17      desirable    n-isl          trunking      1

Port        Vlans allowed on trunk
Fa0/17      1-4094
```



```
Port        Vlans allowed and active in management domain
Fa0/17      1

Port        Vlans in spanning tree forwarding state and not pruned
Fa0/17      1
```

Task 2.2

R1:

```
interface FastEthernet0/0.1
 encapsulation dot1q 136
 ip address 128.1.136.1 255.255.255.0
!
interface FastEthernet0/0.2
 encapsulation dot1q 14
 ip address 128.1.14.1 255.255.255.0
```

R3:

```
interface Ethernet0/0.1
 encapsulation dot1q 136
 ip address 128.1.136.3 255.255.255.0
!
interface Ethernet0/0.2
 encapsulation dot1q 36
 ip address 128.1.36.3 255.255.255.0
```

R6:

```
interface GigabitEthernet0/0.1
 encapsulation dot1q 136
 ip address 128.1.136.6 255.255.255.0
!
interface GigabitEthernet0/0.2
 encapsulation dot1q 36
 ip address 128.1.36.6 255.255.255.0
```


SW1:

```
vlan 5,10,14,27,33,36,48,59,72,109,136
!
interface FastEthernet0/1
 switchport trunk encapsulation dot1q
 switchport mode trunk
!
interface FastEthernet0/3
 switchport trunk encapsulation dot1q
 switchport mode trunk
!
interface FastEthernet0/5
 switchport access vlan 59
```

SW2:

```
interface FastEthernet0/2
 switchport access vlan 72
!
interface FastEthernet0/4
 switchport access vlan 14
!
interface FastEthernet0/6
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet0/16
 switchport access vlan 109
!
interface FastEthernet0/19
 switchport access vlan 109
!
interface FastEthernet0/24
 switchport access vlan 27
```

SW2:

```
interface FastEthernet0/3
 switchport access vlan 33
!
interface FastEthernet0/5
 switchport access vlan 5
!
interface FastEthernet0/24
 switchport access vlan 33
```

SW4:

```
interface FastEthernet0/4
 switchport access vlan 48
```


Task 2.2 Verification

```
Rack1SW1#show vlan brief | exclude unsup

VLAN Name                 Status    Ports
---- -------------------- --------- -------------------------------
1    default              active    Fa0/2, Fa0/4, Fa0/6, Fa0/7
                                    Fa0/8, Fa0/9, Fa0/10, Fa0/11
                                    Fa0/12, Fa0/13, Fa0/15, Fa0/16
                                    Fa0/17, Fa0/18, Fa0/19, Fa0/20
                                    Fa0/21, Fa0/22, Fa0/23, Fa0/24
                                    Gi0/1, Gi0/2
5    VLAN0005             active
10   VLAN0010             active
14   VLAN0014             active
27   VLAN0027             active
33   VLAN0033             active
36   VLAN0036             active
48   VLAN0048             active
59   VLAN0059             active    Fa0/5
72   VLAN0072             active
109  VLAN0109             active
136  VLAN0136             active


Rack1SW2#show vlan brief | exclude unsup

VLAN Name                 Status    Ports
---- -------------------- --------- -------------------------------
1    default              active    Fa0/1, Fa0/3, Fa0/5, Fa0/7
                                    Fa0/8, Fa0/9, Fa0/10, Fa0/11
                                    Fa0/12, Fa0/13, Fa0/15, Fa0/21
                                    Fa0/22, Fa0/23, Gi0/1, Gi0/2
5    VLAN0005             active
10   VLAN0010             active
14   VLAN0014             active    Fa0/4
27   VLAN0027             active    Fa0/24
33   VLAN0033             active
36   VLAN0036             active
48   VLAN0048             active
59   VLAN0059             active
72   VLAN0072             active    Fa0/2
109  VLAN0109             active    Fa0/16, Fa0/19
136  VLAN0136             active


Rack1SW3#show vlan brief | exclude unsup

VLAN Name                 Status    Ports
---- -------------------- --------- -------------------------------
1    default              active    Fa0/1, Fa0/2, Fa0/4, Fa0/6
                                    Fa0/7, Fa0/8, Fa0/9, Fa0/10
                                    Fa0/11, Fa0/12, Fa0/13, Fa0/14
                                    Fa0/15, Fa0/19, Fa0/20, Fa0/21
                                    Fa0/22, Fa0/23, Gi0/1, Gi0/2
5    VLAN0005             active    Fa0/5
```



```
10   VLAN0010           active
14   VLAN0014           active
27   VLAN0027           active
33   VLAN0033           active    Fa0/3, Fa0/24
36   VLAN0036           active
48   VLAN0048           active
59   VLAN0059           active
72   VLAN0072           active
109  VLAN0109           active
136  VLAN0136           active


Rack1SW4#show vlan brief | exclude unsup

VLAN Name               Status    Ports
---- ----------------- --------- -------------------------------
1    default            active    Fa0/1, Fa0/2, Fa0/3, Fa0/5
                                  Fa0/6, Fa0/7, Fa0/8, Fa0/9
                                  Fa0/10, Fa0/11, Fa0/12, Fa0/13
                                  Fa0/14, Fa0/15, Fa0/18, Fa0/19
                                  Fa0/20, Fa0/21, Fa0/22, Fa0/23
                                  Fa0/24, Gi0/1, Gi0/2
5    VLAN0005           active
10   VLAN0010           active
14   VLAN0014           active
27   VLAN0027           active
33   VLAN0033           active
36   VLAN0036           active
48   VLAN0048           active    Fa0/4
59   VLAN0059           active
72   VLAN0072           active
109  VLAN0109           active
136  VLAN0136           active

Rack1SW1#ping 192.10.1.254

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.10.1.254, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/4/9 ms

Rack1SW1#ping 128.1.27.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 128.1.27.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms

Rack1SW3#ping 128.1.59.5

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 128.1.59.5, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
```



```
Rack1SW3#ping 128.1.109.10

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 128.1.109.10, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/9 ms

Rack1R4#ping 128.1.48.8

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 128.1.48.8, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/4 ms

Rack1R4#ping 128.1.14.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 128.1.14.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/3/4 ms

Rack1R1#ping 128.1.136.3

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 128.1.136.3, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/3/4 ms

Rack1R1#ping 128.1.136.6

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 128.1.136.6, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/4 ms

Rack1R3#ping 128.1.36.6

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 128.1.36.6, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/4 ms

Rack1R3#ping 204.12.1.254

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 204.12.1.254, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 4/5/8 ms
```

Task 2.3

SW2:

```
interface FastEthernet0/19
 l2protocol-tunnel cdp
 no cdp enable

interface FastEthernet0/19
 l2protocol-tunnel cdp
 no cdp enable
```

Task 2.3 Verification

```
Rack1SW2#show l2protocol-tunnel summary
COS for Encapsulated Packets: 5
Drop Threshold for Encapsulated Packets: 0

Port    Protocol    Shutdown         Drop             Status
                    Threshold        Threshold
                    (cdp/stp/vtp)    (cdp/stp/vtp)
                    (pagp/lacp/udld) (pagp/lacp/udld)
------- ----------- ---------------- ---------------- ----------
Fa0/16   cdp --- --- ----/----/----   ----/----/----   up
     ---- ---- ---- ----/----/----   ----/----/----
Fa0/19   cdp --- --- ----/----/----   ----/----/----   up
     ---- ---- ---- ----/----/----   ----/----/----


Rack1SW3#show cdp neighbors fa0/16
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
                  S - Switch, H - Host, I - IGMP, r - Repeater, P -
Phone

Device ID      Local Intrfce   Holdtme   Capability  Platform   Port ID
Rack1SW4       Fas 0/16          145        S I      WS-C3560-2Fas 0/16
```

Task 3.1

R1:

```
interface Serial0/0
 encapsulation frame-relay
!
interface Serial0/0.1 multipoint
 frame-relay interface-dlci 105 ppp virtual-template1
!
interface Virtual-Template1
 ip address 128.1.125.1 255.255.255.0
```


R2:

```
interface Serial0/0
 encapsulation frame-relay
!
interface Serial0/0.1 multipoint
 frame-relay interface-dlci 205 ppp virtual-template1
!
interface Virtual-Template1
 ip address 128.1.125.2 255.255.255.0
```

R5:

```
interface Serial0/0
 encapsulation frame-relay
!
interface Serial0/0.1 multipoint
 frame-relay interface-dlci 501 ppp virtual-template1
 frame-relay interface-dlci 502 ppp virtual-template1
!
interface Virtual-Template1
 ip address 128.1.125.5 255.255.255.0
```

Task 3.1 Verification

```
Rack1R5#show interfaces virtual-access 1
Virtual-Access1 is up, line protocol is up
  Hardware is Virtual Access interface
  Internet address is 128.1.125.5/24
  MTU 1500 bytes, BW 100000 Kbit, DLY 100000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation PPP, LCP Open
  Open: IPCP
  PPPoFR vaccess, cloned from Virtual-Template1
  Vaccess status 0x44
  Bound to Serial0/0.1 DLCI 501, Cloned from Virtual-Template1,
loopback not set

Rack1R5#show interfaces virtual-access 2
Virtual-Access2 is up, line protocol is up
  Hardware is Virtual Access interface
  Internet address is 128.1.125.5/24
  MTU 1500 bytes, BW 100000 Kbit, DLY 100000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation PPP, LCP Open
  Open: IPCP
  PPPoFR vaccess, cloned from Virtual-Template1
  Vaccess status 0x44
  Bound to Serial0/0.1 DLCI 502, Cloned from Virtual-Template1,
loopback not set

Rack1R5#ping 128.1.125.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 128.1.125.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 60/60/64 ms
Rack1R5#ping 128.1.125.2
```

```
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 128.1.125.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 56/57/60 ms
```

Task 3.2

R6:

```
interface Serial0/0/0
 encapsulation frame-relay
 frame-relay interface-dlci 301 ppp virtual-template1
!
interface Virtual-Template1
 ip address 54.1.8.6 255.255.255.0
```

Task 3.2 Verification

Confirm that PPPoFR connection is NOT yet established:

```
Rack1R6#show ip interface brief | include Virtual
Virtual-Access1            54.1.8.6        YES TFTP   up        down
Virtual-Template1          54.1.8.6        YES manual down      down
Virtual-Access2            unassigned      YES unset  down      down
```

Task 3.3

R4:

```
interface Serial0/1
 dialer in-band
 dialer pool-member 1
!
interface Dialer0
 ip address 128.1.45.4 255.255.255.0
 encapsulation ppp
 dialer pool 1
 dialer idle-timeout 0
 dialer persistent
```

R5:

```
interface Serial0/1
 dialer in-band
 dialer pool-member 1
 clock rate 64000

interface Dialer0
 ip address 128.1.45.5 255.255.255.0
 encapsulation ppp
 dialer pool 1
 dialer idle-timeout 0
 dialer persistent
```


Task 3.3 Verification

```
Rack1R4#show dialer

Se0/1 - dialer type = IN-BAND SYNC NO-PARITY
Dialer pool 1, priority 0
Idle timer (never), Fast idle timer (20 secs)
Wait for carrier (30 secs), Re-enable (15 secs)
Dialer state is data link layer up
Interface bound to profile Di0
Time until disconnect never
Connected to <unknown phone number>

Di0 - dialer type = DIALER PROFILE
Idle timer (never), Fast idle timer (20 secs)
Wait for carrier (30 secs), Re-enable (15 secs)
Dialer state is data link layer up
Number of active calls = 1


Rack1R4#ping 128.1.45.5

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 128.1.45.5, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 28/29/32 ms
```

Task 3.4

R6:

```
interface Virtual-Template1
 ppp pap sent-username ROUTER6 password CISCO
```

Task 3.4 Verification

```
Rack1R6#deb ppp authentication
PPP authentication debugging is on
Rack1R6#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Rack1R6(config)#interface s0/0/0
Rack1R6(config-if)#shutdown
Rack1R6(config-if)#no shutdown
%LINK-3-UPDOWN: Interface Serial0/0/0, changed state to up
%LINK-3-UPDOWN: Interface Virtual-Access1, changed state to up
Vi1 PPP: Using default call direction
Vi1 PPP: Treating connection as a dedicated line
Vi1 PPP: Session handle[66000006] Session id[1]
Vi1 PPP: Authorization required
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/0, changed
state to up
Vi1 PPP: No authorization without authentication
Vi1 PAP: Using hostname from interface PAP
Vi1 PAP: Using password from interface PAP
Vi1 PAP: O AUTH-REQ id 1 len 18 from "ROUTER6"
Vi1 PAP: I AUTH-ACK id 1 len 5
```



```
%LINEPROTO-5-UPDOWN: Line protocol on Interface Virtual-Access1,
changed state to up
```

Task 4.1

R1:

```
router eigrp 10
 no auto-summary
 network 128.1.14.1 0.0.0.0
 neighbor 128.1.14.4 FastEthernet0/0.2
```

R4:

```
router eigrp 10
 no auto-summary
 network 128.1.14.4 0.0.0.0
 neighbor 128.1.14.1 Ethernet0/0
```

Task 4.1 Verification

Verify EIGRP neighbors:

```
Rack1R4#show ip eigrp neighbors
IP-EIGRP neighbors for process 10
H   Address            Interface       Hold Uptime   SRTT   RTO  Q  Seq
                                       (sec)         (ms)       Cnt Num
0   128.1.14.1         Et0/0             13 00:00:06  950  5000  0  1
```

Confirm that adjacency is formed via unicast packets:

```
Rack1R4#debug ip packet detail
IP packet debugging is on (detailed)
*May 13 06:18:39.167: IP: tableid=0, s=128.1.14.1 (Ethernet0/0),
d=128.1.14.4 (Ethernet0/0), routed via RIB
*May 13 06:18:39.167: IP: s=128.1.14.1 (Ethernet0/0), d=128.1.14.4
(Ethernet0/0), len 60, rcvd 3, proto=88
*May 13 06:18:43.263: IP: s=128.1.14.4 (local), d=128.1.14.1
(Ethernet0/0), len 60, sending, proto=88
```

Task 4.2

R1:

```
router ospf 1
 network 128.1.136.1 0.0.0.0 area 0.0.0.0
```

R3:

```
router ospf 1
 network 128.1.136.3 0.0.0.0 area 0.0.0.0
```

R6:

```
router ospf 1
 network 128.1.136.6 0.0.0.0 area 0.0.0.0
```


Task 4.2 Verification

Verify OSPF neighbors:

```
Rack1R6#show ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
150.1.1.1         1   FULL/DROTHER    00:00:39    128.1.136.1
GigabitEthernet0/0.1
150.1.3.3         1   FULL/BDR        00:00:39    128.1.136.3
GigabitEthernet0/0.1
```

Task 4.3

R3:

```
interface Tunnel0
 ip address 128.1.63.3 255.255.255.0
 tunnel source Ethernet0/0.2
 tunnel destination 128.1.36.6
!
router ospf 1
 network 128.1.63.3 0.0.0.0 area 0.0.0.0
```

R6:

```
interface Tunnel0
 ip address 128.1.63.6 255.255.255.0
 tunnel source GigabitEthernet0/0.2
 tunnel destination 128.1.36.3
!
router ospf 1
 network 128.1.63.6 0.0.0.0 area 0.0.0.0
```

Task 4.3 Verification

Verify OSPF neighbors:

```
Rack1R6#show ip ospf neighbor tunnel 0

Neighbor ID     Pri   State       Dead Time   Address         Interface
150.1.3.3         0   FULL/  -    00:00:37    128.1.63.3      Tunnel0
```

Task 4.4

R1:

```
interface Virtual-Template1
 ip ospf network point-to-multipoint
!
router ospf 1
 network 128.1.125.1 0.0.0.0 area 125
```

R2:

```
interface Virtual-Template1
 ip ospf network point-to-multipoint
!
router ospf 1
```



```
 network 128.1.125.2 0.0.0.0 area 125
```

R5:

```
interface Virtual-Template1
 ip ospf network point-to-multipoint
!
router ospf 1
 network 128.1.125.5 0.0.0.0 area 125
```

Task 4.4 Verification

Verify OSPF neighbors:

```
Rack1R5#show ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
150.1.2.2         0   FULL/  -        00:01:57    128.1.125.2     Virtual-Access2
150.1.1.1         0   FULL/  -        00:01:45    128.1.125.1     Virtual-Access1
```

Check for /32 routes:

```
Rack1R1#show ip route ospf
     128.1.0.0/16 is variably subnetted, 6 subnets, 2 masks
O       128.1.63.0/24 [110/11112] via 128.1.136.3, 00:01:59,
FastEthernet0/0.1
                      [110/11112] via 128.1.136.6, 00:01:59,
FastEthernet0/0.1
O       128.1.125.2/32 [110/2] via 128.1.125.5, 00:01:09, Virtual-
Access2

Rack1R2#show ip route ospf
     128.1.0.0/16 is variably subnetted, 6 subnets, 2 masks
O IA    128.1.136.0/24 [110/3] via 128.1.125.5, 00:01:38, Virtual-
Access2
O IA    128.1.63.0/24 [110/11114] via 128.1.125.5, 00:01:38, Virtual-
Access2
O       128.1.125.1/32 [110/2] via 128.1.125.5, 00:01:38, Virtual-
Access2
```


Task 4.5

R1:
```
router ospf 1
 router-id 150.1.1.1
 area 125 virtual-link 150.1.5.5
```

R2:
```
router ospf 1
 router-id 150.1.2.2
 network 128.1.27.2 0.0.0.0 area 12
 area 12 stub
 area 125 virtual-link 150.1.5.5
```

R5:
```
router ospf 1
 router-id 150.1.5.5
 area 125 virtual-link 150.1.1.1
 area 125 virtual-link 150.1.2.2
```

SW1:
```
ip routing
!
router ospf 1
 network 128.1.27.7 0.0.0.0 area 12
 area 12 stub
```

Task 4.5 Verification

Verify adjacencies at R2:

```
Rack1R2#show ip ospf neighbor fastEthernet 0/0

Neighbor ID     Pri   State     Dead Time   Address       Interface
150.1.7.7         1   FULL/DR   00:00:32    128.1.27.7    FastEthernet0/0
```

Verify OSPF virtual links at R5:

```
Rack1R5#show ip ospf virtual-links | inc Virtual Link
Virtual Link OSPF_VL1 to router 150.1.2.2 is up
Virtual Link OSPF_VL0 to router 150.1.1.1 is up
```

Verify area 12 type at R2:

```
Rack1R2#show ip ospf | beg Area 12
    Area 12
        Number of interfaces in this area is 1
        It is a stub area
          generates stub default route with cost 1
        Area has no authentication
        SPF algorithm last executed 00:01:50.660 ago
        SPF algorithm executed 5 times
        Area ranges are
<output omitted>
```

Verify inter-area prefixes at R3:


```
Rack1R3#show ip route ospf
     128.1.0.0/16 is variably subnetted, 7 subnets, 2 masks
O IA    128.1.27.0/24 [110/13] via 128.1.136.1, 00:02:28, Ethernet0/0.1
O IA    128.1.125.5/32 [110/11] via 128.1.136.1,00:03:10, Ethernet0/0.1
O IA    128.1.125.1/32 [110/10] via 128.1.136.1,00:03:10, Ethernet0/0.1
O IA    128.1.125.2/32 [110/12] via 128.1.136.1,00:03:10, Ethernet0/0.1
```

Task 4.6

R2:

```
interface Tunnel0
 ip address 128.1.72.2 255.255.255.0
 tunnel source FastEthernet0/0
 tunnel destination 128.1.27.7
!
router ospf 1
 network 128.1.72.2 0.0.0.0 area 0
```

SW1:

```
interface Tunnel0
 ip address 128.1.72.7 255.255.255.0
 tunnel source FastEthernet0/2
 tunnel destination 128.1.27.2
!
router ospf 1
 network 192.10.1.7 0.0.0.0 area 51
 network 128.1.72.7 0.0.0.0 area 0
```

Task 4.6 Verification

Verify inter-area prefixes at R3:

```
Rack1R3#show ip route ospf
     51.0.0.0/32 is subnetted, 1 subnets
O E2    51.51.51.51 [110/20] via 128.1.136.1, 00:00:18, Ethernet0/0.1
     128.1.0.0/16 is variably subnetted, 8 subnets, 2 masks
O IA    128.1.27.0/24 [110/13] via 128.1.136.1, 00:00:28, Ethernet0/0.1
O       128.1.72.0/24 [110/11123] via 128.1.136.1, 00:00:28,
Ethernet0/0.1
O IA    128.1.125.5/32 [110/11] via 128.1.136.1, 00:00:28,
Ethernet0/0.1
O IA    128.1.125.1/32 [110/10] via 128.1.136.1, 00:00:28,
Ethernet0/0.1
O IA    128.1.125.2/32 [110/12] via 128.1.136.1, 00:00:28,
Ethernet0/0.1
O IA 192.10.1.0/24 [110/11124] via 128.1.136.1, 00:00:28, Ethernet0/0.1
```



```
Rack1R3#show ip ospf database summary 192.10.1.0

            OSPF Router with ID (150.1.3.3) (Process ID 1)

                Summary Net Link States (Area 0.0.0.0)

  Routing Bit Set on this LSA
  LS age: 4 (DoNotAge)
  Options: (No TOS-capability, DC, Upward)
  LS Type: Summary Links(Network)
  Link State ID: 192.10.1.0 (summary Network Number)
  Advertising Router: 150.1.7.7
  LS Seq Number: 80000003
  Checksum: 0x9335
  Length: 28
  Network Mask: /24
        TOS: 0  Metric: 1
```

Task 4.7

R1:

```
router ospf 1
 network 150.1.1.1 0.0.0.0 area 321
```

R2:

```
router ospf 1
 network 150.1.2.2 0.0.0.0 area 321
```

R3:

```
router ospf 1
 network 150.1.3.3 0.0.0.0 area 321
```

R5:

```
router ospf 1
 network 150.1.5.5 0.0.0.0 area 765
```

R6:

```
router ospf 1
 network 150.1.6.6 0.0.0.0 area 765
```

SW1:

```
router ospf 1
 network 150.1.7.7 0.0.0.0 area 765
```


Task 4.7 Verification

Confirm that all respective Loopback0 networks have been advertised:

```
Rack1R1#sho ip route ospf | inc 150.1
     150.1.0.0/16 is variably subnetted, 6 subnets, 2 masks
O IA    150.1.7.7/32 [110/11114] via 128.1.125.5, 00:01:02, Virtual-
Access2
O IA    150.1.6.6/32 [110/2] via 128.1.136.6, 00:01:14,
FastEthernet0/0.1
O IA    150.1.5.5/32 [110/2] via 128.1.125.5, 00:01:14, Virtual-Access2
O IA    150.1.3.3/32 [110/2] via 128.1.136.3, 00:01:14,
FastEthernet0/0.1
O IA    150.1.2.2/32 [110/3] via 128.1.125.5, 00:01:14, Virtual-Access2
```

Task 4.8

R4:

```
router rip
 version 2
 no auto-summary
 network 128.1.0.0
 network 150.1.0.0
```

R5:

```
router rip
 version 2
 no auto-summary
 network 128.1.0.0
```

SW2:

```
ip routing
!
router rip
 version 2
 no auto-summary
 network 128.1.0.0
```

SW3:

```
ip routing
!
router rip
 version 2
 network 128.1.0.0
 network 150.1.0.0
 no auto-summary
```

SW4:

```
ip routing
!
router rip
 version 2
 network 128.1.0.0
 network 150.1.0.0
 no auto-summary
```


Task 4.8 Verification

Verify RIP routes at SW2:

```
Rack1SW2#show ip route rip
     128.1.0.0/16 is variably subnetted, 8 subnets, 2 masks
R       128.1.5.0/24 [120/2] via 128.1.48.4, 00:00:21, Vlan48
R       128.1.14.0/24 [120/1] via 128.1.48.4, 00:00:21, Vlan48
R       128.1.45.0/24 [120/1] via 128.1.48.4, 00:00:21, Vlan48
R       128.1.59.0/24 [120/2] via 128.1.48.4, 00:00:21, Vlan48
R       128.1.125.0/24 [120/2] via 128.1.48.4, 00:00:21, Vlan48
R       128.1.125.1/32 [120/2] via 128.1.48.4, 00:00:21, Vlan48
R       128.1.125.2/32 [120/2] via 128.1.48.4, 00:00:21, Vlan48
     150.1.0.0/24 is subnetted, 2 subnets
R       150.1.4.0 [120/1] via 128.1.48.4, 00:00:21, Vlan48
```

Task 4.9

R4:

```
router rip
 default-information originate route-map SW2_ONLY
!
route-map SW2_ONLY permit 10
 set interface Ethernet0/1
```

Task 4.9 Verification

Confirm that R4 originates default route only to SW2:

```
Rack1SW2#show ip route rip
     128.1.0.0/16 is variably subnetted, 8 subnets, 2 masks
R       128.1.5.0/24 [120/2] via 128.1.48.4, 00:00:06, Vlan48
R       128.1.14.0/24 [120/1] via 128.1.48.4, 00:00:06, Vlan48
R       128.1.45.0/24 [120/1] via 128.1.48.4, 00:00:06, Vlan48
R       128.1.59.0/24 [120/2] via 128.1.48.4, 00:00:06, Vlan48
R       128.1.125.0/24 [120/2] via 128.1.48.4, 00:00:06, Vlan48
R       128.1.125.1/32 [120/2] via 128.1.48.4, 00:00:06, Vlan48
R       128.1.125.2/32 [120/2] via 128.1.48.4, 00:00:06, Vlan48
     150.1.0.0/24 is subnetted, 2 subnets
R       150.1.4.0 [120/1] via 128.1.48.4, 00:00:07, Vlan48
R*   0.0.0.0/0 [120/1] via 128.1.48.4, 00:00:07, Vlan48

Rack1R5#show ip route rip
     128.1.0.0/16 is variably subnetted, 12 subnets, 2 masks
R       128.1.14.0/24 [120/1] via 128.1.45.4, 00:00:04, Dialer0
R       128.1.48.0/24 [120/1] via 128.1.45.4, 00:00:04, Dialer0
     150.1.0.0/16 is variably subnetted, 7 subnets, 2 masks
R       150.1.4.0/24 [120/1] via 128.1.45.4, 00:00:04, Dialer0
```

Task 4.10

SW2:

```
router rip
 offset-list 1 in 16 Vlan48
!
access-list 1 permit 128.1.14.0
```


Task 4.10 Verification

Confirm that SW2 has no specific route for 128.1.14.0:

```
Rack1SW2#show ip route 128.1.14.0
% Subnet not in table
```

Task 4.11

R2:

```
no ip classless
```

R5:

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

Task 4.12

R1:

```
router ospf 1
 redistribute eigrp 10 subnets
!
router eigrp 10
 redistribute ospf 1 metric 1 1 1 1 1
```

R4:

```
router rip
 redistribute eigrp 10 metric 1
!
router eigrp 10
 redistribute rip metric 1 1 1 1 1
```

R5:

```
router rip
 redistribute ospf 1 metric 1
!
router ospf 1
 redistribute rip subnets
```


Task 4.13

R1:

```
router eigrp 10
 redistribute ospf 1 metric 1 1 1 1 1 route-map OSPF-->EIGRP
!
ip access-list standard DEFAULT
 permit 0.0.0.0
!
route-map OSPF-->EIGRP deny 10
 match ip address DEFAULT
!
route-map OSPF-->EIGRP permit 1000
```

R4:

```
router eigrp 10
 redistribute rip metric 1 1 1 1 1 route-map SET_TAG
!
route-map SET_TAG permit 10
 set tag 1
```

R5:

```
router rip
 redistribute ospf 1 metric 1 route-map MATCH_TAG
!
route-map MATCH_TAG deny 10
 match tag 1
!
route-map MATCH_TAG permit 20

router ospf 1
 distance ospf external 121
```


Tasks 4.12 – 4.13 Verification

Verify full internal connectivity with the following Tcl script:

```
foreach i {
128.1.136.1
128.1.14.1
128.1.125.1
150.1.1.1
128.1.27.2
128.1.125.2
150.1.2.2
128.1.72.2
128.1.136.3
150.1.3.3
128.1.63.3
128.1.14.4
128.1.48.4
128.1.45.4
150.1.4.4
128.1.59.5
128.1.5.5
128.1.125.5
128.1.45.5
150.1.5.5
128.1.136.6
150.1.6.6
128.1.63.6
192.10.1.7
128.1.27.7
150.1.7.7
128.1.72.7
128.1.48.8
128.1.59.9
128.1.109.9
150.1.9.9
128.1.10.10
128.1.109.10
150.1.10.10
} { puts [ exec "ping $i" ] }
```

Note that SW2's Loopback, VLAN 36, VLAN 33 and PPPoFR to BB1 networks are not included into any IGP and therefore are excluded from connectivity test.

Task 5.1

R1:
```
router bgp 100
 neighbor 128.1.136.3 remote-as 100
 neighbor 128.1.14.4 remote-as 200
 neighbor 128.1.125.5 remote-as 200
 neighbor 128.1.136.6 remote-as 100
```

R3:
```
router bgp 100
 neighbor 128.1.136.1 remote-as 100
 neighbor 128.1.136.1 next-hop-self
 neighbor 128.1.136.6 remote-as 100
 neighbor 128.1.136.6 next-hop-self
 neighbor 204.12.1.254 remote-as 54
```

R4:
```
router bgp 200
 neighbor 128.1.14.1 remote-as 100
 neighbor 128.1.45.5 remote-as 200
 neighbor 128.1.45.5 route-reflector-client
 neighbor 128.1.48.8 remote-as 200
 neighbor 128.1.48.8 route-reflector-client
```

R5:
```
router bgp 200
 neighbor 128.1.125.1 remote-as 100
 neighbor 128.1.45.4 remote-as 200
```

R6:
```
router bgp 100
 neighbor 128.1.136.1 remote-as 100
 neighbor 128.1.136.1 next-hop-self
 neighbor 128.1.136.3 remote-as 100
 neighbor 128.1.136.3 next-hop-self
 neighbor 54.1.8.254 remote-as 54
```

SW2:
```
router bgp 200
 neighbor 128.1.48.4 remote-as 200
 network 150.1.8.0 mask 255.255.255.0
```

SW3:
```
router bgp 200
 neighbor 128.1.45.4 remote-as 200
```

SW4:
```
router bgp 200
 neighbor 128.1.45.4 remote-as 200
```


Task 5.1 Verification

```
Rack1R1#show ip bgp summary | begin Neighbor
Neighbor        V    AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down
State/PfxRcd
128.1.14.4      4   200      13      15       12    0    0 00:08:48
1
128.1.125.5     4   200      13      16       12    0    0 00:08:05
1
128.1.136.3     4   100      70      68       12    0    0 01:04:56
2
128.1.136.6     4   100      71      65       12    0    0 01:00:47
8

Rack1R3#show ip bgp summary | begin Neighbor
Neighbor        V    AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down
State/PfxRcd
128.1.136.1     4   100      69      71       12    0    0 01:05:13
1
128.1.136.6     4   100      71      67       12    0    0 01:01:11
8
204.12.1.254    4    54      13      14       12    0    0 00:07:10
2

Rack1R4#show ip bgp summary | begin Neighbor
Neighbor        V    AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down
State/PfxRcd
128.1.14.1      4   100      16      14       12    0    0 00:09:16
10
128.1.45.5      4   200      58      71       12    0    0 00:15:14
10
128.1.48.8      4   200      54      57       12    0    0 00:49:04
1
128.1.59.9      4   200      34      42       12    0    0 00:15:36
0
128.1.109.10    4   200      29      37       12    0    0 00:15:17
0

Rack1R5#show ip bgp summary | begin Neighbor
Neighbor        V    AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down
State/PfxRcd
128.1.45.4      4   200      63      67       12    0    0 00:15:23
11
128.1.125.1     4   100      16      13       12    0    0 00:08:42
10

Rack1R6#show ip bgp summary | begin Neighbor
Neighbor        V    AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down
State/PfxRcd
54.1.8.254      4    54      14      13       12    0    0 00:07:10
8
128.1.136.1     4   100      66      72       12    0    0 01:01:37
1
128.1.136.3     4   100      67      71       12    0    0 01:01:44
2
```



```
Rack1SW2#show ip bgp summary | begin Neighbor
Neighbor        V    AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down
State/PfxRcd
128.1.48.4      4   200      57      54       12    0    0 00:49:37
10

Rack1SW3#show ip bgp summary | begin Neighbor
Neighbor        V    AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down
State/PfxRcd
128.1.45.4      4   200      39      39       12    0    0 00:16:18
11

Rack1SW4#show ip bgp summary | begin Neighbor
Neighbor        V    AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down
State/PfxRcd
128.1.45.4      4   200      34      34       12    0    0 00:16:11
11


Rack1R4#show ip bgp neighbors | include (BGP nei|Reflector)
BGP neighbor is 128.1.14.1,  remote AS 100, external link
BGP neighbor is 128.1.45.5,  remote AS 200, internal link
  Route-Reflector Client
BGP neighbor is 128.1.48.8,  remote AS 200, internal link
  Route-Reflector Client
BGP neighbor is 128.1.59.9,  remote AS 200, internal link
  Route-Reflector Client
BGP neighbor is 128.1.109.10,  remote AS 200, internal link
  Route-Reflector Client


Rack1SW2#show ip bgp | include 0.0.0.0
*> 150.1.8.0/24     0.0.0.0                  0         32768 i
```


Task 5.2

R1:

```
router bgp 100
 neighbor 128.1.125.5 route-map LOCAL_PREFERENCE in
!
route-map LOCAL_PREFERENCE permit 10
 set local-preference 200
```

R4:

```
router bgp 200
 neighbor 128.1.14.1 route-map LOCAL_PREFERENCE in
!
route-map LOCAL_PREFERENCE permit 10
 set local-preference 200
```

Task 5.2 Verification

```
Rack1SW2#show ip bgp
BGP table version is 22, local router ID is 150.1.8.8
Status codes: s suppressed, d damped, h history, * valid, > best, i -
internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
*>i28.119.16.0/24   128.1.14.1               0    200      0 100 54 i
*>i28.119.17.0/24   128.1.14.1               0    200      0 100 54 i
*>i112.0.0.0        128.1.14.1               0    200      0 100 54 50
60 i
*>i113.0.0.0        128.1.14.1               0    200      0 100 54 50
60 i
*>i114.0.0.0        128.1.14.1               0    200      0 100 54 i
*>i115.0.0.0        128.1.14.1               0    200      0 100 54 i
*>i116.0.0.0        128.1.14.1               0    200      0 100 54 i
*>i117.0.0.0        128.1.14.1               0    200      0 100 54 i
*>i118.0.0.0        128.1.14.1               0    200      0 100 54 i
*>i119.0.0.0        128.1.14.1               0    200      0 100 54 i
*> 150.1.8.0/24     0.0.0.0                  0         32768 i


Rack1R1#show ip bgp | include 200
*> 150.1.8.0/24     128.1.125.5                            0 200 i
*                   128.1.14.4                             0 200 200 i

Rack1R6#traceroute 150.1.8.8

Type escape sequence to abort.
Tracing the route to 150.1.8.8

  1 128.1.136.1 4 msec 0 msec 0 msec
  2 128.1.125.5 32 msec 28 msec 32 msec
  3 128.1.45.4 44 msec 44 msec 40 msec
  4 128.1.48.8 44 msec *  44 msec
```


Task 5.3

R4:

```
router bgp 200
 bgp redistribute-internal
!
router eigrp 10
 redistribute bgp 200 metric 1 1 1 1 1 route-map BGP->EIGRP
!
route-map BGP->EIGRP permit 10
 match ip address prefix-list SW2_LOOPBACK
!
ip prefix-list SW2_LOOPBACK seq 5 permit 150.1.8.0/24
```

Task 5.3 Verification

```
Rack1R4#show ip eigrp topology | include 150.1.8.0
P 150.1.8.0/24, 1 successors, FD is 2560000256
```


Task 1.1

1) Wrong subnet mask on R5 Fa0/0
2) Secondary IP address on R6 S0/0/0 should be removed

Task 2.1

R1:

```
interface FastEthernet0/0.13
 encapsulation dot1Q 13
 ip address 204.12.1.1 255.255.255.0
!
interface FastEthernet0/0.16
 encapsulation dot1Q 16
 ip address 145.1.16.1 255.255.255.0
!
interface FastEthernet0/0.136
 encapsulation dot1Q 136
 ip address 145.1.136.1 255.255.255.0
```

R2:

```
interface FastEthernet0/0.28
 encapsulation dot1Q 28
 ip address 145.1.28.2 255.255.255.0
!
interface FastEthernet0/0.245
 encapsulation dot1Q 245
 ip address 145.1.245.2 255.255.255.0
```

R6:

```
interface GigabitEthernet0/0.16
 encapsulation dot1Q 16
 ip address 145.1.16.6 255.255.255.0
!
interface GigabitEthernet0/0.136
 encapsulation dot1Q 136
 ip address 145.1.136.6 255.255.255.0
```

SW1:

```
interface FastEthernet0/1
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet0/13
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
 channel-group 1 mode on
!
interface FastEthernet0/14
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
 channel-group 1 mode on
```



```
!
interface FastEthernet0/15
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
 channel-group 1 mode on
```

SW2:

```
interface FastEthernet0/2
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet0/6
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet0/13
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
 channel-group 1 mode on
!
interface FastEthernet0/14
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
 channel-group 1 mode on
!
interface FastEthernet0/15
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
 channel-group 1 mode on
!
interface FastEthernet0/18
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet0/19
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
```

SW3:

```
interface FastEthernet0/18
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
```

SW4:

```
interface FastEthernet0/16
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
```


Task 2.1 Verification

```
Rack1SW1#show etherchannel summary
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 1
Number of aggregators:           1

Group  Port-channel  Protocol    Ports
------+-------------+---------+-----------------------------------------
1      Po1(SU)          -        Fa0/13(P)   Fa0/14(P)   Fa0/15(P)


Rack1SW2#show etherchannel summary
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 1
Number of aggregators:           1

Group  Port-channel  Protocol    Ports
------+-------------+---------+-----------------------------------------
1      Po1(SU)          -        Fa0/13(P)   Fa0/14(P)   Fa0/15(P)

Rack1SW1#show interfaces trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/1       on           802.1q         trunking      1
Po1         on           802.1q         trunking      1

Port        Vlans allowed on trunk
Fa0/1       1-4094
Po1         1-4094

Port        Vlans allowed and active in management domain
Fa0/1       1
Po1         1

Port        Vlans in spanning tree forwarding state and not pruned
Fa0/1       1
Po1         none
```



```
Rack1SW2#show interfaces trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/2       on           802.1q         trunking      1
Fa0/6       on           802.1q         trunking      1
Fa0/18      on           802.1q         trunking      1
Fa0/19      on           802.1q         trunking      1
Po1         on           802.1q         trunking      1

Port        Vlans allowed on trunk
Fa0/2       1-4094
Fa0/6       1-4094
Fa0/18      1-4094
Fa0/19      1-4094
Po1         1-4094

Port        Vlans allowed and active in management domain
Fa0/2       1
Fa0/6       1
Fa0/18      1
Fa0/19      1
Po1         1

Port        Vlans in spanning tree forwarding state and not pruned

Port        Vlans in spanning tree forwarding state and not pruned
Fa0/2       1
Fa0/6       1
Fa0/18      none
Fa0/19      none
Po1         1
```

Task 2.2

SW1:

```
vtp domain IE
vlan 13,14,16,28,52,89,100,136,245
!
Interface Vlan14
 ip address 145.1.47.7 255.255.255.0
!
interface FastEthernet0/3
 no switchport
 ip address 145.1.37.7 255.255.255.0
!
interface FastEthernet0/5
 switchport access vlan 52
```

SW2:

```
vtp domain IE
!
interface FastEthernet0/4
 switchport access vlan 14
!
interface FastEthernet0/24
```



```
 switchport access vlan 52
```

SW3:

```
vtp domain IE
!
interface FastEthernet0/3
 switchport access vlan 136
!
interface FastEthernet0/5
 switchport access vlan 245
!
interface FastEthernet0/24
 switchport access vlan 13
```

SW4:

```
vtp domain IE
!
interface FastEthernet0/4
 switchport access vlan 245
```

Task 2.2 Verification

```
Rack1SW1#show vlan brief | exclude unsup

VLAN Name                 Status    Ports
---- -------------------- --------- -------------------------------
1    default              active    Fa0/2, Fa0/4, Fa0/6, Fa0/7
                                    Fa0/8, Fa0/9, Fa0/10, Fa0/11
                                    Fa0/12, Fa0/16, Fa0/17, Fa0/18
                                    Fa0/19, Fa0/20, Fa0/21, Fa0/22
                                    Fa0/23, Fa0/24, Gi0/1, Gi0/2
13   VLAN0013             active
14   VLAN0014             active
16   VLAN0016             active
28   VLAN0028             active
52   VLAN0052             active    Fa0/5
89   VLAN0089             active
100  VLAN0100             active
136  VLAN0136             active
245  VLAN0245             active

Rack1SW2#show vlan brief | exclude unsup

VLAN Name                 Status    Ports
---- -------------------- --------- -------------------------------
1    default              active    Fa0/1, Fa0/3, Fa0/5, Fa0/7
                                    Fa0/8, Fa0/9, Fa0/10, Fa0/11
                                    Fa0/12, Fa0/16, Fa0/17, Fa0/20
                                    Fa0/21, Fa0/22, Fa0/23, Gi0/1
                                    Gi0/2
13   VLAN0013             active
14   VLAN0014             active    Fa0/4
16   VLAN0016             active
28   VLAN0028             active
```



```
52   VLAN0052             active    Fa0/24
89   VLAN0089             active
100  VLAN0100             active
136  VLAN0136             active
245  VLAN0245             active

Rack1SW3#show vlan brief | exclude unsup

VLAN Name                 Status    Ports
---- -------------------- --------- -----------------------
1    default              active    Fa0/1, Fa0/2, Fa0/3, Fa0/4
                                    Fa0/6, Fa0/7, Fa0/8, Fa0/9
                                    Fa0/10, Fa0/11, Fa0/12, Fa0/13
                                    Fa0/14, Fa0/15, Fa0/16, Fa0/17
                                    Fa0/19, Fa0/20, Fa0/21, Fa0/22
                                    Fa0/23, Gi0/1, Gi0/2
13   VLAN0013             active    Fa0/24
14   VLAN0014             active
16   VLAN0016             active
28   VLAN0028             active
52   VLAN0052             active
89   VLAN0089             active
100  VLAN0100             active
136  VLAN0136             active
245  VLAN0245             active    Fa0/5

Rack1SW4#show vlan brief | exclude unsup

VLAN Name                 Status    Ports
---- -------------------- --------- -----------------------
1    default              active    Fa0/1, Fa0/2, Fa0/3, Fa0/5
                                    Fa0/6, Fa0/7, Fa0/8, Fa0/9
                                    Fa0/10, Fa0/11, Fa0/12, Fa0/13
                                    Fa0/14, Fa0/15, Fa0/17, Fa0/18
                                    Fa0/19, Fa0/20, Fa0/21, Fa0/22
                                    Fa0/23, Fa0/24, Gi0/1, Gi0/2
13   VLAN0013             active
14   VLAN0014             active
16   VLAN0016             active
28   VLAN0028             active
52   VLAN0052             active
89   VLAN0089             active
100  VLAN0100             active
136  VLAN0136             active
245  VLAN0245             active    Fa0/4


Rack1R1#ping 204.12.1.254

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 204.12.1.254, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 4/4/8 ms
```



```
Rack1R1#ping 145.1.16.6

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 145.1.16.6, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/4 ms

Rack1R1#ping 145.1.136.3

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 145.1.136.3, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/3/4 ms
Rack1R1#ping 145.1.136.6

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 145.1.136.6, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/4 ms

Rack1R3#ping 145.1.37.7

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 145.1.37.7, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/4 ms

Rack1R4#ping 145.1.47.7

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 145.1.47.7, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/4 ms

Rack1R4#ping 145.1.245.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 145.1.245.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/4 ms
Rack1R4#ping 145.1.245.5

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 145.1.245.5, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/4 ms

Rack1R5#ping 192.10.1.254

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.10.1.254, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 4/6/8 ms
```



```
Rack1SW2#ping 145.1.28.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 145.1.28.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/8 ms
Rack1SW2#ping 145.1.8.9

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 145.1.8.9, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/8 ms

Rack1SW3#ping 145.1.100.10

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 145.1.100.10, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
```

Task 2.3

SW3:

```
interface FastEthernet0/19
 switchport access vlan 100
 switchport mode access
 channel-group 1 mode on
!
interface FastEthernet0/20
 switchport access vlan 100
 switchport mode access
 channel-group 1 mode on
!
interface FastEthernet0/21
 switchport access vlan 100
 switchport mode access
 channel-group 1 mode on
```

SW4:

```
interface FastEthernet0/19
 switchport access vlan 100
 switchport mode access
 channel-group 1 mode on
!
interface FastEthernet0/20
 switchport access vlan 100
 switchport mode access
 channel-group 1 mode on
!
interface FastEthernet0/21
 switchport access vlan 100
 switchport mode access
 channel-group 1 mode on
```

Task 2.3 Verification


```
Rack1SW3#show etherchannel summary
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 1
Number of aggregators:           1

Group  Port-channel  Protocol    Ports
------+-------------+-----------+-----------------------------------
1      Po34(SU)         -        Fa0/19(P)   Fa0/20(P)   Fa0/21(P)

Rack1SW4#show etherchannel summary
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 1
Number of aggregators:           1

Group  Port-channel  Protocol    Ports
------+-------------+-----------+-----------------------------------
1      Po1(SU)          -        Fa0/19(P)   Fa0/20(P)   Fa0/21(P)
```

Confirm connectivity:

```
Rack1SW4#ping 145.1.100.9

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 145.1.100.9, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/4 ms
```

Task 3.1

R3:

```
interface Multilink34
 ip address 145.1.0.3 255.255.255.0
 ppp multilink
 ppp multilink group 34
!
interface Multilink35
 ip address 145.1.0.3 255.255.255.0
```



```
 ppp multilink
 ppp multilink group 35
!
interface Serial1/0
 encapsulation frame-relay
!
interface Serial1/0.304 point-to-point
 frame-relay interface-dlci 304 ppp Virtual-Template2
!
interface Serial1/0.305 point-to-point
 frame-relay interface-dlci 305 ppp Virtual-Template1
!
interface Serial1/1
 encapsulation frame-relay
!
interface Serial1/1.314 point-to-point
 frame-relay interface-dlci 314 ppp Virtual-Template2
!
interface Serial1/1.315 point-to-point
 frame-relay interface-dlci 315 ppp Virtual-Template1
!
interface Virtual-Template1
 ppp multilink
 ppp multilink group 35
!
interface Virtual-Template2
 ppp multilink
 ppp multilink group 34
```

R4:

```
interface Multilink1
 ip address 145.1.0.4 255.255.255.0
 ppp multilink
!
interface Serial0/0
 encapsulation frame-relay
!
interface Serial0/0.403 point-to-point
 frame-relay interface-dlci 403 ppp Virtual-Template1
!
interface Serial0/0.413 point-to-point
 frame-relay interface-dlci 413 ppp Virtual-Template1
!
interface Virtual-Template1
 ppp multilink
 ppp multilink group 1
```

R5:

```
interface Multilink1
 ip address 145.1.0.5 255.255.255.0
 ppp multilink
!
interface Serial0/0
 encapsulation frame-relay
!
interface Serial0/0.503 point-to-point
 frame-relay interface-dlci 503 ppp Virtual-Template1
```



```
!
interface Serial0/0.513 point-to-point
 frame-relay interface-dlci 513 ppp Virtual-Template1
!
interface Virtual-Template1
 ppp multilink
 ppp multilink group 1
```

Task 3.1 Verification

```
Rack1R3#show ppp multilink

Multilink34, bundle name is Rack1R4
  Endpoint discriminator is Rack1R4
  Bundle up for 00:00:06, 1/255 load
  Receive buffer limit 24000 bytes, frag timeout 1000 ms
    0/0 fragments/bytes in reassembly list
    0 lost fragments, 0 reordered
    0/0 discarded fragments/bytes, 0 lost received
    0x0 received sequence, 0x0 sent sequence
  Member links: 2 active, 1 inactive (max not set, min not set)
    Vi1, since 00:00:09
    Vi3, since 00:00:05
    Vt2 (inactive)

Multilink35, bundle name is Rack1R5
  Endpoint discriminator is Rack1R5
  Bundle up for 00:00:19, 1/255 load
  Receive buffer limit 24000 bytes, frag timeout 1000 ms
    0/0 fragments/bytes in reassembly list
    0 lost fragments, 0 reordered
    0/0 discarded fragments/bytes, 0 lost received
    0x0 received sequence, 0x2 sent sequence
  Member links: 2 active, 1 inactive (max not set, min not set)
    Vi4, since 00:00:24
    Vi2, since 00:00:18
    Vt1 (inactive)
No inactive multilink interfaces

Rack1R3#ping 145.1.0.5

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 145.1.0.5, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 52/55/56 ms

Rack1R3#ping 145.1.0.4

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 145.1.0.4, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 52/53/56 ms
```


Task 3.2

R4:
```
interface Serial0/1
 encapsulation frame-relay
 no keepalive
!
interface Serial0/1.1 point-to-point
 ip address 145.1.45.4 255.255.255.0
 frame-relay interface-dlci 111
```

R5:
```
interface Serial0/1
 clock rate 64000
 encapsulation frame-relay
 no keepalive
!
interface Serial0/1.1 point-to-point
 ip address 145.1.45.5 255.255.255.0
 frame-relay interface-dlci 111
```

Task 3.2 Verification

```
Rack1R4#ping 145.1.45.5

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 145.1.45.5, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 28/30/36 ms
```

Task 3.3

R6:
```
interface Serial0/0/0
 ip address 54.1.3.6 255.255.255.0
 encapsulation frame-relay
 frame-relay map ip 54.1.3.254 51 broadcast
```

Task 3.3 Verification

Verify L3 to L2 mapping and confirm connectivity:

```
Rack1R6#show frame-relay map
Serial0/0/0 (up): ip 54.1.3.254 dlci 51(0x33,0xC30), static,
              broadcast,
              CISCO, status defined, active
Rack1R6#ping 54.1.3.254

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 54.1.3.254, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 32/32/36 ms
```


Task 3.4

R3:

```
username Rack1R4 password CISCO
username Rack1R5 password CISCO
!
interface Multilink34
 ppp authentication pap
 ppp pap sent-username Rack1R3 password CISCO
!
interface Multilink35
 ppp authentication chap
```

R4:

```
username Rack1R3 password CISCO
!
interface Multilink1
 ppp authentication pap
 ppp pap sent-username Rack1R4 password CISCO
```

R5:

```
username Rack1R3 password CISCO
!
interface Multilink1
 ppp authentication chap
```

Task 3.4 Verification

Verify PPP PAP authentication:

```
Rack1R4#debug ppp authentication
Rack1R4(config)#interface multilink 1
Rack1R4(config-if)#no shutdown
Rack1R4(config-if)#
 Vi1 PPP: Authorization required
 Vi2 PPP: Authorization required
 Vi1 PAP: Using hostname from interface PAP
 Vi1 PAP: Using password from interface PAP
 Vi1 PAP: O AUTH-REQ id 6 len 18 from "Rack1R4"
 Vi2 PAP: Using hostname from interface PAP
 Vi2 PAP: Using password from interface PAP
 Vi2 PAP: O AUTH-REQ id 6 len 18 from "Rack1R4"
 %LINK-3-UPDOWN: Interface Multilink1, changed state to down
 Vi1 PAP: I AUTH-REQ id 6 len 18 from "Rack1R3"
 Vi1 PAP: Authenticating peer Rack1R3
 Vi1 PPP: Sent PAP LOGIN Request
 Vi2 PAP: I AUTH-REQ id 6 len 18 from "Rack1R3"
 Vi2 PAP: Authenticating peer Rack1R3
 Vi1 PPP: Received LOGIN Response PASS
 Vi2 PPP: Sent PAP LOGIN Request
 Vi1 PPP: Sent LCP AUTHOR Request
 Vi1 PPP: Sent MLP AUTHOR Request
 Vi2 PPP: Received LOGIN Response PASS
 Vi1 LCP: Received AAA AUTHOR Response PASS
 Vi1 MLP: Received AAA AUTHOR Response PASS
 Vi1 PAP: O AUTH-ACK id 6 len 5
```



```
 Vi2 PPP: Sent LCP AUTHOR Request
 Vi2 PPP: Sent MLP AUTHOR Request
 Vi2 LCP: Received AAA AUTHOR Response PASS
 Vi2 MLP: Received AAA AUTHOR Response PASS
 Vi2 PAP: O AUTH-ACK id 6 len 5
 Vi1 PAP: I AUTH-ACK id 6 len 5
 Vi2 PAP: I AUTH-ACK id 6 len 5
 %FR-3-MLPOFR_ERROR: MLPoFR not configured properly on Link Virtual-
Access1 Bundle Multilink1 :Frame Relay traffic shaping must be enabled
 %FR-3-MLPOFR_ERROR: MLPoFR not configured properly on Link Virtual-
Access2 Bundle Multilink1 :Frame Relay traffic shaping must be enabled
 %LINK-3-UPDOWN: Interface Multilink1, changed state to up
 Mu1 PPP: Sent IPCP AUTHOR Request
 Mu1 PPP: Sent CDPCP AUTHOR Request
 Mu1 IPCP: Received AAA AUTHOR Response PASS
 Mu1 CDPCP: Received AAA AUTHOR Response PASS
 Mu1 PPP: Sent IPCP AUTHOR Request-if)#
 %LINEPROTO-5-UPDOWN: Line protocol on Interface Multilink1, changed
state to up
```

Verify PPP CHAP authentication:

```
Rack1R5#debug ppp authentication
Rack1R5(config)#interface multilink 1
Rack1R5(config-if)#no shutdown
Rack1R5(config-if)#
 Vi1 PPP: Authorization required
 Vi3 PPP: Authorization required
 Vi1 CHAP: O CHALLENGE id 4 len 28 from "Rack1R5"
 Vi3 CHAP: O CHALLENGE id 4 len 28 from "Rack1R5"
 %LINK-3-UPDOWN: Interface Multilink1, changed state to down
 Vi1 CHAP: I CHALLENGE id 24 len 28 from "Rack1R3"
 Vi1 CHAP: Using hostname from unknown source
 Vi1 CHAP: Using password from AAA
 Vi1 CHAP: O RESPONSE id 24 len 28 from "Rack1R5"
 Vi1 CHAP: I RESPONSE id 4 len 28 from "Rack1R3"
 Vi1 PPP: Sent CHAP LOGIN Request
 Vi3 CHAP: I CHALLENGE id 24 len 28 from "Rack1R3"
 Vi1 PPP: Received LOGIN Response PASS
 Vi1 PPP: Sent LCP AUTHOR Request
 Vi1 PPP: Sent MLP AUTHOR Request
 Vi3 CHAP: I RESPONSE id 4 len 28 from "Rack1R3"
 Vi3 CHAP: Using hostname from unknown source
 Vi3 CHAP: Using password from AAA
 Vi3 CHAP: O RESPONSE id 24 len 28 from "Rack1R5"
 Vi3 PPP: Sent CHAP LOGIN Request
 Vi1 LCP: Received AAA AUTHOR Response PASS
 Vi1 MLP: Received AAA AUTHOR Response PASS
 Vi1 CHAP: O SUCCESS id 4 len 4
 Vi3 PPP: Received LOGIN Response PASS
 Vi1 CHAP: I SUCCESS id 24 len 4
 %FR-3-MLPOFR_ERROR: MLPoFR not configured properly on Link Virtual-
Access1 Bundle Multilink1 :Frame Relay traffic shaping must be enabled
 Vi3 PPP: Sent LCP AUTHOR Request
 %LINK-3-UPDOWN: Interface Multilink1, changed state to up
 Mu1 PPP: Sent IPCP AUTHOR Request
 Mu1 PPP: Sent CDPCP AUTHOR Request
```



```
 Vi3 LCP: Received AAA AUTHOR Response PASS
 Vi3 CHAP: O SUCCESS id 4 len 4
 Mu1 IPCP: Received AAA AUTHOR Response PASS
 Mu1 CDPCP: Received AAA AUTHOR Response PASS
 Mu1 PPP: Sent IPCP AUTHOR Request
 Vi3 CHAP: I SUCCESS id 24 len 4
 %FR-3-MLPOFR_ERROR: MLPoFR not configured properly on Link Virtual-
Access3 Bundle Multilink1 :Frame Relay traffic shaping must be enabled
%LINEPROTO-5-UPDOWN: Line protocol on Interface Multilink1, changed
state to up
```

Task 3.5

R4:

```
interface Serial0/1
 encapsulation frame-relay
 no keepalive
!
interface Serial0/1.1 point-to-point
 ip address 145.1.45.4 255.255.255.0
 frame-relay interface-dlci 111
```

R5:

```
interface Serial0/1
 clock rate 64000
 encapsulation frame-relay
 no keepalive
!
interface Serial0/1.1 point-to-point
 ip address 145.1.45.5 255.255.255.0
 frame-relay interface-dlci 111
```

Task 3.5 Verification

```
Rack1R4#ping 145.1.45.5

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 145.1.45.5, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 28/30/36 ms
```

Task 3.6

R6:

```
interface Serial0/0/0
 ip address 54.1.3.6 255.255.255.0
 encapsulation frame-relay
 frame-relay map ip 54.1.3.254 51 broadcast
```

Task 3.6 Verification

Verify L3 to L2 mapping and confirm connectivity:

```
Rack1R6#show frame-relay map
Serial0/0/0 (up): ip 54.1.3.254 dlci 51(0x33,0xC30), static,
```

```
              broadcast,
              CISCO, status defined, active
Rack1R6#ping 54.1.3.254

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 54.1.3.254, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 32/32/36 ms
```

Task 3.7

R3:

```
username Rack1R4 password CISCO
username Rack1R5 password CISCO
!
interface Multilink34
 ppp authentication pap
 ppp pap sent-username Rack1R3 password CISCO
!
interface Multilink35
 ppp authentication chap
```

R4:

```
username Rack1R3 password CISCO
!
interface Multilink1
 ppp authentication pap
 ppp pap sent-username Rack1R4 password CISCO
```

R5:

```
username Rack1R3 password CISCO
!
interface Multilink1
 ppp authentication chap
```

Task 3.7 Verification

Verify PPP PAP authentication:

```
Rack1R4#debug ppp authentication
Rack1R4(config)#interface multilink 1
Rack1R4(config-if)#no shutdown
Rack1R4(config-if)#
 Vi1 PPP: Authorization required
 Vi2 PPP: Authorization required
 Vi1 PAP: Using hostname from interface PAP
 Vi1 PAP: Using password from interface PAP
 Vi1 PAP: O AUTH-REQ id 6 len 18 from "Rack1R4"
 Vi2 PAP: Using hostname from interface PAP
 Vi2 PAP: Using password from interface PAP
 Vi2 PAP: O AUTH-REQ id 6 len 18 from "Rack1R4"
 %LINK-3-UPDOWN: Interface Multilink1, changed state to down
 Vi1 PAP: I AUTH-REQ id 6 len 18 from "Rack1R3"
 Vi1 PAP: Authenticating peer Rack1R3
 Vi1 PPP: Sent PAP LOGIN Request
 Vi2 PAP: I AUTH-REQ id 6 len 18 from "Rack1R3"
```



```
 Vi2 PAP: Authenticating peer Rack1R3
 Vi1 PPP: Received LOGIN Response PASS
 Vi2 PPP: Sent PAP LOGIN Request
 Vi1 PPP: Sent LCP AUTHOR Request
 Vi1 PPP: Sent MLP AUTHOR Request
 Vi2 PPP: Received LOGIN Response PASS
 Vi1 LCP: Received AAA AUTHOR Response PASS
 Vi1 MLP: Received AAA AUTHOR Response PASS
 Vi1 PAP: O AUTH-ACK id 6 len 5
 Vi2 PPP: Sent LCP AUTHOR Request
 Vi2 PPP: Sent MLP AUTHOR Request
 Vi2 LCP: Received AAA AUTHOR Response PASS
 Vi2 MLP: Received AAA AUTHOR Response PASS
 Vi2 PAP: O AUTH-ACK id 6 len 5
 Vi1 PAP: I AUTH-ACK id 6 len 5
 Vi2 PAP: I AUTH-ACK id 6 len 5
 %FR-3-MLPOFR_ERROR: MLPoFR not configured properly on Link Virtual-
Access1 Bundle Multilink1 :Frame Relay traffic shaping must be enabled
 %FR-3-MLPOFR_ERROR: MLPoFR not configured properly on Link Virtual-
Access2 Bundle Multilink1 :Frame Relay traffic shaping must be enabled
 %LINK-3-UPDOWN: Interface Multilink1, changed state to up
 Mu1 PPP: Sent IPCP AUTHOR Request
 Mu1 PPP: Sent CDPCP AUTHOR Request
 Mu1 IPCP: Received AAA AUTHOR Response PASS
 Mu1 CDPCP: Received AAA AUTHOR Response PASS
 Mu1 PPP: Sent IPCP AUTHOR Request-if)#
 %LINEPROTO-5-UPDOWN: Line protocol on Interface Multilink1, changed
state to up
```

Verify PPP CHAP authentication:

```
Rack1R5#debug ppp authentication
Rack1R5(config)#interface multilink 1
Rack1R5(config-if)#no shutdown
Rack1R5(config-if)#
 Vi1 PPP: Authorization required
 Vi3 PPP: Authorization required
 Vi1 CHAP: O CHALLENGE id 4 len 28 from "Rack1R5"
 Vi3 CHAP: O CHALLENGE id 4 len 28 from "Rack1R5"
 %LINK-3-UPDOWN: Interface Multilink1, changed state to down
 Vi1 CHAP: I CHALLENGE id 24 len 28 from "Rack1R3"
 Vi1 CHAP: Using hostname from unknown source
 Vi1 CHAP: Using password from AAA
 Vi1 CHAP: O RESPONSE id 24 len 28 from "Rack1R5"
 Vi1 CHAP: I RESPONSE id 4 len 28 from "Rack1R3"
 Vi1 PPP: Sent CHAP LOGIN Request
 Vi3 CHAP: I CHALLENGE id 24 len 28 from "Rack1R3"
 Vi1 PPP: Received LOGIN Response PASS
 Vi1 PPP: Sent LCP AUTHOR Request
 Vi1 PPP: Sent MLP AUTHOR Request
 Vi3 CHAP: I RESPONSE id 4 len 28 from "Rack1R3"
 Vi3 CHAP: Using hostname from unknown source
 Vi3 CHAP: Using password from AAA
 Vi3 CHAP: O RESPONSE id 24 len 28 from "Rack1R5"
 Vi3 PPP: Sent CHAP LOGIN Request
 Vi1 LCP: Received AAA AUTHOR Response PASS
 Vi1 MLP: Received AAA AUTHOR Response PASS
```



```
 Vi1 CHAP: O SUCCESS id 4 len 4
 Vi3 PPP: Received LOGIN Response PASS
 Vi1 CHAP: I SUCCESS id 24 len 4
 %FR-3-MLPOFR_ERROR: MLPoFR not configured properly on Link Virtual-
Access1 Bundle Multilink1 :Frame Relay traffic shaping must be enabled
 Vi3 PPP: Sent LCP AUTHOR Request
 %LINK-3-UPDOWN: Interface Multilink1, changed state to up
 Mu1 PPP: Sent IPCP AUTHOR Request
 Mu1 PPP: Sent CDPCP AUTHOR Request
 Vi3 LCP: Received AAA AUTHOR Response PASS
 Vi3 CHAP: O SUCCESS id 4 len 4
 Mu1 IPCP: Received AAA AUTHOR Response PASS
 Mu1 CDPCP: Received AAA AUTHOR Response PASS
 Mu1 PPP: Sent IPCP AUTHOR Request
 Vi3 CHAP: I SUCCESS id 24 len 4
 %FR-3-MLPOFR_ERROR: MLPoFR not configured properly on Link Virtual-
Access3 Bundle Multilink1 :Frame Relay traffic shaping must be enabled
%LINEPROTO-5-UPDOWN: Line protocol on Interface Multilink1, changed
state to up
```

Task 4.1

R3:

```
router eigrp 100
 no auto-summary
 network 145.1.37.3 0.0.0.0
```

R4:

```
router eigrp 200
 no auto-summary
 network 145.1.47.4 0.0.0.0
```

SW1:

```
ip routing
!
router eigrp 100
 no auto-summary
 network 145.1.37.7 0.0.0.0
!
router eigrp 200
 no auto-summary
 network 145.1.47.7 0.0.0.0
```

Task 4.1 Verification

Verify EIGRP neighbors:

```
Rack1SW1#show ip eigrp neighbors
IP-EIGRP neighbors for process 100
H   Address                 Interface       Hold Uptime   SRTT   RTO  Q  Seq
Type                                        (sec)         (ms)       Cnt Num
0   145.1.37.3               Fa0/3           12 00:00:07   12     200  0  2
IP-EIGRP neighbors for process 200
H   Address                 Interface       Hold Uptime   SRTT   RTO  Q  Seq
Type                                        (sec)         (ms)       Cnt Num
```



```
0   145.1.47.4          Fa0/4           12 00:00:06   12      200  0  2
```

Task 4.2

R3:
```
router eigrp 100
 redistribute connected metric 1 1 1 1 1 route-map CONNECTED->EIGRP
!
route-map CONNECTED->EIGRP permit 10
 match interface loopback0
```

SW1:
```
router eigrp 100
 redistribute connected metric 1 1 1 1 1 route-map CONNECTED->EIGRP
!
route-map CONNECTED->EIGRP permit 10
 match interface loopback0
```

Task 4.2 Verification

Check administrative distance for Loopback0 networks:

```
Rack1SW1#show ip route eigrp
     150.1.0.0/24 is subnetted, 2 subnets
D EX    150.1.3.0 [170/2560025856] via 145.1.37.3, 00:03:46,
FastEthernet0/3

Rack1R3#show ip route eigrp
     150.1.0.0/24 is subnetted, 2 subnets
D EX    150.1.7.0 [170/2560025856] via 145.1.37.7, 00:02:22,
Ethernet0/0
```

Task 4.3

R2:
```
router ospf 1
 network 145.1.245.2 0.0.0.0 area 245
 redistribute ospf 2 subnets
!
router ospf 2
 network 145.1.28.2 0.0.0.0 area 28
 redistribute ospf 1 subnets
```

R4:
```
router ospf 1
 network 145.1.45.4 0.0.0.0 area 0
 network 145.1.245.4 0.0.0.0 area 245
```

R5:
```
router ospf 1
 network 145.1.45.5 0.0.0.0 area 0
 network 145.1.245.5 0.0.0.0 area 245
```

SW2:
```
ip routing
!
```



```
router ospf 1
 network 145.1.28.8 0.0.0.0 area 28
```

Task 4.3 Verification

Verify OSPF neighbors:

```
Rack1R5#show ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
150.1.4.4         0   FULL/  -        00:00:38    145.1.45.4      Serial0/1.1
150.1.2.2         1   FULL/DROTHER    00:00:35    145.1.245.2     Ethernet0/1
150.1.4.4         1   FULL/BDR        00:00:39    145.1.245.4     Ethernet0/1

Rack1R2#show ip ospf neighbor

Neighbor ID     Pri   State     Dead Time Address     Interface
150.1.8.8         1   FULL/BDR  00:00:38  145.1.28.8  FastEthernet0/0.28
150.1.4.4         1   FULL/BDR  00:00:38  145.1.245.4 FastEthernet0/0.245
150.1.5.5         1   FULL/DR   00:00:33  145.1.245.5 FastEthernet0/0.245
```

Confirm that R5 can reach VLAN28:

```
Rack1R5#show ip route ospf
     145.1.0.0/16 is variably subnetted, 5 subnets, 2 masks
O E2    145.1.28.0/24 [110/1] via 145.1.245.2, 00:00:26, Ethernet0/1
```

Task 4.4

SW2:

```
router ospf 1
 network 145.1.8.8 0.0.0.0 area 0
 network 150.1.8.8 0.0.0.0 area 0
```

SW3:

```
router ospf 1
 network 145.1.8.9 0.0.0.0 area 0
 network 145.1.100.9 0.0.0.0 area 0
 network 150.1.9.9 0.0.0.0 area 0
```

SW4:

```
router ospf 1
 network 145.1.100.10 0.0.0.0 area 0
 network 150.1.10.10 0.0.0.0 area 0
```

Task 4.4 Verification

```
Confirm that we have Sw2-Sw4 routes on R5:

Rack1R5#show ip route ospf
     145.1.0.0/16 is variably subnetted, 7 subnets, 2 masks
O E2    145.1.28.0/24 [110/1] via 145.1.245.2, 01:07:36, Ethernet0/1
O E2    145.1.8.0/24 [110/2] via 145.1.245.2, 00:00:10, Ethernet0/1
O E2    145.1.100.0/24 [110/3] via 145.1.245.2, 00:00:20, Ethernet0/1
     150.1.0.0/16 is variably subnetted, 4 subnets, 2 masks
O E2    150.1.10.10/32 [110/4] via 145.1.245.2, 00:00:20, Ethernet0/1
```



```
O E2    150.1.9.9/32 [110/3] via 145.1.245.2, 00:00:20, Ethernet0/1
O E2    150.1.8.8/32 [110/2] via 145.1.245.2, 00:00:30, Ethernet0/1

Rack1SW2#show ip ospf database | begin Area 0
                Router Link States (Area 0)

Link ID         ADV Router      Age         Seq#       Checksum Link
count
145.1.28.2      145.1.28.2      7     (DNA) 0x80000002 0x0087DC 1
145.1.245.2     145.1.245.2     7     (DNA) 0x80000002 0x00A41B 1
150.1.8.8       150.1.8.8       388         0x80000002 0x002EB4 2
150.1.9.9       150.1.9.9       1742        0x80000007 0x00F9CC 3
150.1.10.10     150.1.10.10     1463        0x80000004 0x00EB2E 2
```

Task 4.5

R2:

```
router ospf 1
 network 150.1.2.2 0.0.0.0 area 245
```

R4:

```
router ospf 1
 redistribute connected subnets route-map CONNECTED->OSPF
!
route-map CONNECTED->OSPF permit 10
 match interface loopback0
```

R5:

```
router ospf 1
 network 150.1.5.5 0.0.0.0 area 245
```

Task 4.5 Verification

Confirm that Loopback0 networks have been advertised:

```
Rack1R2#show ip route ospf
     145.1.0.0/24 is subnetted, 3 subnets
O IA    145.1.45.0 [110/65] via 145.1.245.4, 00:00:53,
FastEthernet0/0.245
                   [110/65] via 145.1.245.5, 00:00:53,
FastEthernet0/0.245
     150.1.0.0/16 is variably subnetted, 4 subnets, 2 masks
O E2    150.1.4.0/24 [110/20] via 145.1.245.4, 00:00:53,
FastEthernet0/0.245
O IA    150.1.8.8/32 [110/2] via 145.1.28.8, 00:03:50,
FastEthernet0/0.28
O       150.1.5.5/32 [110/2] via 145.1.245.5, 00:00:53,
FastEthernet0/0.245

Rack1R5#show ip route ospf
     145.1.0.0/16 is variably subnetted, 5 subnets, 2 masks
O E2    145.1.28.0/24 [110/1] via 145.1.245.2, 00:01:35, Ethernet0/1
     150.1.0.0/16 is variably subnetted, 4 subnets, 2 masks
O E2    150.1.4.0/24 [110/20] via 145.1.245.4, 00:01:35, Ethernet0/1
O E2    150.1.8.8/32 [110/2] via 145.1.245.2, 00:01:35, Ethernet0/1
```



```
O       150.1.2.2/32 [110/11] via 145.1.245.2, 00:01:35, Ethernet0/1
```

Task 4.6

R2:

```
interface FastEthernet0/0.28
 ip nat inside
!
interface FastEthernet0/0.245
 ip nat outside
!
interface Loopback0
 ip ospf network point-to-point
!
ip nat inside source static 145.1.8.8 150.1.2.8
```

SW2:

```
router ospf 1
 network 145.1.8.8 0.0.0.0 area 28
```

Task 4.6 Verification

Verify NAT configuration:

```
Rack1R2#show ip nat translations
Pro Inside global     Inside local       Outside local      Outside global
--- 150.1.2.8         145.1.8.8            ---                ---
```

Confirm that NAT works:

```
Rack1R2#debug ip nat detailed

Rack1R5#ping 145.1.8.8 repeat 100

Type escape sequence to abort.
Sending 100, 100-byte ICMP Echos to 145.1.8.8, timeout is 2 seconds:
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!
Success rate is 100 percent (100/100), round-trip min/avg/max = 1/3/8 ms

Rack1R2#
<output omitted>
 NAT*: i: icmp (145.1.8.8, 2) -> (145.1.245.5, 2) [28]
 NAT*: s=145.1.8.8->150.1.2.8, d=145.1.245.5 [28]
 NAT*: i: icmp (145.1.8.8, 2) -> (145.1.245.5, 2) [29]
 NAT*: s=145.1.8.8->150.1.2.8, d=145.1.245.5 [29]
 NAT*: i: icmp (145.1.8.8, 2) -> (145.1.245.5, 2) [30]
 NAT*: s=145.1.8.8->150.1.2.8, d=145.1.245.5 [30]
 NAT*: i: icmp (145.1.8.8, 2) -> (145.1.245.5, 2) [31]
 NAT*: s=145.1.8.8->150.1.2.8, d=145.1.245.5 [31]
 NAT*: i: icmp (145.1.8.8, 2) -> (145.1.245.5, 2) [32]
<output omitted>
```


Task 4.7

R1:
```
interface FastEthernet0/0.16
 ip rip send version 2
 ip rip receive version 2
!
interface FastEthernet0/0.136
 ip rip send version 2
 ip rip receive version 2
!
router rip
 no auto-summary
 network 145.1.0.0
 network 150.1.0.0
```

R3:
```
interface Ethernet0/1
 ip rip send version 2
 ip rip receive version 2
!
interface Multilink34
 ip rip send version 2
 ip rip receive version 2
!
interface Multilink35
 ip rip send version 2
 ip rip receive version 2
!
router rip
 no auto-summary
 network 145.1.0.0
```

R4:
```
interface Multilink1
 ip rip send version 2
 ip rip receive version 2
!
router rip
 no auto-summary
 network 145.1.0.0
```

R5:
```
interface Ethernet0/0
 ip rip send version 2
 ip rip receive version 2
!
interface Multilink1
 ip rip send version 2
 ip rip receive version 2
!
router rip
 no auto-summary
 network 145.1.0.0
 network 192.10.1.0
```


R6:

```
interface GigabitEthernet0/0.16
 ip rip send version 2
 ip rip receive version 2
!
interface GigabitEthernet0/0.136
 ip rip send version 2
 ip rip receive version 2
!
router rip
 no auto-summary
 network 145.1.0.0
 network 150.1.0.0
```

Task 4.8

R5:

```
key chain RIP
 key 1
  key-string CISCO
!
interface Ethernet0/0
 ip rip authentication mode md5
 ip rip authentication key-chain RIP
```

Task 4.7 – 4.8 Verification

Verify RIP configuration. For instance at R6:

```
Rack1R6#sho ip protocols
Routing Protocol is "rip"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Sending updates every 30 seconds, next due in 16 seconds
  Invalid after 180 seconds, hold down 180, flushed after 240
  Redistributing: rip
  Default version control: send version 1, receive any version
    Interface             Send  Recv  Triggered RIP  Key-chain
    GigabitEthernet0/0.16 2     2
    GigabitEthernet0/0.13 2     2
    Loopback0             1     1 2
  Automatic network summarization is not in effect
  Maximum path: 4
  Routing for Networks:
    145.1.0.0
    150.1.0.0
  Routing Information Sources:
    Gateway         Distance      Last Update
    145.1.136.1           120      00:00:03
    145.1.136.3           120      00:00:22
    145.1.16.1            120      00:00:03
  Distance: (default is 120)
```


Verify RIP authentication at R5:

```
Rack1R5#debug ip rip

<output omitted>

05:39:31.539: RIP: received packet with MD5 authentication
05:39:31.539: RIP: received v2 update from 192.10.1.254 on Ethernet0/0
05:39:31.543:      205.90.31.0/24 via 0.0.0.0 in 7 hops
05:39:31.543:      220.20.3.0/24 via 0.0.0.0 in 7 hops
05:39:31.543:      222.22.2.0/24 via 0.0.0.0 in 7 hops
```

Verify RIP routes:

```
Rack1R1#show ip route rip
R    222.22.2.0/24 [120/9] via 145.1.136.3, 00:00:02,
FastEthernet0/0.136
R    220.20.3.0/24 [120/9] via 145.1.136.3, 00:00:02,
FastEthernet0/0.136
     145.1.0.0/16 is variably subnetted, 9 subnets, 2 masks
R       145.1.245.0/24 [120/2] via 145.1.136.3, 00:00:02,
FastEthernet0/0.136
R       145.1.0.0/24 [120/1] via 145.1.136.3, 00:00:02,
FastEthernet0/0.136
R       145.1.0.4/32 [120/1] via 145.1.136.3, 00:00:02,
FastEthernet0/0.136
R       145.1.0.5/32 [120/1] via 145.1.136.3, 00:00:02,
FastEthernet0/0.136
R       145.1.37.0/24 [120/1] via 145.1.136.3, 00:00:02,
FastEthernet0/0.136
R       145.1.45.0/24 [120/2] via 145.1.136.3, 00:00:02,
FastEthernet0/0.136
R       145.1.47.0/24 [120/2] via 145.1.136.3, 00:00:02,
FastEthernet0/0.136
R    192.10.1.0/24 [120/2] via 145.1.136.3, 00:00:02,
FastEthernet0/0.136
     150.1.0.0/24 is subnetted, 2 subnets
R       150.1.6.0 [120/1] via 145.1.16.6, 00:00:13, FastEthernet0/0.16
                  [120/1] via 145.1.136.6, 00:00:15,
FastEthernet0/0.136
R    205.90.31.0/24 [120/9] via 145.1.136.3, 00:00:04,
FastEthernet0/0.136
```


Task 4.9

R1:
```
router rip
 distribute-list prefix VLAN16 out FastEthernet0/0.136
!
ip prefix-list VLAN16 seq 5 deny 145.1.16.0/24
ip prefix-list VLAN16 seq 10 permit 0.0.0.0/0 le 32
```

Task 4.9 Verification

Verify routing table at R3:

```
Rack1R3#clear ip route *
Rack1R3#show ip route | inc 145.1.16.0
R       145.1.16.0/24 [120/1] via 145.1.136.6, 00:00:08, Ethernet0/1
```

Task 4.10

R3:
```
router rip
 redistribute eigrp 100 metric 1
 redistribute connected
!
router eigrp 100
 redistribute rip metric 1 1 1 1 1
```

R4:
```
router ospf 1
 redistribute rip subnets
 redistribute eigrp 200 subnets
!
router eigrp 200
 redistribute ospf 1 metric 1 1 1 1 1
 redistribute rip metric 1 1 1 1 1
!
router rip
 passive-interface default
 no passive-interface Multilink 1
 redistribute eigrp 200 metric 10
 redistribute ospf 1 metric 10

route-map CONNECTED->OSPF permit 10
 match interface Loopback0 Ethernet0/0
```

R5:
```
router ospf 1
 redistribute rip subnets metric 40
!
router rip
 passive-interface default
 no passive-interface Multilink 1
 redistribute ospf 1 metric 10
```


SW1:

```
router eigrp 100
 redistribute eigrp 200
!
router eigrp 200
 redistribute eigrp 100
```

Task 4.11

R3:

```
router rip
 distribute-list prefix R3->SW1 out Multilink34
!
ip prefix-list R3->SW1 seq 5 deny 145.1.37.0/24
ip prefix-list R3->SW1 seq 10 permit 0.0.0.0/0 le 32
```

Task 4.12

R4:

```
router ospf 1
 distance ospf external 121
 distance 110 150.1.2.2 0.0.0.0
```

R5:

```
router ospf 1
 distance ospf external 121
 distance 110 150.1.2.2 0.0.0.0
```


Task 4.10 – 4.12 Verification

Confirm that R4 uses EIGRP to reach network 145.1.37.0/24

```
Rack1R4#show ip route | inc 145.1.37.0
D EX    145.1.37.0/24 [170/307200] via 145.1.47.7, 00:02:34,
Ethernet0/0
```

Verify full connectivity with the following Tcl script:

```
foreach i {
145.1.16.1
145.1.136.1
150.1.1.1
145.1.28.2
145.1.245.2
150.1.2.2
145.1.37.3
145.1.136.3
145.1.0.3
150.1.3.3
145.1.47.4
145.1.245.4
145.1.45.4
145.1.0.4
150.1.4.4
192.10.1.5
145.1.245.5
145.1.45.5
145.1.0.5
150.1.5.5
145.1.16.6
145.1.136.6
150.1.6.6
145.1.47.7
145.1.37.7
150.1.7.7
145.1.28.8
145.1.8.8
150.1.8.8
145.1.8.9
145.1.100.9
150.1.9.9
145.1.100.10
150.1.10.10
} { puts [ exec "ping $i" ] }
```

Note that VLAN8, VLAN13, and Serial link to BB1 are excluded from connectivity test.

Task 4.13

R2:

```
ip route 0.0.0.0 0.0.0.0 150.1.5.5
```

R6:

```
router rip
 default-information originate
```

Task 4.13 Verification

Verify default routing at R2.

When R5 is reachable:

```
Rack1R2#show ip route 0.0.0.0
Routing entry for 0.0.0.0/0, supernet
  Known via "static", distance 1, metric 0, candidate default path
  Routing Descriptor Blocks:
  * 150.1.5.5
      Route metric is 0, traffic share count is 1

Rack1R2#show ip route 150.1.5.5
Routing entry for 150.1.5.5/32
  Known via "ospf 1", distance 110, metric 2, type intra area
  Redistributing via ospf 2
  Advertised by ospf 2 subnets
  Last update from 145.1.245.5 on FastEthernet0/0.245, 00:00:37 ago
  Routing Descriptor Blocks:
  * 145.1.245.5, from 150.1.5.5, 00:00:37 ago, via FastEthernet0/0.245
      Route metric is 2, traffic share count is 1
```

When R5 is unreachable:

```
Rack1R5(config)#interface ethernet 0/1
Rack1R5(config-if)#shutdown

Rack1R2#
*Mar  1 02:37:49.135: %OSPF-5-ADJCHG: Process 1, Nbr 150.1.5.5 on
FastEthernet0/0.245 from FULL to DOWN, Neighbor Down: Dead timer
expired

Rack1R2#show ip route 0.0.0.0
Routing entry for 0.0.0.0/0, supernet
  Known via "static", distance 1, metric 0, candidate default path
  Routing Descriptor Blocks:
  * 150.1.5.5
      Route metric is 0, traffic share count is 1
```



```
Rack1R2#show ip route 150.1.5.5
Routing entry for 150.1.5.5/32
  Known via "ospf 1", distance 110, metric 66, type inter area
  Redistributing via ospf 2
  Advertised by ospf 2 subnets
  Last update from 145.1.245.4 on FastEthernet0/0.245, 00:00:27 ago
  Routing Descriptor Blocks:
  * 145.1.245.4, from 150.1.4.4, 00:00:27 ago, via FastEthernet0/0.245
      Route metric is 66, traffic share count is 1
```

Task 5.1

R1:

```
router bgp 100
 neighbor 145.1.16.6 remote-as 100
 neighbor 145.1.37.7 remote-as 100
 neighbor 204.12.1.254 remote-as 54
```

R4:

```
router bgp 200
 neighbor 145.1.47.7 remote-as 100
 neighbor 145.1.28.8 remote-as 200
```

R5:

```
router bgp 200
 neighbor 145.1.28.8 remote-as 200
```

R6:

```
router bgp 100
 neighbor 145.1.16.1 remote-as 100
```

SW1:

```
router bgp 100
 neighbor 145.1.136.1 remote-as 100
 neighbor 145.1.47.4 remote-as 200
```

SW2:

```
router bgp 200
 neighbor 145.1.245.4 remote-as 200
 neighbor 145.1.245.4 route-reflector-client
 neighbor 145.1.245.5 remote-as 200
 neighbor 145.1.245.5 route-reflector-client
```


Task 5.1 Verification

Verify BGP neighbors:

```
Rack1R1#show ip bgp summary | begin Neighbor
Neighbor        V AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd
145.1.16.6      4 100    9      13        11    0    0 00:05:29        0
145.1.37.7      4 100    8      12        11    0    0 00:04:16        0
204.12.1.254    4  54   14      10        11    0    0 00:06:02       10

Rack1R4#show ip bgp summary  | begin Neighbor
Neighbor        V AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd
145.1.28.8      4 200   11      11        11    0    0 00:06:36        0
145.1.47.7      4 100   11       9        11    0    0 00:06:33       10

Rack1SW2#show ip bgp summary | begin Neighbor
Neighbor        V AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd
145.1.245.4     4 200    12      12        11    0    0 00:07:00       10
145.1.245.5     4 200     9      11        11    0    0 00:06:43        0
```

Verify route-reflector configuration:

```
Rack1SW2#show ip bgp Neighbors | include (neighbor is|Reflec)
BGP neighbor is 145.1.245.4,  remote AS 200, internal link
  Route-Reflector Client
BGP neighbor is 145.1.245.5,  remote AS 200, internal link
  Route-Reflector Client
```

Task 5.2

R5:

```
router bgp 200
 network 222.22.2.0 mask 255.255.255.0
 network 220.20.3.0 mask 255.255.255.0
 network 205.90.31.0 mask 255.255.255.0
```

Task 5.2 Verification

Confirm that R5 advertised RIP networks into BGP:

```
Rack1R1#show ip bgp | begin Network
   Network          Next Hop            Metric LocPrf Weight Path
*> 28.119.16.0/24   204.12.1.254             0             0 54 i
*> 28.119.17.0/24   204.12.1.254             0             0 54 i
*> 112.0.0.0        204.12.1.254                           0 54 50 60 i
*> 113.0.0.0        204.12.1.254                           0 54 50 60 i
*> 114.0.0.0        204.12.1.254                           0 54 i
*> 115.0.0.0        204.12.1.254                           0 54 i
*> 116.0.0.0        204.12.1.254                           0 54 i
*> 117.0.0.0        204.12.1.254                           0 54 i
*> 118.0.0.0        204.12.1.254                           0 54 i
*> 119.0.0.0        204.12.1.254                           0 54 i
r>i205.90.31.0      145.1.47.4               0    100      0 200 i
r>i220.20.3.0       145.1.47.4               0    100      0 200 i
r>i222.22.2.0       145.1.47.4               0    100      0 200 i
```


Task 1.1

1) Fault 1: Wrong R3 IP addresses
2) Fault 2: Wrong IP address on SVI 510 on Sw4

Task 2.1

SW1:

```
interface FastEthernet0/13
 channel-group 1 mode on
 no switchport
!
interface FastEthernet0/13
 channel-group 1 mode on
 no switchport
!
interface FastEthernet0/13
 channel-group 1 mode on
 no switchport
!
interface FastEthernet0/16
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
!
interface Port-channel1
 ip address 144.1.78.7 255.255.255.0
```

SW2:

```
interface FastEthernet0/13
 no switchport
 channel-group 1 mode on
!
interface FastEthernet0/14
 no switchport
 channel-group 1 mode on
!
interface FastEthernet0/15
 no switchport
 channel-group 1 mode on
!
interface FastEthernet0/19
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
!
interface Port-channel1
 ip address 144.1.78.8 255.255.255.0
```

SW3:

```
interface FastEthernet0/13
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
!
```



```
interface FastEthernet0/19
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
```

SW4:

```
interface FastEthernet0/16
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet0/19
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
```

Task 2.1 Verification

```
Rack1SW1#show etherchannel summary
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 1
Number of aggregators:           1

Group  Port-channel  Protocol    Ports
------+-------------+----------+-----------------------------------------
------
1      Po1(RU)           -        Fa0/13(P)   Fa0/14(P)   Fa0/15(P)

Rack1SW2#show etherchannel summary
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 1
Number of aggregators:           1

Group  Port-channel  Protocol    Ports
------+-------------+----------+-----------------------------------------
------
1      Po1(RU)           -        Fa0/13(P)   Fa0/14(P)   Fa0/15(P)
```



```
Rack1SW1#ping 144.1.78.8

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 144.1.78.8, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/8 ms
```

Verifying L2 path from Sw1 to Sw2:

```
Rack1SW1#show interfaces trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/16      on           802.1q         trunking      1

Rack1SW1#show cdp neighbors f0/16
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
                  S - Switch, H - Host, I - IGMP, r - Repeater, P -
Phone

Device ID            Local Intrfce         Holdtme   Capability
Platform   Port ID
Rack1SW3             Fas 0/16              158            S I      WS-
C3560-2Fas 0/13

Rack1SW3#show interfaces trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/13      on           802.1q         trunking      1
Fa0/19      on           802.1q         trunking      1

Rack1SW3#show cdp neighbors f0/19
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
                  S - Switch, H - Host, I - IGMP, r - Repeater, P -
Phone

Device ID            Local Intrfce         Holdtme   Capability
Platform   Port ID
Rack1SW4             Fas 0/19              161            S I      WS-
C3560-2Fas 0/19

Rack1SW4#show interfaces trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/16      on           802.1q         trunking      1
Fa0/19      on           802.1q         trunking      1

Rack1SW4#show cdp neighbors f0/16
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
                  S - Switch, H - Host, I - IGMP, r - Repeater, P -
Phone

Device ID            Local Intrfce         Holdtme   Capability
Platform   Port ID
Rack1SW2             Fas 0/16              143            S I      WS-
C3560-2Fas 0/19
```


Task 2.2

SW1:
```
vtp domain IE
!
interface FastEthernet0/1
 switchport access vlan 17
!
interface FastEthernet0/3
 switchport access vlan 34
!
interface FastEthernet0/5
 switchport access vlan 510
```

SW2:
```
vtp domain IE
!
interface FastEthernet0/2
 switchport access vlan 27
!
interface FastEthernet0/4
 switchport access vlan 46
!
interface FastEthernet0/6
 switchport access vlan 46
!
interface FastEthernet0/24
 switchport access vlan 82
```

SW3:
```
vtp domain IE
!
interface FastEthernet0/3
 switchport access vlan 33
!
interface FastEthernet0/5
 switchport access vlan 55
!
interface FastEthernet0/24
 switchport access vlan 33
```

SW4:
```
vtp domain IE
!
interface FastEthernet0/4
 switchport access vlan 34
```


Task 2.2 Verification

```
Rack1SW1#show vtp status
VTP Version                     : 2
Configuration Revision          : 8
Maximum VLANs supported locally : 1005
Number of existing VLANs        : 13
VTP Operating Mode              : Server
VTP Domain Name                 : IE
VTP Pruning Mode                : Disabled
VTP V2 Mode                     : Disabled
VTP Traps Generation            : Disabled
MD5 digest                      : 0x34 0x38 0x5B 0x50 0x4B 0xF0 0xD6
0x01
Configuration last modified by 144.1.78.8 at 3-1-93 01:36:51
Local updater ID is 144.1.17.7 on interface Vl17 (lowest numbered VLAN
interface found)

Rack1SW1#show vlan brief | exclude unsup

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------
--------
1    default                          active    Fa0/2, Fa0/4, Fa0/6,
Fa0/7
                                                Fa0/8, Fa0/9, Fa0/10,
Fa0/11
                                                Fa0/12, Fa0/17, Fa0/18,
Fa0/19
                                                Fa0/20, Fa0/21, Fa0/22,
Fa0/23
                                                Fa0/24, Gi0/1, Gi0/2
17   VLAN0017                         active    Fa0/1
27   VLAN0027                         active
33   VLAN0033                         active
34   VLAN0034                         active    Fa0/3
46   VLAN0046                         active
55   VLAN0055                         active
82   VLAN0082                         active
510  VLAN0510                         active    Fa0/5


Rack1SW2#show vtp status
VTP Version                     : 2
Configuration Revision          : 8
Maximum VLANs supported locally : 1005
Number of existing VLANs        : 13
VTP Operating Mode              : Server
VTP Domain Name                 : IE
VTP Pruning Mode                : Disabled
VTP V2 Mode                     : Disabled
VTP Traps Generation            : Disabled
MD5 digest                      : 0x34 0x38 0x5B 0x50 0x4B 0xF0 0xD6
0x01
Configuration last modified by 144.1.78.8 at 3-1-93 01:36:51
```

```
Local updater ID is 192.10.1.8 on interface Vl82 (lowest numbered VLAN
interface found)


Rack1SW2#show vlan brief | exclude unsup

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------
--------
1    default                          active    Fa0/1, Fa0/3, Fa0/5,
Fa0/7
                                                Fa0/8, Fa0/9, Fa0/10,
Fa0/11
                                                Fa0/12, Fa0/16, Fa0/17,
Fa0/18
                                                Fa0/20, Fa0/21, Fa0/22,
Fa0/23
                                                Gi0/1, Gi0/2
17   VLAN0017                         active
27   VLAN0027                         active    Fa0/2
33   VLAN0033                         active
34   VLAN0034                         active
46   VLAN0046                         active    Fa0/4, Fa0/6
55   VLAN0055                         active
82   VLAN0082                         active    Fa0/24
510  VLAN0510                         active


Rack1SW3#show vtp status
VTP Version                     : 2
Configuration Revision          : 8
Maximum VLANs supported locally : 1005
Number of existing VLANs        : 13
VTP Operating Mode              : Server
VTP Domain Name                 : IE
VTP Pruning Mode                : Disabled
VTP V2 Mode                     : Disabled
VTP Traps Generation            : Disabled
MD5 digest                      : 0x34 0x38 0x5B 0x50 0x4B 0xF0 0xD6
0x01
Configuration last modified by 144.1.78.8 at 3-1-93 01:36:51
Local updater ID is 0.0.0.0 (no valid interface found)


Rack1SW3#show vlan brief | exclude unsup

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------
1    default                          active    Fa0/1, Fa0/2, Fa0/4,
Fa0/6
                                                Fa0/7, Fa0/8, Fa0/9,
Fa0/10
                                                Fa0/11, Fa0/12, Fa0/14,
Fa0/15
                                                Fa0/16, Fa0/17, Fa0/18,
Fa0/20
```



```
                                                Fa0/21, Fa0/22, Fa0/23,
Gi0/1
                                                Gi0/2
17   VLAN0017                           active
27   VLAN0027                           active
33   VLAN0033                           active    Fa0/3, Fa0/24
34   VLAN0034                           active
46   VLAN0046                           active
55   VLAN0055                           active    Fa0/5
82   VLAN0082                           active
510  VLAN0510                           active


Rack1SW4#show vtp status
VTP Version                     : 2
Configuration Revision          : 8
Maximum VLANs supported locally : 1005
Number of existing VLANs        : 13
VTP Operating Mode              : Server
VTP Domain Name                 : IE
VTP Pruning Mode                : Disabled
VTP V2 Mode                     : Disabled
VTP Traps Generation            : Disabled
MD5 digest                      : 0x34 0x38 0x5B 0x50 0x4B 0xF0 0xD6
0x01
Configuration last modified by 144.1.78.8 at 3-1-93 01:36:51
Local updater ID is 145.1.5.10 on interface Vl510 (lowest numbered VLAN
interface found)


Rack1SW4#show vlan brief | exclude unsup

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------
--------
1    default                          active    Fa0/1, Fa0/2, Fa0/3,
Fa0/5
                                                Fa0/6, Fa0/7, Fa0/8,
Fa0/9
                                                Fa0/10, Fa0/11, Fa0/12,
Fa0/13
                                                Fa0/14, Fa0/15, Fa0/17,
Fa0/18
                                                Fa0/20, Fa0/21, Fa0/22,
Fa0/23
                                                Fa0/24, Gi0/1, Gi0/2
17   VLAN0017                           active
27   VLAN0027                           active
33   VLAN0033                           active
34   VLAN0034                           active    Fa0/4
46   VLAN0046                           active
55   VLAN0055                           active
82   VLAN0082                           active
510  VLAN0510                           active
```


Task 2.3

SW3:

```
vtp pruning
```

Task 2.3 Verification

```
Rack1SW4#show interfaces trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/16      on           802.1q         trunking      1
Fa0/19      on           802.1q         trunking      1

Port        Vlans allowed on trunk
Fa0/16      1-4094
Fa0/19      1-4094

Port        Vlans allowed and active in management domain
Fa0/16      1,17,27,33-34,46,55,82,510
Fa0/19      1,17,27,33-34,46,55,82,510

Port        Vlans in spanning tree forwarding state and not pruned
Fa0/16      1,27,46,82
Fa0/19      1,17,27,33-34,55,510


Rack1SW4#show cdp neighbors f0/16
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
                  S - Switch, H - Host, I - IGMP, r - Repeater, P -
Phone

Device ID            Local Intrfce         Holdtme   Capability
Platform   Port ID
Rack1SW2           Fas 0/16              157           R S I     WS-
C3560-2Fas 0/19
```

Task 3.1

R2:

```
interface Serial0/0
 encapsulation frame-relay
 frame-relay interface-dlci 204 ppp virtual-template1
!
interface Virtual-Template1
 ip address 144.1.24.2 255.255.255.0
```

R4:

```
interface Serial0/0
 encapsulation frame-relay
 frame-relay interface-dlci 402 ppp virtual-template1
!
interface Virtual-Template1
 ip address 144.1.24.4 255.255.255.0
```


Task 3.1 Verification

Verify PPPoFR status:

```
Rack1R4#show frame-relay pvc 402

PVC Statistics for interface Serial0/0 (Frame Relay DTE)

DLCI = 402, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE =
Serial0/0

  input pkts 4             output pkts 9            in bytes 68
  out bytes 150            dropped pkts 0           in pkts dropped 0
  out pkts dropped 0                 out bytes dropped 0
  in FECN pkts 0           in BECN pkts 0           out FECN pkts 0
  out BECN pkts 0          in DE pkts 0             out DE pkts 0
  out bcast pkts 0         out bcast bytes 0
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 1 packets/sec
  pvc create time 00:00:35, last time pvc status changed 00:00:09
  Bound to Virtual-Access1 (up, cloned from Virtual-Template1)
```

Confirm connectivity:

```
Rack1R4#ping 144.1.24.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 144.1.24.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 56/58/60 ms
```

Task 3.2

R1:

```
interface Serial0/0
 encapsulation frame-relay
!
interface Serial0/0.1 point-to-point
 ip address 144.1.15.1 255.255.255.0
 frame-relay interface-dlci 105
```

R5:

```
interface Serial0/0
 encapsulation frame-relay
!
interface Serial0/0.1 multipoint
 ip address 144.1.15.5 255.255.255.0
 frame-relay map ip 144.1.15.1 501 broadcast
```


Task 3.2 Verification

Verify L3 to L2 mapping and confirm connectivity:

```
Rack1R5#show frame-relay map
Serial0/0.1 (up): ip 144.1.15.1 dlci 501(0x1F5,0x7C50), static,
              broadcast,
              CISCO, status defined, active

Rack1R5#ping 144.1.15.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 144.1.15.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max=56/67/104 ms
```

Task 3.3

R6:

```
bridge irb
bridge 1 protocol ieee
bridge 1 route ip
!
interface Serial0/0/0
 encapsulation frame-relay
 bridge-group 1
 frame-relay map bridge 401 broadcast
!
interface BVI1
 ip address 54.1.10.6 255.255.255.0
```

Task 3.3 Verification

Verify bridging status:

```
Rack1R6#show bridge 1 verbose

Total of 300 station blocks, 299 free
Codes: P - permanent, S - self

BG Hash      Address    Action  Interface    VC  Age RX count TX count
 1 AA/0   0000.0cab.be14 forward Serial0/0/0 401   0   10          0

Flood ports (BG 1)           RX count    TX count
Serial0/0/0                         0           0
```

Confirm connectivity:

```
Rack1R6#ping 54.1.10.254

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 54.1.10.254, timeout is 2 seconds:
.!!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 36/39/40 ms
```


Task 3.4

R4:
```
interface Serial0/1
 encapsulation ppp
 ip unnumbered Virtual-Template1
```

R5:
```
interface Serial0/1
 clock rate 64000
 encapsulation ppp
 ip unnumbered Serial0/0.1
```

Task 3.4 Verification

Verify PPP configuration:

```
Rack1R4#show ip interface serial 0/1
Serial0/1 is up, line protocol is up
  Interface is unnumbered. Using address of Virtual-Template1
(144.1.24.4)
  Broadcast address is 255.255.255.255
  Peer address is 144.1.15.5
  MTU is 1500 bytes
<output omitted>

Rack1R4#ping 144.1.15.5

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 144.1.15.5, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 28/29/32 ms
```

Task 3.5

R2:
```
username Rack1R4
!
interface Virtual-Template1
 ppp authentication chap
```

R4:
```
username Rack1R2
!
interface Virtual-Template1
 ppp authentication chap
```


Task 3.5 Verification

Verify PPP authentication process:

```
Rack1R4(config)#interface serial 0/0
Rack1R4(config-if)#shutdown
*May 15 13:39:02.523: %LINK-5-CHANGED: Interface Serial0/0, changed
state to administratively down
*May 15 13:39:02.527: %LINK-3-UPDOWN: Interface Virtual-Access1,
changed state to down
*May 15 13:39:03.523: %LINEPROTO-5-UPDOWN: Line protocol on Interface
Serial0/0, changed state to down
Rack1R4(config-if)#no shutdown
*May 15 13:39:08.203: %LINK-3-UPDOWN: Interface Serial0/0, changed
state to up
*May 15 13:39:08.207: %LINK-3-UPDOWN: Interface Virtual-Access1,
changed state to up
*May 15 13:39:08.207: Vi1 PPP: Using default call direction
*May 15 13:39:08.207: Vi1 PPP: Treating connection as a dedicated line
*May 15 13:39:08.207: Vi1 PPP: Session handle[48000007] Session id[6]
*May 15 13:39:08.207: Vi1 PPP: Authorization required
*May 15 13:39:08.231: %LINK-3-UPDOWN: Interface Virtual-Access1,
changed state to down
*May 15 13:39:09.203: %LINEPROTO-5-UPDOWN: Line protocol on Interface
Serial0/0, changed state to up
*May 15 13:39:28.223: %LINK-3-UPDOWN: Interface Virtual-Access1,
changed state to up
*May 15 13:39:28.223: Vi1 PPP: Using default call direction
*May 15 13:39:28.223: Vi1 PPP: Treating connection as a dedicated line
*May 15 13:39:28.223: Vi1 PPP: Session handle[80000008] Session id[7]
*May 15 13:39:28.223: Vi1 PPP: Authorization required
*May 15 13:39:28.643: Vi1 CHAP: O CHALLENGE id 2 len 28 from "Rack1R4"
*May 15 13:39:28.663: Vi1 CHAP: I CHALLENGE id 2 len 28 from "Rack1R2"
*May 15 13:39:28.663: Vi1 CHAP: Using hostname from unknown source
*May 15 13:39:28.667: Vi1 CHAP: Using password from AAA
*May 15 13:39:28.667: Vi1 CHAP: O RESPONSE id 2 len 28 from "Rack1R4"
*May 15 13:39:28.671: Vi1 CHAP: I RESPONSE id 2 len 28 from "Rack1R2"
*May 15 13:39:28.671: Vi1 PPP: Sent CHAP LOGIN Request
*May 15 13:39:28.675: Vi1 PPP: Received LOGIN Response PASS
*May 15 13:39:28.679: Vi1 PPP: Sent LCP AUTHOR Request
*May 15 13:39:28.679: Vi1 PPP: Sent IPCP AUTHOR Request
*May 15 13:39:28.679: Vi1 LCP: Received AAA AUTHOR Response PASS
*May 15 13:39:28.683: Vi1 IPCP: Received AAA AUTHOR Response PASS
*May 15 13:39:28.683: Vi1 CHAP: O SUCCESS id 2 len 4
*May 15 13:39:28.691: Vi1 CHAP: I SUCCESS id 2 len 4
*May 15 13:39:28.695: Vi1 PPP: Sent IPCP AUTHOR Request
*May 15 13:39:29.691: %LINEPROTO-5-UPDOWN: Line protocol on Interface
Virtual-Access1, changed state to up
```


Task 4.1

R2:
```
router eigrp 10
 no auto-summary
 network 144.1.24.2 0.0.0.0
```

R3:
```
router eigrp 10
 no auto-summary
 network 144.1.34.3 0.0.0.0
 redistribute connected route-map CONNECTED->EIGRP metric 1 1 1 1 1
!
route-map CONNECTED->EIGRP permit 10
 match interface Loopback0
```

R4:
```
router eigrp 10
 no auto-summary
 network 144.1.24.4 0.0.0.0
 network 144.1.34.4 0.0.0.0
 network 144.1.46.4 0.0.0.0
```

R6:
```
router eigrp 10
 no auto-summary
 network 54.1.10.6 0.0.0.0
 network 144.1.46.6 0.0.0.0
 redistribute connected route-map CONNECTED->EIGRP
!
route-map CONNECTED->EIGRP permit 10
 match interface Loopback0
```

Task 4.1 Verification

Verify EIGRP neighbors:

```
Rack1R6#show ip eigrp neighbors
IP-EIGRP neighbors for process 10
H   Address                 Interface       Hold Uptime   SRTT   RTO  Q  Seq
                                            (sec)         (ms)       Cnt Num
1   54.1.10.254             BV1               14 00:00:14   89   534  0  3
0   144.1.46.4              Gi0/0             12 00:00:16 1026  5000  0  15

Rack1R4#show ip eigrp neighbors
IP-EIGRP neighbors for process 10
H   Address                 Interface       Hold Uptime   SRTT   RTO  Q  Seq
                                            (sec)         (ms)       Cnt Num
2   144.1.46.6              Et0/0             13 00:00:48    1   200  0  6
1   144.1.24.2              Vi1               11 00:00:58  191  1146  0  5
0   144.1.34.3              Et0/1             14 00:01:00  525  3150  0  6
```


Verify EIGRP routes:

```
Rack1R2#show ip route eigrp
D    200.0.0.0/24 [90/4499456] via 144.1.24.4, 00:01:37, Virtual-
Access2
     54.0.0.0/24 is subnetted, 1 subnets
D       54.1.10.0 [90/4371456] via 144.1.24.4, 00:01:37, Virtual-
Access2
D    200.0.1.0/24 [90/4499456] via 144.1.24.4, 00:01:37, Virtual-
Access2
D    200.0.2.0/24 [90/4499456] via 144.1.24.4, 00:01:37, Virtual-
Access2
D    200.0.3.0/24 [90/4499456] via 144.1.24.4, 00:01:37, Virtual-
Access2
     144.1.0.0/16 is variably subnetted, 6 subnets, 2 masks
D       144.1.15.5/32 [90/4729856] via 144.1.24.4, 00:01:48, Virtual-
Access2
D       144.1.34.0/24 [90/2841600] via 144.1.24.4, 00:01:48, Virtual-
Access2
D       144.1.46.0/24 [90/2841600] via 144.1.24.4, 00:01:48, Virtual-
Access2
     150.1.0.0/24 is subnetted, 3 subnets
D EX    150.1.6.0 [170/2969600] via 144.1.24.4, 00:01:37, Virtual-
Access2
D EX    150.1.3.0 [170/2562585856] via 144.1.24.4, 00:01:48, Virtual-
Access2
```

Task 4.2

R3:

```
router rip
 version 2
 network 204.12.1.0
```

Task 4.2 Verification

Verify RIP routes at R3:

```
Rack1R3#show ip route rip
     31.0.0.0/16 is subnetted, 4 subnets
R       31.3.0.0 [120/1] via 204.12.1.254, 00:00:01, Ethernet0/1
R       31.2.0.0 [120/1] via 204.12.1.254, 00:00:01, Ethernet0/1
R       31.1.0.0 [120/1] via 204.12.1.254, 00:00:01, Ethernet0/1
R       31.0.0.0 [120/1] via 204.12.1.254, 00:00:01, Ethernet0/1
     30.0.0.0/16 is subnetted, 4 subnets
R       30.2.0.0 [120/1] via 204.12.1.254, 00:00:01, Ethernet0/1
R       30.3.0.0 [120/1] via 204.12.1.254, 00:00:01, Ethernet0/1
R       30.0.0.0 [120/1] via 204.12.1.254, 00:00:01, Ethernet0/1
R       30.1.0.0 [120/1] via 204.12.1.254, 00:00:01, Ethernet0/1
```


Task 4.3

R3:
```
router rip
 network 150.1.0.0
 network 144.1.0.0
```

Task 4.3 Verification

Confirm auto-summaries generation:
```
Rack1R3#debug ip rip
RIP protocol debugging is on
Rack1R3#
*May 14 19:22:12.107: RIP: sending v2 update to 224.0.0.9 via
Ethernet0/1 (204.12.1.3)
*May 14 19:22:12.107: RIP: build update entries
*May 14 19:22:12.107:   144.1.0.0/16 via 0.0.0.0, metric 1, tag 0
*May 14 19:22:12.107:   150.1.0.0/16 via 0.0.0.0, metric 1, tag 0
```

Task 4.4

R1:
```
router ospf 1
 network 144.1.15.1 0.0.0.0 area 0
 network 144.1.17.1 0.0.0.0 area 1
 network 150.1.1.1 0.0.0.0 area 1
```
R2:
```
router ospf 1
 network 144.1.27.2 0.0.0.0 area 1
 network 150.1.2.2 0.0.0.0 area 1
```

R5:
```
interface Serial0/0.1 multipoint
 ip ospf network point-to-point
!
router ospf 1
 network 144.1.5.5 0.0.0.0 area 0
 network 144.1.15.5 0.0.0.0 area 0
```

SW1:
```
router ospf 1
 network 144.1.17.7 0.0.0.0 area 1
 network 144.1.27.7 0.0.0.0 area 1
 network 144.1.78.7 0.0.0.0 area 1
 network 150.1.7.7 0.0.0.0 area 1
```

SW2:
```
router ospf 1
 network 144.1.78.8 0.0.0.0 area 1
 network 150.1.8.8 0.0.0.0 area 1
 network 192.10.1.8 0.0.0.0 area 51
```

SW4:
```
router ospf 1
 network 144.1.5.10 0.0.0.0 area 0
 network 150.1.10.10 0.0.0.0 area 1
```


Task 4.4 Verification

Verify OSPF adjacencies:

```
Rack1SW1#show ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
150.1.8.8         1   FULL/BDR        00:00:32    144.1.78.8      Port-channel1
150.1.2.2         1   FULL/DR         00:00:30    144.1.27.2      Vlan27
150.1.1.1         1   FULL/DR         00:00:30    144.1.17.1      Vlan17

Rack1SW2#show ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
150.1.7.7         1   FULL/DR         00:00:32    144.1.78.7      Port-channel1
192.10.1.254      1   FULL/DR         00:00:36    192.10.1.254    Vlan82

Rack1R5#show ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
150.1.1.1         0   FULL/  -        00:00:36    144.1.15.1      Serial0/0.1
150.1.10.10       1   FULL/BDR        00:00:32    144.1.5.10      Ethernet0/0

Rack1R5#show ip route ospf
     144.1.0.0/16 is variably subnetted, 7 subnets, 2 masks
O IA    144.1.17.0/24 [110/65] via 144.1.15.1, 00:16:15, Serial0/0.1
O IA    144.1.27.0/24 [110/66] via 144.1.15.1, 00:16:15, Serial0/0.1
O IA    144.1.78.0/24 [110/66] via 144.1.15.1, 00:16:15, Serial0/0.1
     150.1.0.0/16 is variably subnetted, 6 subnets, 2 masks
O IA    150.1.10.10/32 [110/11] via 144.1.5.10, 00:16:15, Ethernet0/0
O IA    150.1.8.8/32 [110/67] via 144.1.15.1, 00:16:15, Serial0/0.1
O IA    150.1.7.7/32 [110/66] via 144.1.15.1, 00:16:15, Serial0/0.1
O IA    150.1.2.2/32 [110/67] via 144.1.15.1, 00:16:15, Serial0/0.1
O IA    150.1.1.1/32 [110/65] via 144.1.15.1, 00:16:15, Serial0/0.1


Rack1SW2#show ip route ospf
     51.0.0.0/32 is subnetted, 1 subnets
O E2    51.51.51.51 [110/20] via 192.10.1.254, 00:16:29, Vlan82
     144.1.0.0/24 is subnetted, 5 subnets
O       144.1.17.0 [110/2] via 144.1.78.7, 00:17:33, Port-channel1
O       144.1.27.0 [110/2] via 144.1.78.7, 00:17:33, Port-channel1
O IA    144.1.5.0 [110/76] via 144.1.78.7, 00:17:33, Port-channel1
O IA    144.1.15.0 [110/66] via 144.1.78.7, 00:17:33, Port-channel1
     150.1.0.0/16 is variably subnetted, 5 subnets, 2 masks
O IA    150.1.10.10/32 [110/77] via 144.1.78.7, 00:16:34, Port-channel1
O       150.1.7.7/32 [110/2] via 144.1.78.7, 00:17:34, Port-channel1
O       150.1.2.2/32 [110/3] via 144.1.78.7, 00:17:34, Port-channel1
O       150.1.1.1/32 [110/3] via 144.1.78.7, 00:17:34, Port-channel1

Rack1SW2#show ip ospf database | begin Area 1

[...skipped...]

                Summary Net Link States (Area 1)
```

```
Link ID         ADV Router      Age         Seq#       Checksum
144.1.5.0       150.1.1.1       1890        0x80000001 0x00754D
144.1.15.0      150.1.1.1       1890        0x80000001 0x00A220
150.1.10.10     150.1.1.1       1103        0x80000001 0x009517
<output omitted>
```

Task 4.5

R1:

```
router ospf 1
 router-id 150.1.1.1
 area 1 virtual-link 150.1.7.7
```

SW1:

```
router ospf 1
 router-id 150.1.7.7
 area 1 virtual-link 150.1.1.1
 area 1 virtual-link 150.1.8.8
```

SW2:

```
router ospf 1
 router-id 150.1.8.8
 area 1 virtual-link 150.1.7.7
```

Task 4.5 Verification

Verify virtual-link status:

```
Rack1SW1#show ip ospf neighbor

Neighbor ID  Pri   State           Dead Time   Address         Interface
150.1.8.8      0   FULL/  -        -           144.1.78.8      OSPF_VL1
150.1.1.1      0   FULL/  -        -           144.1.17.1      OSPF_VL0
<output omitted>
```

Verify OSPF routes at R5:

```
Rack1R5#sho ip route ospf
      51.0.0.0/32 is subnetted, 1 subnets
O E2     51.51.51.51 [110/20] via 144.1.15.1, 00:04:17, Serial0/0.1
     144.1.0.0/16 is variably subnetted, 7 subnets, 2 masks
O IA     144.1.17.0/24 [110/65] via 144.1.15.1, 00:04:17, Serial0/0.1
O IA     144.1.27.0/24 [110/66] via 144.1.15.1, 00:04:17, Serial0/0.1
O IA     144.1.78.0/24 [110/66] via 144.1.15.1, 00:04:17, Serial0/0.1
O IA 192.10.1.0/24 [110/67] via 144.1.15.1, 00:04:17, Serial0/0.1
     150.1.0.0/16 is variably subnetted, 5 subnets, 2 masks
O IA     150.1.8.8/32 [110/67] via 144.1.15.1, 00:04:17, Serial0/0.1
O IA     150.1.7.7/32 [110/66] via 144.1.15.1, 00:04:17, Serial0/0.1
O IA     150.1.2.2/32 [110/67] via 144.1.15.1, 00:04:17, Serial0/0.1
O IA     150.1.1.1/32 [110/65] via 144.1.15.1, 00:04:17, Serial0/0.1
```


Task 4.6

R4:

```
router ospf 1
 network 150.1.4.4 0.0.0.0 area 4
 area 4 range 150.1.4.0 255.255.255.0
```

Task 4.7

R5:

```
router ospf 1
 redistribute connected subnets route-map CONNECTED->OSPF
!
route-map CONNECTED->OSPF permit 10
 match interface loopback0
```

Task 4.8

R4:

```
router ospf 1
 network 144.1.24.4 0.0.0.0 area 0
```

Tasks 4.6 – 4.8 Verification

Verify OSPF neighbors at R4:

```
Rack1R4#show ip ospf neighbor

Neighbor ID  Pri   State           Dead Time   Address         Interface
150.1.5.5      0   FULL/  -        00:00:37    144.1.15.5      Serial0/1
```

Verify /24 prefix generation for Loopback0 at R4:

```
Rack1R4#show ip ospf database summary self-originate

            OSPF Router with ID (150.1.4.4) (Process ID 1)

                Summary Net Link States (Area 0)

  LS age: 58
  Options: (No TOS-capability, DC, Upward)
  LS Type: Summary Links(Network)
  Link State ID: 150.1.4.0 (summary Network Number)
  Advertising Router: 150.1.4.4
  LS Seq Number: 80000001
  Checksum: 0x2ED2
  Length: 28
  Network Mask: /24
        TOS: 0  Metric: 1

<output omitted>
```

Verify route to R5 Loopback0:

```
Rack1R4#show ip route ospf | inc 150.1.
     150.1.0.0/16 is variably subnetted, 8 subnets, 2 masks
```

```
O E2    150.1.5.0/24 [110/20] via 144.1.15.5, 00:01:50, Serial0/1
O IA    150.1.8.8/32 [110/131] via 144.1.15.5, 00:01:50, Serial0/1
O IA    150.1.7.7/32 [110/130] via 144.1.15.5, 00:01:50, Serial0/1
O IA    150.1.2.2/32 [110/131] via 144.1.15.5, 00:01:50, Serial0/1
O IA    150.1.1.1/32 [110/129] via 144.1.15.5, 00:01:50, Serial0/1
```

Task 4.9

R5:

```
ip nat inside source list 1 interface Loopback0 overload
!
interface Loopback0
 ip nat outside
!
interface Ethernet0/1
 ip nat inside
!
access-list 1 permit 144.1.55.0 0.0.0.255
access-list 100 permit ip host 144.1.55.5 any
!
route-map POLICY permit 10
 match ip address 100
 set interface Loopback0
!
ip local policy route-map POLICY
```

Task 4.9 Verification

Verify NAT:

```
Rack1R5#debug ip nat detailed
IP NAT detailed debugging is on

Rack1R5#ping 144.1.78.7 source ethernet 0/1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 144.1.78.7, timeout is 2 seconds:
Packet sent with a source address of 144.1.55.5
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 60/62/68 ms

Rack1R5#
*May 20 19:36:12.007: NAT: creating portlist proto 1 globaladdr 150.1.5.5
*May 20 19:36:12.007: NAT: Allocated Port for 144.1.55.5 -> 150.1.5.5: wanted 5
got 5
*May 20 19:36:12.007: NAT: i: icmp (144.1.55.5, 5) -> (144.1.78.7, 5) [22]
*May 20 19:36:12.007: NAT: s=144.1.55.5->150.1.5.5, d=144.1.78.7 [22]
*May 20 19:36:12.071: NAT: i: icmp (144.1.55.5, 5) -> (144.1.78.7, 5) [23]
*May 20 19:36:12.071: NAT: s=144.1.55.5->150.1.5.5, d=144.1.78.7 [23]
*May 20 19:36:12.131: NAT: i: icmp (144.1.55.5, 5) -> (144.1.78.7, 5) [24]
*May 20 19:36:12.131: NAT: s=144.1.55.5->150.1.5.5, d=144.1.78.7 [24]
*May 20 19:36:12.191: NAT: i: icmp (144.1.55.5, 5) -> (144.1.78.7, 5) [25]
*May 20 19:36:12.191: NAT: s=144.1.55.5->150.1.5.5, d=144.1.78.7 [25]
*May 20 19:36:12.251: NAT: i: icmp (144.1.55.5, 5) -> (144.1.78.7, 5) [26]
*May 20 19:36:12.255: NAT: s=144.1.55.5->150.1.5.5, d=144.1.78.7 [26]

Rack1R5#show ip nat translations
Pro Inside global     Inside local       Outside local      Outside global
```

```
icmp 150.1.5.5:6        144.1.55.5:6        144.1.78.7:6    144.1.78.7:6
```

Task 4.10

R3:

```
router eigrp 10
 redistribute rip metric 1 1 1 1 1

route-map CONNECTED->EIGRP permit 20
 match interface Ethernet0/1
```

Task 4.11

R2:

```
router eigrp 10
 redistribute ospf 1 metric 1 1 1 1 1
!
router ospf 1
 redistribute eigrp 10 subnets
 distance ospf external 171
```

R4:

```
router eigrp 10
 redistribute ospf 1 metric 1 1 1 1 1
!
router ospf 1
 distance ospf external 171
```

Task 4.12

SW1:

```
interface Vlan27
 ip ospf cost 65535
```

Task 4.13

R2:

```
router ospf 1
 redistribute eigrp 10 subnets route-map TAG
!
router eigrp 10
 redistribute ospf 1 metric 1 1 1 1 1 route-map DENY_TAG
!
route-map TAG permit 10
 match tag 1
 set tag 1
!
route-map TAG permit 20
!
route-map DENY_TAG deny 10
 match tag 1
!
route-map DENY_TAG permit 20
```

R3:

```
router eigrp 10
```



```
 redistribute rip metric 1 1 1 1 1 route-map TAG
!
route-map TAG permit 10
 set tag 1
```

R4:

```
router ospf 1
 redistribute eigrp 10 subnets route-map TAG
!
router eigrp 10
 redistribute ospf 1 metric 1 1 1 1 1 route-map DENY_TAG
!
route-map TAG permit 10
 match tag 1
 set tag 1
!
route-map TAG permit 20
!
route-map DENY_TAG deny 10
 match tag 1
!
route-map DENY_TAG permit 20
```

Task 4.10 - 4.13 Verification

Confirm that OSPF routers prefer to reach external prefixes via R4:

```
Rack1R1#show ip route 200.0.3.0
Routing entry for 200.0.3.0/24
  Known via "ospf 1", distance 110, metric 20, type extern 2, forward
metric 128
  Last update from 144.1.15.5 on Serial0/0.1, 00:01:01 ago
  Routing Descriptor Blocks:
  * 144.1.15.5, from 150.1.4.4, 00:01:01 ago, via Serial0/0.1
      Route metric is 20, traffic share count is 1
```

Confirm that R1 has two paths to reach external prefix:

```
Rack1R1#show ip ospf database external 200.0.3.0

            OSPF Router with ID (150.1.1.1) (Process ID 1)

                Type-5 AS External Link States

  LS age: 578
  Options: (No TOS-capability, DC)
  LS Type: AS External Link
  Link State ID: 200.0.3.0 (External Network Number )
  Advertising Router: 150.1.2.2
  LS Seq Number: 80000001
  Checksum: 0x2712
  Length: 36
  Network Mask: /24
        Metric Type: 2 (Larger than any link state path)
        TOS: 0
        Metric: 20
```

```
        Forward Address: 0.0.0.0
        External Route Tag: 0

  Routing Bit Set on this LSA
  LS age: 511
  Options: (No TOS-capability, DC)
  LS Type: AS External Link
  Link State ID: 200.0.3.0 (External Network Number )
  Advertising Router: 150.1.4.4
  LS Seq Number: 80000001
  Checksum: 0xD28
  Length: 36
  Network Mask: /24
        Metric Type: 2 (Larger than any link state path)
        TOS: 0
        Metric: 20
        Forward Address: 0.0.0.0
        External Route Tag: 0
```

Compare forwarding metric for two ASBRS (R4 and R2):

```
Rack1R1#show ip ospf border-routers

OSPF Process 1 internal Routing Table

Codes: i - Intra-area route, I - Inter-area route

i 150.1.5.5 [64] via 144.1.15.5, Serial0/0.1, ASBR, Area 0, SPF 11
I 192.10.1.254 [3] via 144.1.17.7, FastEthernet0/0, ASBR, Area 0, SPF
11
i 150.1.2.2 [65536] via 144.1.17.7, FastEthernet0/0, ASBR, Area 1, SPF
10
i 150.1.7.7 [1] via 144.1.17.7, FastEthernet0/0, ABR, Area 0, SPF 11
i 150.1.7.7 [1] via 144.1.17.7, FastEthernet0/0, ABR, Area 1, SPF 10
i 150.1.8.8 [2] via 144.1.17.7, FastEthernet0/0, ABR, Area 0, SPF 11
i 150.1.8.8 [2] via 144.1.17.7, FastEthernet0/0, ABR, Area 1, SPF 10
i 150.1.4.4 [128] via 144.1.15.5, Serial0/0.1, ABR/ASBR, Area 0, SPF 11
```

Next, confirm that R2 and R4 prefer to reach RIP prefixes via EIGRP domain:

```
Rack1R2#sh ip route | inc 30|31
     31.0.0.0/16 is subnetted, 4 subnets
D EX    31.3.0.0 [170/2562585856] via 144.1.24.4, 00:13:02, Virtual-
Access2
D EX    31.2.0.0 [170/2562585856] via 144.1.24.4, 00:13:02, Virtual-
Access2
D EX    31.1.0.0 [170/2562585856] via 144.1.24.4, 00:13:02, Virtual-
Access2
D EX    31.0.0.0 [170/2562585856] via 144.1.24.4, 00:13:02, Virtual-
Access2
O IA    150.1.4.0/24 [110/131] via 144.1.27.7, 00:02:13,
FastEthernet0/0
     30.0.0.0/16 is subnetted, 4 subnets
D EX    30.2.0.0 [170/2562585856] via 144.1.24.4, 00:13:02, Virtual-
Access2
```



```
D EX    30.3.0.0 [170/2562585856] via 144.1.24.4, 00:13:02, Virtual-
Access2
D EX    30.0.0.0 [170/2562585856] via 144.1.24.4, 00:13:02, Virtual-
Access2
D EX    30.1.0.0 [170/2562585856] via 144.1.24.4, 00:13:02, Virtual-
Access2
```

```
Rack1R4#sh ip route | inc 30|31
O IA    144.1.78.0/24 [110/130] via 144.1.15.5, 00:13:18, Serial0/1
O IA 192.10.1.0/24 [110/131] via 144.1.15.5, 00:13:18, Serial0/1
     31.0.0.0/16 is subnetted, 4 subnets
D EX    31.3.0.0 [170/2560025856] via 144.1.34.3, 00:13:23, Ethernet0/1
D EX    31.2.0.0 [170/2560025856] via 144.1.34.3, 00:13:23, Ethernet0/1
D EX    31.1.0.0 [170/2560025856] via 144.1.34.3, 00:13:23, Ethernet0/1
D EX    31.0.0.0 [170/2560025856] via 144.1.34.3, 00:13:23, Ethernet0/1
O IA    150.1.8.8/32 [110/131] via 144.1.15.5, 00:13:18, Serial0/1
O IA    150.1.7.7/32 [110/130] via 144.1.15.5, 00:13:18, Serial0/1
     30.0.0.0/16 is subnetted, 4 subnets
D EX    30.2.0.0 [170/2560025856] via 144.1.34.3, 00:13:23, Ethernet0/1
D EX    30.3.0.0 [170/2560025856] via 144.1.34.3, 00:13:23, Ethernet0/1
D EX    30.0.0.0 [170/2560025856] via 144.1.34.3, 00:13:23, Ethernet0/1
D EX    30.1.0.0 [170/2560025856] via 144.1.34.3, 00:13:23, Ethernet0/1
```

Finally, verify full internal connectivity with the following Tcl script:

```
foreach i {
144.1.17.1
144.1.15.1
150.1.1.1
144.1.27.2
144.1.24.2
150.1.2.2
144.1.34.3
204.12.1.3
150.1.3.3
144.1.46.4
144.1.34.4
144.1.24.4
150.1.4.4
144.1.5.5
144.1.15.5
150.1.5.5
144.1.46.6
54.1.10.6
150.1.6.6
144.1.17.7
144.1.27.7
144.1.78.7
150.1.7.7
192.10.1.8
144.1.78.8
150.1.8.8
144.1.5.10
150.1.10.10
} { ping $i }
```


Note that VLAN55 is not a part of any IGP, and thereby is excluded from test.

Task 4.14

R1:

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

Task 4.14 Verification

Verify default route:

```
Rack1R5#show ip route 0.0.0.0
Routing entry for 0.0.0.0/0, supernet
  Known via "ospf 1", distance 110, metric 1, candidate default path
  Tag 1, type extern 2, forward metric 64
  Last update from 144.1.15.1 on Serial0/0.1, 00:00:00 ago
  Routing Descriptor Blocks:
  * 144.1.15.1, from 150.1.1.1, 00:00:00 ago, via Serial0/0.1
      Route metric is 1, traffic share count is 1
      Route tag 1
```

Task 5.1

R1:

```
router bgp 200
 neighbor 144.1.15.5 remote-as 200
 neighbor 144.1.15.5 route-reflector-client
 neighbor 144.1.27.2 remote-as 200
 neighbor 144.1.27.2 route-reflector-client
 neighbor 144.1.78.8 remote-as 200
 neighbor 144.1.78.8 route-reflector-client
```

R2:

```
router bgp 200
 neighbor 144.1.24.4 remote-as 100
 neighbor 144.1.17.1 remote-as 200
```

R3:

```
router bgp 100
 neighbor 204.12.1.254 remote-as 54
 neighbor 144.1.34.4 remote-as 100
```

R4:

```
router bgp 100
 neighbor 144.1.24.2 remote-as 200
 neighbor 144.1.15.5 remote-as 200
 neighbor 144.1.15.5 ebgp-multihop
 neighbor 144.1.34.3 remote-as 100
 neighbor 144.1.34.3 route-reflector-client
 neighbor 144.1.46.6 remote-as 100
 neighbor 144.1.46.6 route-reflector-client
```

R5:

```
router bgp 200
```



```
 neighbor 144.1.24.4 remote-as 100
 neighbor 144.1.24.4 ebgp-multihop
 neighbor 144.1.24.4 route-map LOCAL_PREFERENCE in
 neighbor 144.1.15.1 remote-as 200
 neighbor 144.1.15.1 next-hop-self
!
route-map LOCAL_PREFERENCE permit 10
 set local-preference 200
```

R6:

```
router bgp 100
 neighbor 54.1.10.254 remote-as 54
 neighbor 144.1.46.4 remote-as 100
```

SW2:

```
router bgp 200
 neighbor 144.1.17.1 remote-as 200
 no auto-summary
```

Task 5.1 Verification

Verify BGP neighbors:

```
Rack1R4#sh ip bgp summary  | beg Nei
Neighbor        V AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd
144.1.15.5      4 200      19       21       11    0    0 00:15:21        0
144.1.24.2      4 200      22       21       11    0    0 00:16:17        0
144.1.34.3      4 100      23       21       11    0    0 00:16:04       10
144.1.46.6      4 100      18       20       11    0    0 00:14:52        0

Rack1R1#sh ip bgp summary | beg Nei
Neighbor        V AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd
144.1.15.5      4 200      27       28       21    0    0 00:21:32       10
144.1.27.2      4 200      31       29       21    0    0 00:23:19        0
144.1.78.8      4 200       4        6       21    0    0 00:00:29        0

Rack1R3#show ip bgp summary | beg Nei
Neighbor        V AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd
144.1.34.4      4 100      28       30       11    0    0 00:23:23        0
204.12.1.254    4  54      31       27       11    0    0 00:23:31       10

Rack1R6#show ip bgp summary | beg Nei
Neighbor        V AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd
54.1.10.254     4 54       9        8       21    0    0 00:01:08       10
144.1.46.4      4 100     33       35       21    0    0 00:27:46       10

Rack1R3#show ip bgp  summary  | beg Nei
Neighbor        V AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd
144.1.34.4      4 100      34       36       11    0    0 00:29:26        0
204.12.1.254    4  54      37       33       11    0    0 00:29:33       10
```

Confirm that SW1 can reach external BGP prefixes by the virtue of default route originated at R1:

```
Rack1R1#sh ip bgp
BGP table version is 31, local router ID is 150.1.1.1
Status codes: s suppressed, d damped, h history, * valid, > best, i -
internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
*>i28.119.16.0/24   144.1.15.5               0    200      0 100 54 i
*>i28.119.17.0/24   144.1.15.5               0    200      0 100 54 i
*>i112.0.0.0        144.1.15.5               0    200      0 100 54 50 60 i
*>i113.0.0.0        144.1.15.5               0    200      0 100 54 50 60 i
<output omitted>

Rack1SW1#traceroute 28.119.16.1

Type escape sequence to abort.
Tracing the route to 28.119.16.1

  1 144.1.17.1 0 msec 0 msec 0 msec
  2 144.1.15.5 32 msec 28 msec 28 msec
  3 144.1.24.4 44 msec 44 msec 40 msec
  4 144.1.34.3 44 msec 40 msec 44 msec
  5 204.12.1.254 44 msec *  44 msec
```


Task 1.1

Fault1 : Wrong interface on SW1 - Fa0/2 (should be Fa0/3)
Fault2 : Wrong mask of IP address on Fa0/21 of SW3 (should be /24)

Task 2.1

SW1:

```
interface FastEthernet0/13
 shutdown
!
interface FastEthernet0/14
 shutdown
!
interface FastEthernet0/15
 shutdown
!
interface FastEthernet0/16
 shutdown
!
interface FastEthernet0/17
 shutdown
!
interface FastEthernet0/18
 shutdown
!
interface FastEthernet0/19
 switchport trunk encapsulation isl
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet0/20
 shutdown
!
interface FastEthernet0/21
 shutdown
```

SW2:

```
interface FastEthernet0/13
 shutdown
!
interface FastEthernet0/14
 shutdown
!
interface FastEthernet0/15
 shutdown
!
interface FastEthernet0/16
 switchport trunk encapsulation isl
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet0/17
 shutdown
!
interface FastEthernet0/18
```



```
 shutdown
!
interface FastEthernet0/19
 shutdown
!
interface FastEthernet0/20
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet0/21
 shutdown
```

SW3:

```
interface FastEthernet0/13
 shutdown
!
interface FastEthernet0/14
 shutdown
!
interface FastEthernet0/15
 shutdown
!
interface FastEthernet0/16
 switchport trunk encapsulation isl
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet0/17
 shutdown
!
interface FastEthernet0/18
 shutdown
!
interface FastEthernet0/19
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
```

SW4:

```
interface FastEthernet0/13
 switchport trunk encapsulation isl
 switchport mode trunk
 switchport nonegotiate
!
interface FastEthernet0/15
 shutdown
!
interface FastEthernet0/16
 shutdown
!
interface FastEthernet0/17
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
!
```



```
interface FastEthernet0/18
shutdown
!

interface FastEthernet0/19
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
```

Task 2.1 Verification

```
Rack1SW1#show cdp neighbors | include SW4
Rack1SW4         Fas 0/19         168       S I      WS-C3560-2Fas 0/13
Rack1SW4         Fas 0/21         168       S I      WS-C3560-2Fas 0/15
Rack1SW4         Fas 0/20         168       S I      WS-C3560-2Fas 0/14

Rack1SW1#show interfaces trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/19      on           isl            trunking      1

[...skipped...]


Rack1SW2#show cdp neighbors | include SW3
Rack1SW3         Fas 0/16         172       S I      WS-C3560-2Fas 0/16
Rack1SW3         Fas 0/18         172       S I      WS-C3560-2Fas 0/18
Rack1SW3         Fas 0/17         172       S I      WS-C3560-2Fas 0/17


Rack1SW2#show cdp neighbors | include SW4
Rack1SW4         Fas 0/20         168       S I      WS-C3560-2Fas 0/17
Rack1SW4         Fas 0/21         168       S I      WS-C3560-2Fas 0/18
Rack1SW4         Fas 0/19         168       S I      WS-C3560-2Fas 0/16

Rack1SW2#show interfaces trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/16      on           isl            trunking      1
Fa0/20      on           802.1q         trunking      1

[...skipped...]

Rack1SW3#show cdp neighbors | include SW4
Rack1SW4         Fas 0/20         121        S I      WS-C3560-2Fas 0/20
Rack1SW4         Fas 0/21         141        S I      WS-C3560-2Fas 0/21
Rack1SW4         Fas 0/19         121        S I      WS-C3560-2Fas 0/19

Rack1SW3#show interfaces trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/16      on           isl            trunking      1
Fa0/20      on           802.1q         trunking      1

[...skipped...]
```


Task 2.2

SW1:
```
vtp domain IECWB
!
vlan 7,8,28,34,46,53,58,100
!
interface FastEthernet0/1
 switchport access vlan 100
!
interface FastEthernet0/5
 switchport access vlan 53
```

SW2:
```
vtp domain IECWB
!
interface FastEthernet0/2
 switchport access vlan 28
!
interface FastEthernet0/4
 switchport access vlan 46
!
interface FastEthernet0/6
 switchport access vlan 46
!
interface FastEthernet0/24
 switchport access vlan 100
```

SW3:
```
vtp domain IECWB
!
interface FastEthernet0/3
 switchport access vlan 34
!
interface FastEthernet0/4
!
interface FastEthernet0/5
 switchport access vlan 58
!
interface FastEthernet0/20
 switchport access vlan 53
!
interface FastEthernet0/24
 switchport access vlan 53
```

SW4:
```
vtp domain IECWB
!
interface FastEthernet0/4
 switchport access vlan 34
!
interface FastEthernet0/21
 switchport access vlan 53
```

Task 2.3

SW4:


```
spanning-tree vlan 7,8,28,34,46,53,58,100 priority 0
```

SW2:

```
interface FastEthernet0/20
 spanning-tree cost 100
```

Task 2.3 Verification

```
Rack1SW4#show spanning-tree summary
Switch is in pvst mode
Root bridge for: VLAN0007-VLAN0008, VLAN0028, VLAN0034, VLAN0046,
VLAN0053,  VLAN0058, VLAN0100

[...skipped...]
```

Confirm that Sw2 interface to Sw4 is blocked by STP for configured vlans:

```
Rack1SW2#show cdp neighbors f0/20
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
                  S - Switch, H - Host, I - IGMP, r - Repeater, P -
Phone

Device ID            Local Intrfce         Holdtme   Capability
Platform   Port ID
Rack1SW4            Fas 0/20              171            S I      WS-
C3560-2Fas 0/17

Rack1SW2#show spanning-tree interface f0/20

Vlan              Role Sts Cost      Prio.Nbr Type
----------------- ---- --- --------- -------- --------------------------
------
VLAN0001          Altn BLK 100       128.22   P2p
VLAN0007          Altn BLK 100       128.22   P2p
VLAN0008          Altn BLK 100       128.22   P2p
VLAN0028          Altn BLK 100       128.22   P2p
VLAN0034          Altn BLK 100       128.22   P2p
VLAN0046          Altn BLK 100       128.22   P2p
VLAN0053          Altn BLK 100       128.22   P2p
VLAN0058          Altn BLK 100       128.22   P2p
VLAN0100          Altn BLK 100       128.22   P2p
```

Task 2.4

SW4:

```
vtp pruning
!
interface FastEthernet0/13
 switchport trunk pruning vlan 2-57,59-1001
```

Task 2.4 Verification

```
Rack1SW4#show vtp status
VTP Version                     : 2
Configuration Revision          : 8
```



```
Maximum VLANs supported locally : 1005
Number of existing VLANs        : 13
VTP Operating Mode              : Server
VTP Domain Name                 : IECWB
VTP Pruning Mode                : Enabled
VTP V2 Mode                     : Disabled
VTP Traps Generation            : Disabled
MD5 digest                      : 0x76 0x7D 0x65 0xA1 0xDE 0x81 0xC0
0x93
Configuration last modified by 204.12.1.10 at 3-1-93 05:11:30
Local updater ID is 204.12.1.10 on interface Fa0/20 (first layer3
interface found)

Rack1SW4#show interfaces f0/17 trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/17      on           802.1q         trunking      1

Port        Vlans allowed on trunk
Fa0/17      1-4094

Port        Vlans allowed and active in management domain
Fa0/17      1,7-8,28,34,46,53,58,100

Port        Vlans in spanning tree forwarding state and not pruned
Fa0/17      1

Rack1SW4#show interfaces f0/19 trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/19      on           802.1q         trunking      1

Port        Vlans allowed on trunk
Fa0/19      1-4094

Port        Vlans allowed and active in management domain
Fa0/19      1,7-8,28,34,46,53,58,100

Port        Vlans in spanning tree forwarding state and not pruned
Fa0/19      1,8,28,34,46,53,58,100

Rack1SW4#show interfaces f0/13 trunk

Port        Mode         Encapsulation  Status        Native vlan
Fa0/13      on           isl            trunking      1

Port        Vlans allowed on trunk
Fa0/13      1-4094

Port        Vlans allowed and active in management domain
Fa0/13      1,7-8,28,34,46,53,58,100

Port        Vlans in spanning tree forwarding state and not pruned
Fa0/13      1,7,53,58,100


Rack1SW4#show interfaces f0/13 switchport | include Pruning
```

```
Pruning VLANs Enabled: 2-57,59-1001
```

Task 3.1

R1:

```
interface Serial0/0
 encapsulation frame-relay
!
interface Serial0/0.1 point-to-point
 ip address 137.1.15.1 255.255.255.0
 frame-relay interface-dlci 105
```

R5:

```
interface Serial0/0
 encapsulation frame-relay
!
interface Serial0/0.1 point-to-point
 ip address 137.1.15.5 255.255.255.0
 frame-relay interface-dlci 501
```

Task 3.1 Verification

Verify L3 to L2 mappings:

```
Rack1R5#show frame-relay map
Serial0/0.1 (up): point-to-point dlci, dlci 501(0x1F5,0x7C50),
broadcast
          status defined, active

Rack1R1#show frame-relay map
Serial0/0.1 (up): point-to-point dlci, dlci 105(0x69,0x1890), broadcast
          status defined, active
```

Confirm connectivity:

```
Rack1R1#ping 137.1.15.5

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 137.1.15.5, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 56/58/60 ms
```

Task 3.2

R2:

```
interface Serial0/0
 encapsulation frame-relay
 ip address 137.1.25.2 255.255.255.0
 frame-relay map ip 137.1.25.5 205 broadcast
 no frame-relay inverse-arp
```

R5:

```
interface Serial0/0.2 multipoint
 ip address 137.1.25.5 255.255.255.0
 frame-relay map ip 137.1.25.2 502 broadcast
```


Task 3.2 Verification

Verify L3 to L2 mappings:

```
Rack1R5#show frame-relay map
Serial0/0.2 (up): ip 137.1.25.2 dlci 502(0x1F6,0x7C60), static,
              broadcast,
              CISCO, status defined, active
Serial0/0.1 (up): point-to-point dlci, dlci 501(0x1F5,0x7C50),
broadcast
          status defined, active

Rack1R2#show frame-relay map
Serial0/0 (up): ip 137.1.25.5 dlci 205(0xCD,0x30D0), static,
              broadcast,
              CISCO, status defined, active
```

Confirm connectivity:

```
Rack1R2#ping 137.1.25.5

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 137.1.25.5, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 56/57/60 ms
```

Task 3.3

R4:

```
interface Serial0/0
 encapsulation frame-relay
 ip address 137.1.45.4 255.255.255.0
 no frame-relay inverse-arp ip 401
 no frame-relay inverse-arp ip 402
 no frame-relay inverse-arp ip 403
 no frame-relay inverse-arp ip 413
```

R5:

```
interface Serial0/0.4 multipoint
 ip address 137.1.45.5 255.255.255.0
 frame-relay interface-dlci 504
```


Task 3.3 Verification

Verify L3 to L2 mapping:

```
Rack1R4#show frame-relay map
Serial0/0 (up): ip 137.1.45.5 dlci 405(0x195,0x6450), dynamic,
              broadcast,, status defined, active

Rack1R5#show frame-relay map
Serial0/0.2 (up): ip 137.1.25.2 dlci 502(0x1F6,0x7C60), static,
              broadcast,
              CISCO, status defined, active
Serial0/0.4 (up): ip 137.1.45.4 dlci 504(0x1F8,0x7C80), dynamic,
              broadcast,, status defined, active
Serial0/0.1 (up): point-to-point dlci, dlci 501(0x1F5,0x7C50),
broadcast
          status defined, active
```

Confirm connectivity:

```
Rack1R4#ping ip 137.1.45.5

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 137.1.45.5, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 56/59/60 ms
```

Task 3.4

R6:

```
interface Serial0/0/0
 encapsulation frame-relay
 ip address 54.1.1.6 255.255.255.0
 no frame-relay inverse-arp ip 51
 no frame-relay inverse-arp ip 100
 no frame-relay inverse-arp ip 201
 no frame-relay inverse-arp ip 301
 no frame-relay inverse-arp ip 401
```

Task 3.4 Verification

Verify L3 to L2 mapping:

```
Rack1R6#show frame-relay map
Serial0/0/0 (up): ip 54.1.1.254 dlci 101(0x65,0x1850), dynamic,
              broadcast,, status defined, active
```

Confirm connectivity:

```
Rack1R6#ping 54.1.1.254

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 54.1.1.254, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 28/31/32 ms
```


Task 3.5

R4:

```
bridge 1 protocol ieee
bridge irb
bridge 1 route ip
!
interface Serial0/1
 encapsulation ppp
 bridge-group 1
!
interface BVI1
 ip address 137.1.54.4 255.255.255.0
```

R5:

```
bridge 1 protocol ieee
bridge irb
bridge 1 route ip
!
interface Serial0/1
 clock rate 64000
 encapsulation ppp
 bridge-group 1
!
interface BVI1
 ip address 137.1.54.5 255.255.255.0
```

Task 3.5 Verification

Confirm that no IPCP is running, just BCP:

```
Rack1R4#show int serial0/1 | in (Encap|Open)
  Encapsulation PPP, LCP Open
  Open: CDPCP, BCP, loopback not set
```

Confirm connectivity:

```
Rack1R5#ping 137.1.54.4

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 137.1.54.4, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 36/36/36 ms
```

Verify bridging table:

```
Rack1R5#show bridge 1 verbose

Total of 300 station blocks, 299 free
Codes: P - permanent, S - self

BG Hash      Address      Action  Interface   VC  Age   RX count   TX
count
 1 1B/0   0000.0ca3.1308 forward  Serial0/1    -   0     10         9

Flood ports (BG 1)           RX count    TX count
```

```
Serial0/1                               0            0
```

Task 3.6

R1:

```
bridge 1 protocol ieee
bridge irb
bridge 1 route ip
!
interface Serial0/1
 bridge-group 1
!
interface BVI1
 ip address 137.1.12.1 255.255.255.0
```

R2:

```
bridge 1 protocol ieee
bridge irb
bridge 1 route ip
!
interface Serial0/1
 bridge-group 1
!
interface BVI1
 ip address 137.1.12.2 255.255.255.0
```

R3:

```
bridge 1 protocol ieee
bridge crb
!
interface Serial1/2
 clock rate 64000
 bridge-group 1
!
interface Serial1/3
 clock rate 64000
 bridge-group 1
```


Task 3.6 Verification

Confirm connectivity:

```
Rack1R1#ping 137.1.12.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 137.1.12.2, timeout is 2 seconds:
.!!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 64/66/68 ms
```

Verify bridging table at R3:

```
Rack1R3#show bridge 1 verbose

Total of 300 station blocks, 298 free
Codes: P - permanent, S - self

BG Hash      Address      Action  Interface   VC Age RX count TX count
 1 18/0   0000.0cbf.dcc4 forward  Serial1/2    -  0     5          5
 1 9A/0   0000.0c89.36ac forward  Serial1/3    -  0     5          4

Flood ports (BG 1)           RX count    TX count
Serial1/2                           0           0
Serial1/3                           0           0
```

Task 4.1

R4:

```
router rip
 version 2
 no auto-summary
 network 137.1.0.0
 passive-interface default
 no passive-interface BVI1
 no passive-interface Ethernet0/0
```

R5:

```
router rip
 version 2
 no auto-summary
 network 137.1.0.0
 network 204.12.1.0
 passive-interface default
 no passive-interface BVI1
 no passive-interface Ethernet0/0
```

R6:

```
router rip
 version 2
 no auto-summary
 network 137.1.0.0
```

SW3:

```
ip routing
!
```



```
router rip
 version 2
 network 150.1.0.0
 network 204.12.1.0
 no auto-summary
```

SW4:

```
ip routing
!
router rip
 version 2
 network 150.1.0.0
 network 204.12.1.0
 no auto-summary
```

Task 4.1 Verification

Verify RIP configuration at R4 and R5:

```
Rack1R4#show ip protocols
Routing Protocol is "rip"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Sending updates every 30 seconds, next due in 10 seconds
  Invalid after 180 seconds, hold down 180, flushed after 240
  Redistributing: rip
  Default version control: send version 2, receive version 2
    Interface             Send  Recv  Triggered RIP  Key-chain
    Ethernet0/0           2     2
    BVI1                  2     2
  Automatic network summarization is not in effect
  Maximum path: 4
  Routing for Networks:
    137.1.0.0
  Passive Interface(s):
    Serial0/0
    Ethernet0/1
    Serial0/1
    Loopback0
    VoIP-Null0
  Routing Information Sources:
    Gateway         Distance      Last Update
    137.1.45.5            120      00:06:38
    Gateway         Distance      Last Update
    137.1.54.5            120      00:00:13
  Distance: (default is 120)

Rack1R5#sh ip protocols
Routing Protocol is "rip"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Sending updates every 30 seconds, next due in 25 seconds
  Invalid after 180 seconds, hold down 180, flushed after 240
  Redistributing: rip
  Default version control: send version 2, receive version 2
    Interface             Send  Recv  Triggered RIP  Key-chain
```



```
    Ethernet0/0             2     2
    BVI1                    2     2
  Automatic network summarization is not in effect
  Maximum path: 4
  Routing for Networks:
    137.1.0.0
    204.12.1.0
  Passive Interface(s):
    Serial0/0
    Serial0/0.1
    Serial0/0.2
    Serial0/0.4
    Ethernet0/1
    Serial0/1
    Loopback0
  Passive Interface(s):
    VoIP-Null0
  Routing Information Sources:
    Gateway         Distance      Last Update
    204.12.1.254         120      00:00:16
    137.1.54.4           120      00:00:07
    204.12.1.9           120      00:00:02
    204.12.1.10          120      00:00:01
  Distance: (default is 120)


Rack1R5#show ip route rip
     137.1.0.0/24 is subnetted, 7 subnets
R       137.1.46.0 [120/1] via 137.1.54.4, 00:00:12, BVI1
R       137.1.34.0 [120/1] via 137.1.54.4, 00:00:12, BVI1
     31.0.0.0/16 is subnetted, 4 subnets
R       31.3.0.0 [120/1] via 204.12.1.254, 00:00:15, Ethernet0/0
R       31.2.0.0 [120/1] via 204.12.1.254, 00:00:15, Ethernet0/0
R       31.1.0.0 [120/1] via 204.12.1.254, 00:00:15, Ethernet0/0
R       31.0.0.0 [120/1] via 204.12.1.254, 00:00:15, Ethernet0/0
     150.1.0.0/24 is subnetted, 3 subnets
R       150.1.10.0 [120/1] via 204.12.1.10, 00:00:03, Ethernet0/0
R       150.1.9.0 [120/1] via 204.12.1.9, 00:00:03, Ethernet0/0
     30.0.0.0/16 is subnetted, 4 subnets
R       30.2.0.0 [120/1] via 204.12.1.254, 00:00:15, Ethernet0/0
R       30.3.0.0 [120/1] via 204.12.1.254, 00:00:15, Ethernet0/0
R       30.0.0.0 [120/1] via 204.12.1.254, 00:00:15, Ethernet0/0
R       30.1.0.0 [120/1] via 204.12.1.254, 00:00:15, Ethernet0/0
```

Task 4.2

R3:

```
router eigrp 10
 no auto-summary
 network 137.1.34.3 0.0.0.0
 network 137.1.37.3 0.0.0.0
```

R4:

```
router eigrp 10
 no auto-summary
 network 137.1.34.4 0.0.0.0
```


SW1:

```
ip routing
!
router eigrp 10
 no auto-summary
 network 137.1.37.7 0.0.0.0
```

Task 4.2 Verification

Verify EIGRP neighbors:

```
Rack1R3#show ip eigrp neighbors
IP-EIGRP neighbors for process 10
H   Address                 Interface       Hold Uptime   SRTT   RTO  Q  Seq
                                            (sec)         (ms)       Cnt Num
1   137.1.37.7              Et0/0             14 00:00:14    3   200  0  2
0   137.1.34.4              Et0/1             13 00:00:29    4   200  0  3
```

Task 4.3

R3:

```
router eigrp 10
 network 150.1.3.3 0.0.0.0
```

R4:

```
router eigrp 10
 distance 170 0.0.0.0 255.255.255.255 1
!
access-list 1 permit 150.1.3.0
access-list 1 permit 150.1.7.0
```

SW1:

```
router eigrp 10
 network 150.1.7.7 0.0.0.0
```

Task 4.3 Verification

Verify EIGRP routes at R4:

```
Rack1R4#show ip route eigrp
     137.1.0.0/24 is subnetted, 8 subnets
D       137.1.37.0 [90/307200] via 137.1.34.3, 00:00:19, Ethernet0/1
     150.1.0.0/24 is subnetted, 3 subnets
D       150.1.7.0 [170/435200] via 137.1.34.3, 00:00:19, Ethernet0/1
D       150.1.3.0 [170/409600] via 137.1.34.3, 00:00:19, Ethernet0/1
```


Task 4.4

```
R6:
key chain EIGRP
 key 1
  key-string CISCO
!
interface Serial0/0/0
 ip authentication mode eigrp 10 md5
 ip authentication key-chain eigrp 10 EIGRP
!
router eigrp 10
 no auto-summary
 network 54.1.1.6 0.0.0.0
 redistribute connected metric 1 1 1 1 1 route-map CONNECTED->EIGRP
!
route-map CONNECTED->EIGRP permit 10
 match interface Loopback0
```

Task 4.4 Verification

Verify EIGRP neighbors:

```
Rack1R6#show ip eigrp neighbors
IP-EIGRP neighbors for process 10
H   Address                 Interface       Hold Uptime   SRTT   RTO  Q  Seq
                                            (sec)         (ms)       Cnt Num
0   54.1.1.254              Se0/0/0           14 00:07:49   48   288  0  59
```

Verify EIGRP topology table:

```
Rack1R6#show ip eigrp topology
IP-EIGRP Topology Table for AS(10)/ID(150.1.6.6)

Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,
       r - reply Status, s - sia Status

P 54.1.1.0/24, 1 successors, FD is 2169856
        via Connected, Serial0/0/0
P 150.1.6.0/24, 1 successors, FD is 2560000256
        via Rconnected (2560000256/0)
P 200.0.0.0/24, 1 successors, FD is 2297856
        via 54.1.1.254 (2297856/128256), Serial0/0/0
P 200.0.1.0/24, 1 successors, FD is 2297856
        via 54.1.1.254 (2297856/128256), Serial0/0/0
P 200.0.2.0/24, 1 successors, FD is 2297856
        via 54.1.1.254 (2297856/128256), Serial0/0/0
P 200.0.3.0/24, 1 successors, FD is 2297856
        via 54.1.1.254 (2297856/128256), Serial0/0/0
```


Task 4.5

R1:
```
router ospf 1
 network 137.1.15.1 0.0.0.0 area 125
 network 137.1.12.1 0.0.0.0 area 125
```

R2:
```
interface Serial0/0
 ip ospf network point-to-point
!
router ospf 1
 network 137.1.25.2 0.0.0.0 area 125
 network 137.1.12.2 0.0.0.0 area 125
!
router ospf 2
 network 137.1.28.2 0.0.0.0 area 0
```

R4:
```
interface Serial0/0
 ip ospf network point-to-point
!
router ospf 1
 network 137.1.45.4 0.0.0.0 area 0
```

R5:
```
interface Serial0/0.2
 ip ospf network point-to-point
!
interface Serial0/0.4
 ip ospf network point-to-point
!
router ospf 1
 network 137.1.45.5 0.0.0.0 area 0
 network 137.1.15.5 0.0.0.0 area 125
 network 137.1.25.5 0.0.0.0 area 125
```

SW2:
```
ip routing
!
router ospf 2
 network 137.1.28.8 0.0.0.0 area 0
```


Task 4.6

R5:
```
router ospf 2
 network 137.1.58.5 0.0.0.0 area 58
```

SW2:
```
router ospf 2
 network 137.1.58.8 0.0.0.0 area 58
```

Task 4.5 – 4.6 Verification

Verify OSPF neighbors:

```
Rack1R2#show ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
150.1.8.8         1   FULL/BDR        00:00:37    137.1.28.8      FastEthernet0/0
150.1.1.1         1   FULL/BDR        00:00:38    137.1.12.1      BVI1
150.1.5.5         0   FULL/  -        00:00:38    137.1.25.5      Serial0/0
```

```
Rack1R5#show ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
150.1.8.8         1   FULL/BDR        00:00:36    137.1.58.8      Ethernet0/1
150.1.4.4         0   FULL/  -        00:00:37    137.1.45.4      Serial0/0.4
150.1.2.2         0   FULL/  -        00:00:35    137.1.25.2      Serial0/0.2
150.1.1.1         0   FULL/  -        00:00:31    137.1.15.1      Serial0/0.1
```

Task 4.7

R1:
```
router ospf 1
 network 150.1.1.1 0.0.0.0 area 125
```

R4:
```
router ospf 1
 network 150.1.4.4 0.0.0.0 area 0
```

R5:
```
router ospf 1
 network 150.1.5.5 0.0.0.0 area 125
 area 125 range 150.1.0.0 255.255.248.0
```

SW2:
```
router ospf 2
 network 150.1.8.8 0.0.0.0 area 0
```


Task 4.7 Verification

Verify summary prefix at R4:

```
Rack1R4#sh ip route ospf
     137.1.0.0/24 is subnetted, 9 subnets
O IA    137.1.12.0 [110/192] via 137.1.45.5, 00:01:51, Serial0/0
O IA    137.1.15.0 [110/128] via 137.1.45.5, 00:01:51, Serial0/0
O IA    137.1.25.0 [110/128] via 137.1.45.5, 00:01:51, Serial0/0
     150.1.0.0/16 is variably subnetted, 4 subnets, 2 masks
O IA    150.1.0.0/21 [110/65] via 137.1.45.5, 00:01:43, Serial0/0
```

Task 4.8

R2:

```
router ospf 1
 network 150.1.2.2 0.0.0.0 area 125
 redistribute ospf 2 subnets
!
router ospf 2
 redistribute ospf 1 subnets
```

Task 4.8 Verification

Verify R2's Loopback0 prefix in routing tables of R1 and SW2:

```
Rack1R1#show ip route ospf  | inc 150.1.2
O       150.1.2.2/32 [110/65] via 137.1.12.2, 00:00:48, BVI1

Rack1SW2#show ip route ospf | inc 150.1.2
O E2    150.1.2.0/24 [110/1] via 137.1.28.2, 00:02:25, Vlan28
```

Task 4.9

R4 & R5:

```
!
router rip
 distance 109
```

R4:

```
access-list 20 permit 150.1.7.0
access-list 20 permit 150.1.3.0
!
router eigrp 10
 redistribute ospf 1 metric 1 1 1 1 1
!
router ospf 1
 redistribute eigrp 10 subnets
 distance ospf external 171
!
router rip
 distance 175 0.0.0.0 255.255.255.255 20
```

R5:

```
router ospf 1
```



```
 redistribute rip subnet
!
router ospf 2
 redistribute rip subnets
 distance 111
!
router rip
 redistribute ospf 1 metric 5
 redistribute ospf 2 metric 5
```

R6:

```
router rip
 redistribute connected
 redistribute eigrp 10 metric 1
!
router eigrp 10
 redistribute connected metric 1 1 1 1 1 route-map CONNECTED->EIGRP
 redistribute rip metric 1 1 1 1 1
```

Task 4.10

R4:

```
router eigrp 10
 redistribute connected metric 1 1 1 1 1
```


Tasks 4.9 – 4.10 Verification

Use the following Tcl script to verify full connectivity:

```
foreach i {
137.1.15.1
137.1.12.1
150.1.1.1
137.1.28.2
137.1.25.2
137.1.12.2
150.1.2.2
137.1.37.3
137.1.34.3
150.1.3.3
137.1.46.4
137.1.45.4
137.1.34.4
137.1.54.4
150.1.4.4
204.12.1.5
137.1.15.5
137.1.25.5
137.1.45.5
137.1.58.5
137.1.54.5
150.1.5.5
137.1.46.6
54.1.1.6
150.1.6.6
137.1.37.7
150.1.7.7
137.1.28.8
137.1.58.8
150.1.8.8
204.12.1.9
150.1.9.9
204.12.1.10
150.1.10.10
} { puts [ exec "ping $i" ] }
```

Note that VLAN100, VLAN7 and VLAN8 are excluded from connectivity test.

Task 5.1

R1:
```
router bgp 200
 neighbor 192.10.1.254 remote-as 254
 neighbor 192.10.1.254 password CISCO
 neighbor 137.1.12.2 remote-as 100
 neighbor 137.1.15.5 remote-as 100
```

R2:
```
router bgp 100
 neighbor 137.1.12.1 remote-as 200
 neighbor 137.1.28.8 remote-as 300
 neighbor 137.1.25.5 remote-as 100
```

R3:
```
router bgp 65037
 neighbor 137.1.34.4 remote-as 100
 neighbor 137.1.37.7 remote-as 65037
```

R4:
```
router bgp 100
 neighbor 137.1.34.3 remote-as 65037
 neighbor 137.1.45.5 remote-as 100
 neighbor 137.1.46.6 remote-as 100
 neighbor 137.1.46.6 route-reflector-client
```

R5:
```
router bgp 100
 neighbor 137.1.15.1 remote-as 200
 neighbor 137.1.58.8 remote-as 300
 neighbor 137.1.25.2 remote-as 100
 neighbor 137.1.25.2 route-reflector-client
 neighbor 137.1.45.4 remote-as 100
```

R6:
```
router bgp 100
 neighbor 137.1.46.4 remote-as 100
```

SW1:
```
router bgp 65037
 neighbor 137.1.37.3 remote-as 65037
```

SW2:
```
router bgp 300
 neighbor 137.1.28.2 remote-as 100
 neighbor 137.1.58.5 remote-as 100
```


Task 5.1 Verification

Verify BGP peering configuration:

```
Rack1R1#show ip bgp summary  | beg Nei
Neighbor        V AS MsgRcvd MsgSent  TblVer  InQ OutQ Up/Down  State/PfxRcd
137.1.12.2      4 100       8        9        4    0    0 00:04:16        0
137.1.15.5      4 100       8        8        4    0    0 00:03:37        0
192.10.1.254    4 254       9        8        4    0    0 00:04:11        3

Rack1SW2#show ip bgp summary  | beg Nei
Neighbor        V  AS MsgRcvd MsgSent  TblVer  InQ OutQ Up/Down  State/PfxRcd
137.1.28.2      4  100       8        8        4    0    0 00:03:55        3
137.1.58.5      4  100       9        9        4    0    0 00:04:15        3

Rack1R4#show ip bgp summary  | beg Nei
Neighbor        V AS  MsgRcvd MsgSent  TblVer  InQ OutQ Up/Down  State/PfxRcd
137.1.34.3      4 65037 8        9        4    0    0   00:05:45        0
137.1.45.5      4   100 9        8        4    0    0   00:05:30        3
137.1.46.6      4   100 8        9        4    0    0   00:05:24        0

Rack1R3#show ip bgp summary  | beg Nei
Neighbor        V AS MsgRcvd MsgSent  TblVer  InQ OutQ Up/Down  State/PfxRcd
137.1.34.4      4 100    10        9        4    0    0 00:06:09        3
137.1.37.7      4 65037  8        9        4    0    0 00:05:35        0
```

Task 5.2

R2:

```
router bgp 100
 bgp bestpath as-path ignore
 no neighbor 137.1.28.8 remote-as 300
 neighbor 137.1.28.8 remote-as 65008
```

SW2:

```
router bgp 300
network 137.1.8.0 mask 255.255.255.0
 neighbor 137.1.28.2 local-as 65008
```

Task 5.2 Verification

Verify BGP table:

```
Rack1R2#show ip bgp
BGP table version is 6, local router ID is 150.1.2.2
Status codes: s suppressed, d damped, h history, * valid, > best, i -
internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
*> 137.1.8.0/24     137.1.28.8               0             0 65008 300 i
* i                 137.1.58.8               0    100      0 300 i
```


Task 5.3

R2:
```
router bgp 100
 neighbor 137.1.12.1 remove-private-as
```

R5:
```
router bgp 100
 neighbor 137.1.15.1 remove-private-as
```

SW1:
```
router bgp 65037
 network 137.1.7.0 mask 255.255.255.0
```

Task 5.3 Verification

Confirm that private-AS has been removed:

```
Rack1R1#sh ip bgp
BGP table version is 6, local router ID is 150.1.1.1
Status codes: s suppressed, d damped, h history, * valid, > best, i -
internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop       Metric LocPrf Weight Path
*  137.1.7.0/24     137.1.15.5                           0 100 i
*>                  137.1.12.2                           0 100 i
*  137.1.8.0/24     137.1.12.2                           0 100 65008 300 i
*>                  137.1.15.5                           0 100 300 i
*> 205.90.31.0      192.10.1.254             0           0 254 ?
*> 220.20.3.0       192.10.1.254             0           0 254 ?
*> 222.22.2.0       192.10.1.254             0           0 254 ?
```


Task 1.1

Fault 1 : Wrong VTP domain name on SW3 - should be internetworkexpert
Fault 2 : ip routing is not needed on SW3

Task 2.1

SW1:

```
interface FastEthernet0/13
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
 channel-group 1 mode on
!
interface FastEthernet0/14
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
 channel-group 1 mode on
!
interface FastEthernet0/15
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
 channel-group 1 mode on
```

SW2:

```
interface FastEthernet0/13
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
 channel-group 1 mode on
!
interface FastEthernet0/14
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
 channel-group 1 mode on
!
interface FastEthernet0/15
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
 channel-group 1 mode on
!
interface FastEthernet0/16
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
 channel-group 2 mode on
!
interface FastEthernet0/17
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
```



```
 channel-group 2 mode on
!
interface FastEthernet0/18
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
 channel-group 2 mode on
```

SW3:

```
interface FastEthernet0/16
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
 channel-group 1 mode on
!
interface FastEthernet0/17
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
 channel-group 1 mode on
!
interface FastEthernet0/18
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
 channel-group 1 mode on
!
interface FastEthernet0/19
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
 channel-group 2 mode on
!
interface FastEthernet0/20
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
 channel-group 2 mode on
!
interface FastEthernet0/21
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
 channel-group 2 mode on
```

SW4:

```
interface FastEthernet0/19
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
 channel-group 1 mode on
!
interface FastEthernet0/20
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
 channel-group 1 mode on
```



```
!
interface FastEthernet0/21
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
 channel-group 1 mode on
```

Task 2.1 Verification

```
Rack1SW2#show interfaces trunk

Port        Mode         Encapsulation  Status        Native vlan
Po1         on           802.1q         trunking      1
Po2         on           802.1q         trunking      1

[...skipped...]

Rack1SW2#show etherchannel summary
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 2
Number of aggregators:           2

Group  Port-channel  Protocol    Ports
------+-------------+----------+-----------------------------------------
------
1      Po1(SU)           -        Fa0/13(P)   Fa0/14(P)   Fa0/15(P)
2      Po2(SU)           -        Fa0/16(P)   Fa0/17(P)   Fa0/18(P)


Rack1SW3#show interfaces trunk

Port        Mode         Encapsulation  Status        Native vlan
Po1         on           802.1q         trunking      1
Po2         on           802.1q         trunking      1

[...skipped...]

Rack1SW3#show etherchannel summary
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port
```



```
Number of channel-groups in use: 2
Number of aggregators:           2

Group  Port-channel  Protocol    Ports
------+-------------+----------+-----------------------------------------
------
1      Po1(SU)          -        Fa0/16(P)   Fa0/17(P)   Fa0/18(P)
2      Po2(SU)          -        Fa0/19(P)   Fa0/20(P)   Fa0/21(P)
```

Task 2.2

SW1:

```
interface FastEthernet0/1
 switchport access vlan 136
!
interface FastEthernet0/3
 switchport access vlan 136
!
interface FastEthernet0/5
 switchport access vlan 54
```

SW2:

```
interface FastEthernet0/2
 switchport access vlan 2
!
interface FastEthernet0/4
 switchport access vlan 54
!
interface FastEthernet0/6
 switchport access vlan 136
!
interface FastEthernet0/24
 switchport access vlan 3
```

SW3:

```
vlan 2,3,7,48,57,136
!
interface FastEthernet0/3
 switchport access vlan 3
!
interface FastEthernet0/5
 switchport access vlan 57
!
interface FastEthernet0/24
 switchport access vlan 3
!
interface Vlan7
 ip address 156.1.7.9 255.255.255.0
```

SW4:

```
interface FastEthernet0/4
 switchport access vlan 48
```

Task 2.2 Verification


```
Rack1SW1#show vlan brief | exclude unsup

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------
--------
1    default                          active    Fa0/2, Fa0/4, Fa0/6,
Fa0/7
                                                Fa0/8, Fa0/9, Fa0/10,
Fa0/11
                                                Fa0/12, Fa0/16, Fa0/17,
Fa0/18
                                                Fa0/19, Fa0/20, Fa0/21,
Fa0/22
                                                Fa0/23, Fa0/24, Gi0/1,
Gi0/2
2    VLAN0002                         active
7    VLAN0007                         active
8    VLAN0008                         active
48   VLAN0048                         active
54   VLAN0054                         active    Fa0/5
57   VLAN0057                         active
136  VLAN0136                         active    Fa0/1, Fa0/3

Rack1SW2#show vlan brief | exclude unsup

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------
--------
1    default                          active    Fa0/1, Fa0/3, Fa0/5,
Fa0/7
                                                Fa0/8, Fa0/9, Fa0/10,
Fa0/11
                                                Fa0/12, Fa0/19, Fa0/20,
Fa0/21
                                                Fa0/22, Fa0/23, Gi0/1,
Gi0/2
2    VLAN0002                         active    Fa0/2, Fa0/24
7    VLAN0007                         active
8    VLAN0008                         active
48   VLAN0048                         active
54   VLAN0054                         active    Fa0/4
57   VLAN0057                         active
136  VLAN0136                         active    Fa0/6


Rack1SW3#show vlan brief | exclude unsup

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------
--------
1    default                          active    Fa0/1, Fa0/2, Fa0/4,
Fa0/6
                                                Fa0/7, Fa0/8, Fa0/9,
Fa0/10
```



```
                                                  Fa0/11, Fa0/12, Fa0/13,
Fa0/14
                                                  Fa0/15, Fa0/22, Fa0/23,
Gi0/1
                                                  Gi0/2
2    VLAN0002                         active
3    VLAN0003                         active    Fa0/3, Fa0/24
7    VLAN0007                         active
48   VLAN0048                         active
57   VLAN0057                         active    Fa0/5
136  VLAN0136                         active


Rack1SW4#show vlan brief | exclude unsup

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------
--------
1    default                          active    Fa0/1, Fa0/2, Fa0/3,
Fa0/5
                                                  Fa0/6, Fa0/7, Fa0/8,
Fa0/9
                                                  Fa0/10, Fa0/11, Fa0/12,
Fa0/13
                                                  Fa0/14, Fa0/15, Fa0/16,
Fa0/17
                                                  Fa0/18, Fa0/22, Fa0/23,
Fa0/24
                                                  Gi0/1, Gi0/2
2    VLAN0002                         active
7    VLAN0007                         active
8    VLAN0008                         active
48   VLAN0048                         active    Fa0/4
54   VLAN0054                         active
57   VLAN0057                         active
136  VLAN0136                         active
```

Task 3.1

R1:

```
interface Serial0/0
 ip address 156.1.0.1 255.255.255.0
 encapsulation frame-relay
 frame-relay map ip 156.1.0.2 102 broadcast
 frame-relay map ip 156.1.0.5 105 broadcast
 no frame-relay inverse-arp
```

R2:

```
interface Serial0/0
 encapsulation frame-relay
 no frame-relay inverse-arp
!
interface Serial0/0.201 multipoint
 ip address 156.1.0.2 255.255.255.0
 frame-relay map ip 156.1.0.1 201 broadcast
```


R4:
```
interface Serial0/0
 encapsulation frame-relay
 no frame-relay inverse-arp
!
interface Serial0/0.405 multipoint
 ip address 156.1.0.4 255.255.255.0
 frame-relay map ip 156.1.0.5 405 broadcast
```

R5:
```
interface Serial0/0
 ip address 156.1.0.5 255.255.255.0
 encapsulation frame-relay
 frame-relay map ip 156.1.0.1 501 broadcast
 frame-relay map ip 156.1.0.4 504 broadcast
 no frame-relay inverse-arp
```

Task 3.1 Verification

Verify L3 to L2 mapping:

```
Rack1R1#show frame-relay map
Serial0/0 (up): ip 156.1.0.2 dlci 102(0x66,0x1860), static,
              broadcast,
              CISCO, status defined, active
Serial0/0 (up): ip 156.1.0.5 dlci 105(0x69,0x1890), static,
              broadcast,
              CISCO, status defined, active

Rack1R2#show frame-relay map
Serial0/0.201 (up): ip 156.1.0.1 dlci 201(0xC9,0x3090), static,
              broadcast,
              CISCO, status defined, active

Rack1R4#show frame-relay map
Serial0/0.405 (up): ip 156.1.0.5 dlci 405(0x195,0x6450), static,
              broadcast,
              CISCO, status defined, active

Rack1R5#show frame-relay map
Serial0/0 (up): ip 156.1.0.1 dlci 501(0x1F5,0x7C50), static,
              broadcast,
              CISCO, status defined, active
Serial0/0 (up): ip 156.1.0.4 dlci 504(0x1F8,0x7C80), static,
              broadcast,
              CISCO, status defined, active
```

Task 3.2

R6:
```
interface Serial0/0/0
 encapsulation frame-relay
!
interface Serial0/0/0.101 point-to-point
 ip address 54.1.1.6 255.255.255.0
```



```
 frame-relay interface-dlci 101
```

Task 3.2 Verification

Verify L3 to L2 mapping and test connectivity:

```
Rack1R6#show frame-relay map
Serial0/0/0.101 (up): point-to-point dlci, dlci 101(0x65,0x1850),
broadcast
          status defined, active

Rack1R6#ping 54.1.1.254

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 54.1.1.254, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 32/32/32 ms
```

Task 3.3

R4:

```
interface Serial0/1
 ip address 156.1.45.4 255.255.255.0
 encapsulation ppp
```

R5:

```
interface Serial0/1
 ip address 156.1.45.5 255.255.255.0
 encapsulation ppp
 clockrate 64000
```

Task 3.3 Verification

Verify connectivity:

```
Rack1R5#ping 156.1.45.4

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 156.1.45.4, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 28/29/32 ms
```

Task 3.4

R4:

```
username ROUTER5 password 0 CISCO
!
interface Serial0/1
 ppp authentication chap
 ppp chap hostname ROUTER4
```

R5:

```
username ROUTER4 password 0 CISCO
!
interface Serial0/1
 ppp authentication chap
```



```
 ppp chap hostname ROUTER5
```

Task 3.4 Verification

Verify PPP authentication:

```
Rack1R5#debug ppp authentication
PPP authentication debugging is on
Rack1R5#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Rack1R5(config)#inter se 0/1
Rack1R5(config-if)#shut
Rack1R5(config-if)#
*May 25 17:04:57.847: %LINK-5-CHANGED: Interface Serial0/1, changed
state to administratively down
*May 25 17:04:58.847: %LINEPROTO-5-UPDOWN: Line protocol on Interface
Serial0/1, changed state to down
Rack1R5(config-if)#no shut

*May 25 17:05:03.671: %LINK-3-UPDOWN: Interface Serial0/1, changed
state to up
*May 25 17:05:03.671: Se0/1 PPP: Using default call direction
*May 25 17:05:03.671: Se0/1 PPP: Treating connection as a dedicated
line
*May 25 17:05:03.671: Se0/1 PPP: Session handle[B1000008] Session id[9]
*May 25 17:05:03.671: Se0/1 PPP: Authorization required
*May 25 17:05:03.683: Se0/1 CHAP: O CHALLENGE id 2 len 28 from
"ROUTER5"
*May 25 17:05:03.687: Se0/1 CHAP: I CHALLENGE id 7 len 28 from
"ROUTER4"
*May 25 17:05:03.691: Se0/1 CHAP: Using hostname from interface CHAP
*May 25 17:05:03.691: Se0/1 CHAP: Using password from AAA
*May 25 17:05:03.691: Se0/1 CHAP: O RESPONSE id 7 len 28 from "ROUTER5"
*May 25 17:05:03.695: Se0/1 CHAP: I RESPONSE id 2 len 28 from "ROUTER4"
*May 25 17:05:03.699: Se0/1 PPP: Sent CHAP LOGIN Request
*May 25 17:05:03.699: Se0/1 PPP: Received LOGIN Response PASS
*May 25 17:05:03.703: Se0/1 PPP: Sent LCP AUTHOR Request
*May 25 17:05:03.703: Se0/1 PPP: Sent IPCP AUTHOR Request
*May 25 17:05:03.707: Se0/1 LCP: Received AAA AUTHOR Response PASS
*May 25 17:05:03.707: Se0/1 IPCP: Received AAA AUTHOR Response PASS
*May 25 17:05:03.707: Se0/1 CHAP: O SUCCESS id 2 len 4
*May 25 17:05:03.711: Se0/1 CHAP: I SUCCESS id 7 len 4
*May 25 17:05:03.711: Se0/1 PPP: Sent CDPCP AUTHOR Request
*May 25 17:05:03.715: Se0/1 CDPCP: Received AAA AUTHOR Response PASS
*May 25 17:05:03.715: Se0/1 PPP: Sent IPCP AUTHOR Request
*May 25 17:05:04.711: %LINEPROTO-5-UPDOWN: Line protocol on Interface
Serial0/1, changed state to up
```

Task 4.1

SW3:

```
no ip routing
!
ip default-gateway 156.1.7.7
```


Task 4.1 Verification

```
Rack1SW3#show ip route
Default gateway is 156.1.7.7

Host               Gateway           Last Use    Total Uses  Interface
ICMP redirect cache is empty
```

Task 4.2

R4:

```
router rip
 version 2
 passive-interface default
 no passive-interface Ethernet0/0
 no passive-interface Ethernet0/1
 network 156.1.0.0
 distance 60
 no auto-summary
```

R5:

```
router rip
 version 2
 passive-interface default
 no passive-interface Ethernet0/0
 network 156.1.0.0
 distance 60
 no auto-summary
```

SW2:

```
ip routing
!
router rip
 version 2
 passive-interface default
 no passive-interface Vlan48
 network 150.1.0.0
 network 156.1.0.0
 no auto-summary
```

Task 4.2 Verification

Verify RIP configuration:

```
Rack1R4#show ip protocols
Routing Protocol is "rip"
  Sending updates every 30 seconds, next due in 5 seconds
  Invalid after 180 seconds, hold down 180, flushed after 240
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Redistributing: rip
  Default version control: send version 2, receive version 2
    Interface             Send  Recv  Triggered RIP  Key-chain
    Ethernet0/0           2     2
    Ethernet0/1           2     2
  Automatic network summarization is not in effect
```



```
  Maximum path: 4
  Routing for Networks:
    156.1.0.0
  Passive Interface(s):
    Serial0/0
    Serial0/0.405
    Serial0/1
    Loopback0
    VoIP-Null0
  Routing Information Sources:
    Gateway         Distance      Last Update
    156.1.48.8           60       00:00:14
    Gateway         Distance      Last Update
    156.1.54.5           60       00:00:13
  Distance: (default is 60)

Rack1R5#show ip protocols
Routing Protocol is "rip"
  Sending updates every 30 seconds, next due in 28 seconds
  Invalid after 180 seconds, hold down 180, flushed after 240
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Redistributing: rip
  Default version control: send version 2, receive version 2
    Interface             Send  Recv  Triggered RIP  Key-chain
    Ethernet0/0           2     2
  Automatic network summarization is not in effect
  Maximum path: 4
  Routing for Networks:
    156.1.0.0
  Passive Interface(s):
    Serial0/0
    Ethernet0/1
    Serial0/1
    Loopback0
    VoIP-Null0
  Routing Information Sources:
    Gateway         Distance      Last Update
    156.1.54.4           60       00:00:13
  Distance: (default is 60)
```

Verify RIP routes:

```
Rack1SW2#show ip route  rip
     156.1.0.0/16 is variably subnetted, 7 subnets, 2 masks
R       156.1.0.0/24 [120/1] via 156.1.48.4, 00:00:03, Vlan48
R       156.1.57.0/24 [120/2] via 156.1.48.4, 00:00:03, Vlan48
R       156.1.54.0/24 [120/1] via 156.1.48.4, 00:00:03, Vlan48
R       156.1.45.0/24 [120/1] via 156.1.48.4, 00:00:03, Vlan48
R       156.1.45.5/32 [120/1] via 156.1.48.4, 00:00:03, Vlan48
```


Task 4.3

R4:

```
router rip
 default-information originate route-map DEFAULT_TO_SW2
!
route-map DEFAULT_TO_SW2 permit 10
 set interface Ethernet0/1
```

Task 4.3 Verification

Verify routes at SW2:

```
Rack1SW2#show ip route rip
     156.1.0.0/16 is variably subnetted, 7 subnets, 2 masks
R       156.1.0.0/24 [120/1] via 156.1.48.4, 00:00:15, Vlan48
R       156.1.57.0/24 [120/2] via 156.1.48.4, 00:00:15, Vlan48
R       156.1.54.0/24 [120/1] via 156.1.48.4, 00:00:15, Vlan48
R       156.1.45.0/24 [120/1] via 156.1.48.4, 00:00:15, Vlan48
R       156.1.45.5/32 [120/1] via 156.1.48.4, 00:00:15, Vlan48
R*   0.0.0.0/0 [120/1] via 156.1.48.4, 00:00:15, Vlan48
```

Confirm that R5 does not have that default:

```
Rack1R5#show ip route rip
     156.1.0.0/16 is variably subnetted, 7 subnets, 2 masks
R       156.1.8.0/24 [60/2] via 156.1.54.4, 00:00:04, Ethernet0/0
R       156.1.48.0/24 [60/1] via 156.1.54.4, 00:00:04, Ethernet0/0
     150.1.0.0/24 is subnetted, 2 subnets
R       150.1.8.0 [60/2] via 156.1.54.4, 00:00:04, Ethernet0/0
```

Task 4.4

R4:

```
interface Ethernet0/0
 ip broadcast-address 156.1.54.255
 ip rip v2-broadcast
```

R5:

```
interface Ethernet0/0
 ip address 156.1.54.5 255.255.255.0
 ip broadcast-address 156.1.54.255
 ip rip v2-broadcast
```


Task 4.4 Verification

Verify RIP updates:

```
Rack1R5#debug condition interface ethernet 0/0
Condition 1 set
Rack1R5#debug ip rip
*May 25 17:20:26.275: RIP: sending v2 update to 156.1.54.255 via
Ethernet0/0 (156.1.54.5)
*May 25 17:20:26.275: RIP: build update entries
*May 25 17:20:26.275:   156.1.0.0/24 via 0.0.0.0, metric 1, tag 0
*May 25 17:20:26.275:   156.1.45.0/24 via 0.0.0.0, metric 1, tag 0
*May 25 17:20:26.275:   156.1.45.4/32 via 0.0.0.0, metric 1, tag 0
*May 25 17:20:26.275:   156.1.57.0/24 via 0.0.0.0, metric 1, tag 0
```

Task 4.5

R1:

```
interface Serial0/0
 ip ospf network point-to-multipoint
!
router ospf 1
 router-id 150.1.1.1
 network 156.1.0.1 0.0.0.0 area 1245
```

R2:

```
interface Serial0/0.201 multipoint
 ip ospf network point-to-multipoint
!
router ospf 1
 router-id 150.1.2.2
 network 156.1.0.2 0.0.0.0 area 1245
```

R4:

```
interface Serial0/0.405 multipoint
 ip ospf network point-to-multipoint
!
router ospf 1
 router-id 150.1.4.4
 network 156.1.0.4 0.0.0.0 area 1245
```

R5:

```
interface Serial0/0
 ip ospf network point-to-multipoint
!
router ospf 1
 router-id 150.1.5.5
 network 156.1.0.5 0.0.0.0 area 1245
```


Task 4.5 Verification

Verify OSPF neighbors:

```
Rack1R1#show ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
150.1.2.2         0   FULL/  -        00:01:56    156.1.0.2       Serial0/0
150.1.5.5         0   FULL/  -        00:01:54    156.1.0.5       Serial0/0

Rack1R5#show ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
150.1.4.4         0   FULL/  -        00:01:41    156.1.0.4       Serial0/0
150.1.1.1         0   FULL/  -        00:01:41    156.1.0.1       Serial0/0
```

Verify OSPF routes and test connectivity across the Frame-Relay cloud:

```
Rack1R5#sh ip route ospf
     156.1.0.0/16 is variably subnetted, 10 subnets, 2 masks
O       156.1.0.4/32 [110/64] via 156.1.0.4, 00:01:18, Serial0/0
O       156.1.0.1/32 [110/64] via 156.1.0.1, 00:01:18, Serial0/0
O       156.1.0.2/32 [110/128] via 156.1.0.1, 00:01:18, Serial0/0

Rack1R5#ping 156.1.0.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 156.1.0.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 56/58/60 ms
Rack1R5#ping 156.1.0.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 156.1.0.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 112/116/124
ms
Rack1R5#ping 156.1.0.4

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 156.1.0.4, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 60/60/60 ms
```


Task 4.6

R4:

```
interface Serial0/1
 ip ospf hello-interval 2400
!
router ospf 1
 network 156.1.45.4 0.0.0.0 area 0
```

R5:

```
interface Serial0/1
 ip ospf hello-interval 2400
!
router ospf 1
 network 156.1.45.5 0.0.0.0 area 0
```

Task 4.6 Verification

Verify OSPF configuration:

```
Rack1R5#show ip ospf interface serial 0/1
Serial0/1 is up, line protocol is up
  Internet Address 156.1.45.5/24, Area 0
  Process ID 1, Router ID 150.1.5.5, Network Type POINT_TO_POINT, Cost:
64
  Transmit Delay is 1 sec, State POINT TO POINT,
  Timer intervals configured, Hello 2400, Dead 9600, Wait 9600,
Retransmit 5
    oob-resync timeout 9600
    Hello due in 00:39:01
  Supports Link-local Signaling (LLS)
  Index 1/2, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 0, maximum is 0
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 0, Adjacent neighbor count is 0
  Suppress hello for 0 neighbor(s)
```

Task 4.7

R1:

```
router ospf 1
 area 1245 virtual-link 150.1.5.5
 area 1245 virtual-link 150.1.2.2
```

R2:

```
router ospf 1
 area 1245 range 156.1.0.0 255.255.0.0
 area 1245 virtual-link 150.1.1.1
 network 192.10.1.2 0.0.0.0 area 51
```

R5:

```
router ospf 1
 area 1245 virtual-link 150.1.1.1
```


Task 4.7 Verification

Verify OSPF neighbors:

```
Rack1R2#show ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
150.1.1.1         0   FULL/  -        -           156.1.0.1       OSPF_VL1
192.10.1.254      1   FULL/DR         00:00:31    192.10.1.254    FastEthernet0/0
150.1.1.1         0   FULL/  -        00:01:50    156.1.0.1       Serial0/0.201

Rack1R1#show ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
150.1.5.5         0   FULL/  -        -           156.1.0.5       OSPF_VL3
150.1.2.2         0   FULL/  -        -           156.1.0.2       OSPF_VL2
150.1.2.2         0   FULL/  -        00:01:34    156.1.0.2       Serial0/0
150.1.5.5         0   FULL/  -        00:01:52    156.1.0.5       Serial0/0
```

Verify summary route generation:

```
Rack1R2#show ip ospf database summary 156.1.0.0

            OSPF Router with ID (150.1.2.2) (Process ID 1)

                Summary Net Link States (Area 0)

  LS age: 86
  Options: (No TOS-capability, DC, Upward)
  LS Type: Summary Links(Network)
  Link State ID: 156.1.0.0 (summary Network Number)
  Advertising Router: 150.1.2.2
  LS Seq Number: 80000001
  Checksum: 0x1CE7
  Length: 28
  Network Mask: /16
        TOS: 0  Metric: 0


                Summary Net Link States (Area 51)

  LS age: 81
  Options: (No TOS-capability, DC, Upward)
  LS Type: Summary Links(Network)
  Link State ID: 156.1.0.0 (summary Network Number)
  Advertising Router: 150.1.2.2
  LS Seq Number: 80000001
  Checksum: 0x1CE7
  Length: 28
  Network Mask: /16
        TOS: 0  Metric: 0
```


Verify external routes:

```
Rack1R5#show ip route ospf
     51.0.0.0/32 is subnetted, 1 subnets
O E2    51.51.51.51 [110/20] via 156.1.0.1, 00:05:02, Serial0/0
     156.1.0.0/16 is variably subnetted, 11 subnets, 3 masks
O       156.1.0.4/32 [110/64] via 156.1.0.4, 00:05:12, Serial0/0
O       156.1.0.1/32 [110/64] via 156.1.0.1, 00:05:12, Serial0/0
O IA    156.1.0.0/16 [110/128] via 156.1.0.1, 00:05:02, Serial0/0
O       156.1.0.2/32 [110/128] via 156.1.0.1, 00:05:12, Serial0/0
O IA 192.10.1.0/24 [110/129] via 156.1.0.1, 00:05:02, Serial0/0
```

Task 4.8

R5:

```
interface Tunnel57
 ip unnumbered Serial0/1
 tunnel source 156.1.57.5
 tunnel destination 156.1.57.7
 tunnel mode ipip
!
router ospf 1
 area 57 stub
 network 156.1.57.5 0.0.0.0 area 57
```

SW1:

```
ip routing
!
interface Tunnel57
 ip unnumbered Vlan7
 tunnel source 156.1.57.7
 tunnel destination 156.1.57.5
 tunnel mode ipip
!
router ospf 1
 router-id 150.1.7.7
 area 57 stub
 network 156.1.7.7 0.0.0.0 area 0
 network 156.1.57.7 0.0.0.0 area 57
```


Task 4.8 Verification

Verify OSPF neighbors and routes at SW1:

```
Rack1SW1#show ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
150.1.5.5         0   FULL/  -        00:00:36    156.1.45.5      Tunnel57
150.1.5.5         1   FULL/BDR        00:00:37    156.1.57.5      Vlan57

Rack1SW1#show ip route ospf
     51.0.0.0/32 is subnetted, 1 subnets
O E2    51.51.51.51 [110/20] via 156.1.45.5, 00:00:03, Tunnel57
     156.1.0.0/16 is variably subnetted, 8 subnets, 3 masks
O IA    156.1.0.5/32 [110/11111] via 156.1.45.5, 00:00:03, Tunnel57
O IA    156.1.0.4/32 [110/11175] via 156.1.45.5, 00:00:03, Tunnel57
O IA    156.1.0.1/32 [110/11175] via 156.1.45.5, 00:00:03, Tunnel57
O IA    156.1.0.0/16 [110/11239] via 156.1.45.5, 00:00:03, Tunnel57
O IA    156.1.0.2/32 [110/11239] via 156.1.45.5, 00:00:03, Tunnel57
O       156.1.45.0/24 [110/11175] via 156.1.45.5, 00:00:44, Tunnel57
O IA 192.10.1.0/24 [110/11240] via 156.1.45.5, 00:00:04, Tunnel57
```

Task 4.9

R4:

```
router ospf 1
 network 150.1.4.4 0.0.0.0 area 0
 area 1245 virtual-link 150.1.5.5
```

R5:

```
router ospf 1
 area 1245 virtual-link 150.1.4.4
 network 150.1.5.5 0.0.0.0 area 0
```

SW1:

```
router ospf 1
 network 150.1.7.7 0.0.0.0 area 0
```


Task 4.9 Verification

Verify OSPF routes:

```
Rack1R4#show ip route ospf | inc /32
     51.0.0.0/32 is subnetted, 1 subnets
O       156.1.0.5/32 [110/64] via 156.1.0.5, 00:01:28, Serial0/0.405
O       156.1.0.1/32 [110/128] via 156.1.0.5, 00:01:28, Serial0/0.405
O       156.1.0.2/32 [110/192] via 156.1.0.5, 00:01:28, Serial0/0.405
O       150.1.7.7/32 [110/11176] via 156.1.0.5, 00:00:26, Serial0/0.405
O       150.1.5.5/32 [110/65] via 156.1.0.5, 00:00:26, Serial0/0.405
O       150.1.2.2/32 [110/193] via 156.1.0.5, 00:00:26, Serial0/0.405
O       150.1.1.1/32 [110/129] via 156.1.0.5, 00:00:26, Serial0/0.405
```

Task 4.10

R4, R5:

```
interface Serial0/1
 ip ospf cost 9999
```

Task 4.10 Verification

Verify routing paths:

```
Rack1R5#traceroute 150.1.4.4

Type escape sequence to abort.
Tracing the route to 150.1.4.4

  1 156.1.0.4 28 msec *  28 msec

Rack1R4#traceroute 150.1.5.5

Type escape sequence to abort.
Tracing the route to 150.1.5.5

  1 156.1.0.5 28 msec *  28 msec
```

Task 4.11

R4, R5:

```
router ospf 1
 redistribute rip subnets
!
router rip
 redistribute ospf 1 metric 1
```


Task 4.12

Sw4,Sw5:

```
router ospf 1
 redistribute rip subnets route-map RIP_OSPF
 distance 59
!
router rip
 redistribute ospf 1 metric 1 route-map OSPF_RIP
!
route-map OSPF_RIP deny 10
 match tag 120
!
route-map OSPF_RIP permit 20
 set tag 110
!
route-map RIP_OSPF deny 10
 match tag 110
!
route-map RIP_OSPF permit 20
 set tag 120
```


Task 4.11 – 4.12 Verification

Verify full connectivity with the following Tcl script:

Full IGP reachability:

```
foreach i {
156.1.0.1
150.1.1.1
192.10.1.2
156.1.0.2
150.1.2.2
156.1.54.4
156.1.0.4
156.1.48.4
156.1.45.4
150.1.4.4
156.1.54.5
156.1.0.5
156.1.57.5
156.1.45.5
150.1.5.5
156.1.45.5
156.1.57.7
150.1.7.7
156.1.7.7
156.1.8.8
156.1.48.8
150.1.8.8
192.10.1.10
} { ping $i }
```

Note, that routers R3 and R6 are excluded from connectivity test. Also, VLAN136 and VLAN7 are not a part of any IGP.

Task 4.13

R1:

```
router ospf 1
default-information originate
```

R4, R5:

```
ip prefix-list DEFAULT seq 5 permit 0.0.0.0/0
!
route-map OSPF_RIP deny 5
 match ip address prefix-list DEFAULT
```


Task 4.14

R1:
```
ip route 0.0.0.0 0.0.0.0 156.1.136.254
```

R3:
```
interface Ethernet0/0
 standby 1 ip 156.1.136.254
 standby 1 preempt
```

R6:
```
interface GigabitEthernet0/0
 standby 1 ip 156.1.136.254
 standby 1 priority 105
 standby 1 preempt
 standby 1 track Serial0/0/0.101
```

Task 4.13 – 4.14 Verification

Verify default route at R5:

```
Rack1R5#show ip route ospf
     51.0.0.0/32 is subnetted, 1 subnets
O E2    51.51.51.51 [110/20] via 156.1.0.1, 00:06:20, Serial0/0
     156.1.0.0/16 is variably subnetted, 12 subnets, 3 masks
O       156.1.0.4/32 [110/64] via 156.1.0.4, 00:12:22, Serial0/0
O       156.1.7.0/24 [110/11112] via 156.1.7.7, 00:06:20, Tunnel57
O       156.1.0.1/32 [110/64] via 156.1.0.1, 00:12:22, Serial0/0
O IA    156.1.0.0/16 [110/128] via 156.1.0.1, 00:06:20, Serial0/0
O       156.1.0.2/32 [110/128] via 156.1.0.1, 00:12:22, Serial0/0
O IA 192.10.1.0/24 [110/129] via 156.1.0.1, 00:06:20, Serial0/0
     150.1.0.0/16 is variably subnetted, 6 subnets, 2 masks
O       150.1.7.7/32 [110/11112] via 156.1.7.7, 00:06:20, Tunnel57
O       150.1.4.4/32 [110/65] via 156.1.0.4, 00:06:20, Serial0/0
O       150.1.2.2/32 [110/129] via 156.1.0.1, 00:06:20, Serial0/0
O       150.1.1.1/32 [110/65] via 156.1.0.1, 00:06:20, Serial0/0
O*E2 0.0.0.0/0 [110/1] via 156.1.0.1, 00:06:20, Serial0/0
```

Confirm that default route is not redistributed into RIP:

```
Rack1R4#show ip route rip | inc 0.0.0.0
Rack1R4#
```

Verify PVC status tracking at R6:

```
Rack1R6#debug standby events
HSRP Events debugging is on
```

Meanwhile, at FRS, remove PVC 101:

```
BB1-FRS#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
BB1-FRS(config)#interface Serial6.101
BB1-FRS(config-subif)#no frame-relay interface-dlci 101
```


Look at R6 console logging output:

```
Rack1R6#
*Jun  1 08:22:06.003: HSRP: Gi0/0 Grp 1 Track 1 object changed, state
Up -> Down
*Jun  1 08:22:06.003: HSRP: Gi0/0 Grp 1 Priority 105 -> 95
*Jun  1 08:22:07.247: HSRP: Gi0/0 Grp 1 Ignoring Coup (100/156.1.136.3
< 105/156.1.136.6)
*Jun  1 08:22:07.247: HSRP: Gi0/0 Grp 1 Hello  in  156.1.136.3 Active
pri 100 vIP 156.1.136.254
*Jun  1 08:22:07.247: HSRP: Gi0/0 Grp 1 Active router is 156.1.136.3,
was local
*Jun  1 08:22:07.247: HSRP: Gi0/0 Grp 1 Standby router is unknown, was
156.1.136.3
*Jun  1 08:22:07.251: HSRP: Gi0/0 Grp 1 Active: g/Hello rcvd from
higher pri Active router (100/156.1.136.3)
*Jun  1 08:22:07.251: HSRP: Gi0/0 Grp 1 Active -> Speak
*Jun  1 08:22:07.251: %HSRP-6-STATECHANGE: GigabitEthernet0/0 Grp 1
state Active -> Speak
*Jun  1 08:22:07.251: HSRP: Gi0/0 Grp 1 Redundancy "hsrp-Gi0/0-1" state
Active -> Speak
*Jun  1 08:22:07.251: HSRP: Gi0/0 API MAC address update
Rack1R6#
*Jun  1 08:22:17.251: HSRP: Gi0/0 Grp 1 Speak: d/Standby timer expired
(unknown)
*Jun  1 08:22:17.251: HSRP: Gi0/0 Grp 1 Standby router is local
*Jun  1 08:22:17.251: HSRP: Gi0/0 Grp 1 Speak -> Standby
*Jun  1 08:22:17.251: %HSRP-6-STATECHANGE: GigabitEthernet0/0 Grp 1
state Speak -> Standby
Rack1R6#
*Jun  1 08:22:17.251: HSRP: Gi0/0 Grp 1 Redundancy "hsrp-Gi0/0-1" state
Speak -> Standby

Rack1R6#show frame-relay pvc 101

PVC Statistics for interface Serial0/0/0 (Frame Relay DTE)

DLCI = 101, DLCI USAGE = LOCAL, PVC STATUS = DELETED, INTERFACE =
Serial0/0/0.101

  input pkts 159           output pkts 18           in bytes 18936
  out bytes 3206           dropped pkts 0           in pkts dropped 0
  out pkts dropped 0                 out bytes dropped 0
  in FECN pkts 0           in BECN pkts 0           out FECN pkts 0
  out BECN pkts 0          in DE pkts 0             out DE pkts 0
  out bcast pkts 7         out bcast bytes 2394
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
  pvc create time 00:09:50, last time pvc status changed 00:01:50
```


Task 5.1

R1:
```
router bgp 200
 bgp router-id 150.1.1.1
 neighbor 156.1.136.3 remote-as 100
 neighbor 156.1.136.6 remote-as 100
```

R3:
```
router bgp 100
 bgp router-id 150.1.3.3
 neighbor 156.1.136.1 remote-as 200
 neighbor 156.1.136.6 remote-as 100
 neighbor 204.12.1.254 remote-as 54
```

R6:
```
router bgp 100
 bgp router-id 150.1.6.6
 neighbor 54.1.1.254 remote-as 54
 neighbor 156.1.136.1 remote-as 200
 neighbor 156.1.136.3 remote-as 100
```

Task 5.1 Verification

Verify BGP peering:

```
Rack1R1#show ip bgp summary | beg Nei
Neighbor        V AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd
156.1.136.3     4 100       8        7       11    0    0 00:01:15        10
156.1.136.6     4 100       8        5       11    0    0 00:01:17        10

Rack1R6#show ip bgp summary | beg Nei
Neighbor        V AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd
54.1.1.254      4 54       10       10       11    0    0 00:02:08        10
156.1.136.1     4 200       5        8       11    0    0 00:01:59         0
156.1.136.3     4 100       8        8       11    0    0 00:01:57        10

Rack1R3#show ip bgp summary | beg Nei
Neighbor        V AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd
156.1.136.1     4 200       8        9       11    0    0 00:02:23         0
156.1.136.6     4 100       9        9       11    0    0 00:02:23        10
204.12.1.254    4 54       10       10       11    0    0 00:02:32        10
```


Task 5.2

R1:
```
router bgp 200
 network 156.1.0.0 mask 255.255.255.0
 redistribute ospf 1
```

R3:
```
router bgp 100
 network 204.12.1.0
 network 150.1.3.0 mask 255.255.255.0
```

R6:
```
router bgp 100
 network 54.1.1.0 mask 255.255.255.0
 network 150.1.3.0 mask 255.255.255.0
```

Task 5.2 Verification

Verify BGP prefix origination:

```
Rack1R6#show ip bgp quote-regexp ^$ | beg Netw
   Network          Next Hop            Metric LocPrf Weight Path
*> 54.1.1.0/24      0.0.0.0                  0         32768 i
*>i150.1.3.0/24     156.1.136.3              0    100      0 i
*> 150.1.6.0/24     0.0.0.0                  0         32768 i
*>i204.12.1.0       156.1.136.3              0    100      0 i

Rack1R6#show ip bgp quote-regexp ^200$ | beg Netw
   Network          Next Hop            Metric LocPrf Weight Path
* i150.1.1.0/24     156.1.136.1              0    100      0 200 ?
*>                  156.1.136.1              0             0 200 ?
* i150.1.2.2/32     156.1.136.1             65    100      0 200 ?
*>                  156.1.136.1             65             0 200 ?
* i150.1.4.4/32     156.1.136.1            129    100      0 200 ?
*>                  156.1.136.1            129             0 200 ?
* i150.1.5.5/32     156.1.136.1             65    100      0 200 ?
*>                  156.1.136.1             65             0 200 ?
* i150.1.7.7/32     156.1.136.1          11176    100      0 200 ?
*>                  156.1.136.1          11176             0 200 ?
* i156.1.0.0/24     156.1.136.1              0    100      0 200 i
*>                  156.1.136.1              0             0 200 i
* i156.1.0.0        156.1.136.1             64    100      0 200 ?
*>                  156.1.136.1             64             0 200 ?
* i156.1.0.2/32     156.1.136.1             64    100      0 200 ?
*>                  156.1.136.1             64             0 200 ?
* i156.1.0.4/32     156.1.136.1            128    100      0 200 ?
*>                  156.1.136.1            128             0 200 ?
* i156.1.0.5/32     156.1.136.1             64    100      0 200 ?
*>                  156.1.136.1             64             0 200 ?
* i156.1.7.0/24     156.1.136.1          11176    100      0 200 ?
*>                  156.1.136.1          11176             0 200 ?
* i156.1.45.0/24    156.1.136.1          10063    100      0 200 ?
*>                  156.1.136.1          10063             0 200 ?
* i156.1.57.0/24    156.1.136.1             74    100      0 200 ?
```



```
*>                  156.1.136.1              74             0 200 ?
* i192.10.1.0       156.1.136.1              65    100      0 200 ?
*>                  156.1.136.1              65             0 200 ?
```

Task 5.3

R3, R6:

```
router bgp 100
 neighbor 156.1.136.1 route-map CHANGE_NEXT_HOP out
!
route-map CHANGE_NEXT_HOP permit 10
 set ip next-hop 156.1.136.254
```

Task 5.3 Verification

Verify BGP next-hop values at R1:

```
Rack1R1#show ip bgp quote-regexp ^100 | beg Netw
   Network          Next Hop         Metric LocPrf Weight Path
*> 28.119.16.0/24   156.1.136.254                        0 100 54 i
*                   156.1.136.254                        0 100 54 i
*> 28.119.17.0/24   156.1.136.254                        0 100 54 i
*                   156.1.136.254                        0 100 54 i
*  54.1.1.0/24      156.1.136.254          0             0 100 i
*>                  156.1.136.254                        0 100 i
*> 112.0.0.0        156.1.136.254                        0 100 54 50 60 i
*                   156.1.136.254                        0 100 54 50 60 i
*> 113.0.0.0        156.1.136.254                        0 100 54 50 60 i
*                   156.1.136.254                        0 100 54 50 60 i
*> 114.0.0.0        156.1.136.254                        0 100 54 i
*                   156.1.136.254                        0 100 54 i
*> 115.0.0.0        156.1.136.254                        0 100 54 i
*                   156.1.136.254                        0 100 54 i
<output omitted>
```


Task 1.1

Fault 1 : IP addresses swapped on Ethernet interfaces of R4
Fault 2 : Wrong IP address of Lo0 on R5 - should be 150.1.5.5/24

Task 2.1

SW1:

```
interface FastEthernet0/14
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
 channel-group 1 mode desirable
!
interface FastEthernet0/15
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
 channel-group 1 mode desirable
!
interface FastEthernet0/16
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
 channel-group 2 mode desirable
!
interface FastEthernet0/17
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
 channel-group 2 mode desirable
```

SW2:

```
interface FastEthernet0/14
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
 channel-group 1 mode desirable
!
interface FastEthernet0/15
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
 channel-group 1 mode desirable
```

SW3:

```
interface FastEthernet0/13
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
 channel-group 1 mode desirable
!
interface FastEthernet0/14
 switchport trunk encapsulation dot1q
 switchport mode trunk
 switchport nonegotiate
```



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

Task 1.2 Verification

```
Rack1SW1#show etherchannel summary
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 2
Number of aggregators:           2

Group  Port-channel  Protocol    Ports
------+-------------+----------+-----------------------------------------
------
1      Po1(SU)          PAgP      Fa0/14(P)   Fa0/15(P)
2      Po2(SU)          PAgP      Fa0/16(P)   Fa0/17(P)

Rack1SW1#show interfaces trunk

Port        Mode         Encapsulation  Status        Native vlan
Po1         on           802.1q         trunking      1
Po2         on           802.1q         trunking      1


[...skipped...]
```

Task 2.2

```
SW1:
vtp domain ONE
vtp mode transparent
!
vlan 7,36-37,53
!
interface FastEthernet0/1
 switchport access vlan 148
!
interface FastEthernet0/3
 switchport access vlan 36
!
interface FastEthernet0/5
 switchport access vlan 53

SW2:
vtp domain TWO
vtp mode transparent
!
vlan 8,22,36,48,148
!
```



```
interface FastEthernet0/2
 switchport access vlan 22
!
interface FastEthernet0/4
 switchport access vlan 148
!
interface FastEthernet0/6
 switchport access vlan 36
!
interface FastEthernet0/24
 switchport access vlan 22
```

SW3:

```
vtp domain THREE
vtp mode transparent
!
vlan 5,37,53
!
interface FastEthernet0/3
 switchport access vlan 37
!
interface FastEthernet0/5
 switchport access vlan 5
!
interface FastEthernet0/24
 switchport access vlan 53
```

SW4:

```
vtp domain FOUR
vtp mode transparent
!
vlan 48
!
interface FastEthernet0/4
 switchport access vlan 48
```

Task 2.2 Verification

```
Rack1SW1#show vtp status
VTP Version                     : 2
Configuration Revision          : 0
Maximum VLANs supported locally : 1005
Number of existing VLANs        : 10
VTP Operating Mode              : Transparent
VTP Domain Name                 : ONE
VTP Pruning Mode                : Disabled
VTP V2 Mode                     : Disabled
VTP Traps Generation            : Disabled
MD5 digest                      : 0x32 0x7C 0x63 0x62 0xD4 0xAE 0x0D
0xBF
Configuration last modified by 150.1.7.7 at 0-0-00 00:00:00

Rack1SW1#show vlan brief | exclude unsup

VLAN Name                             Status    Ports
```

```
---- -------------------------------- --------- ------------------------
--------
1    default                          active    Fa0/1, Fa0/2, Fa0/4,
Fa0/6
                                                Fa0/7, Fa0/8, Fa0/9,
Fa0/10
                                                Fa0/11, Fa0/12, Fa0/13,
Fa0/18
                                                Fa0/19, Fa0/20, Fa0/21,
Fa0/22
                                                Fa0/23, Fa0/24, Gi0/1,
Gi0/2
7    VLAN0007                         active
36   VLAN0036                         active    Fa0/3
37   VLAN0037                         active
53   VLAN0053                         active    Fa0/5
148  VLAN0148                         active

Rack1SW2#show vtp status
VTP Version                     : 2
Configuration Revision          : 0
Maximum VLANs supported locally : 1005
Number of existing VLANs        : 10
VTP Operating Mode              : Transparent
VTP Domain Name                 : TWO
VTP Pruning Mode                : Disabled
VTP V2 Mode                     : Disabled
VTP Traps Generation            : Disabled
MD5 digest                      : 0x41 0x7F 0xD5 0xE8 0x36 0xB2 0x01
0x56
Configuration last modified by 157.1.8.8 at 0-0-00 00:00:00


Rack1SW2#show vlan brief | exclude unsup

VLAN Name                             Status    Ports
---- -------------------------------- --------- ------------------------
--------
1    default                          active    Fa0/1, Fa0/3, Fa0/5,
Fa0/7
                                                Fa0/8, Fa0/9, Fa0/10,
Fa0/11
                                                Fa0/12, Fa0/13, Fa0/16,
Fa0/17
                                                Fa0/18, Fa0/19, Fa0/20,
Fa0/21
                                                Fa0/22, Fa0/23, Gi0/1,
Gi0/2
8    VLAN0008                         active
22   VLAN0022                         active    Fa0/2, Fa0/24
36   VLAN0036                         active    Fa0/6
48   VLAN0048                         active
148  VLAN0148                         active    Fa0/4


Rack1SW3#show vtp status
VTP Version                     : 2
```

```
Configuration Revision          : 0
Maximum VLANs supported locally : 1005
Number of existing VLANs        : 8
VTP Operating Mode              : Transparent
VTP Domain Name                 : THREE
VTP Pruning Mode                : Disabled
VTP V2 Mode                     : Disabled
VTP Traps Generation            : Disabled
MD5 digest                      : 0x86 0x77 0xC8 0x47 0xF3 0x7C 0xF8
0x6C
Configuration last modified by 0.0.0.0 at 0-0-00 00:00:00

Rack1SW3#show vlan brief | exclude unsup

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------
--------
1    default                          active    Fa0/1, Fa0/2, Fa0/4,
Fa0/6
                                                Fa0/7, Fa0/8, Fa0/9,
Fa0/10
                                                Fa0/11, Fa0/12, Fa0/15,
Fa0/16
                                                Fa0/17, Fa0/18, Fa0/19,
Fa0/20
                                                Fa0/21, Fa0/22, Fa0/23,
Gi0/1
                                                Gi0/2
5    VLAN0005                         active    Fa0/5
37   VLAN0037                         active    Fa0/3
53   VLAN0053                         active    Fa0/24


Rack1SW4#show vtp status
VTP Version                     : 2
Configuration Revision          : 0
Maximum VLANs supported locally : 1005
Number of existing VLANs        : 6
VTP Operating Mode              : Transparent
VTP Domain Name                 : FOUR
VTP Pruning Mode                : Disabled
VTP V2 Mode                     : Disabled
VTP Traps Generation            : Disabled
MD5 digest                      : 0x12 0x49 0xA8 0xAE 0xDD 0x7D 0x6F
0xD8
Configuration last modified by 0.0.0.0 at 0-0-00 00:00:00


Rack1SW4#show vlan brief | exclude unsup

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------
1    default                          active    Fa0/1, Fa0/2, Fa0/3,
Fa0/5
                                                Fa0/6, Fa0/7, Fa0/8,
Fa0/9
```

```
                                                Fa0/10, Fa0/11, Fa0/12,
Fa0/13
                                                Fa0/14, Fa0/15, Fa0/16,
Fa0/17
                                                Fa0/18, Fa0/19, Fa0/20,
Fa0/21
                                                Fa0/22, Fa0/23, Fa0/24,
Gi0/1
                                                Gi0/2
48   VLAN0048                         active    Fa0/4
```

Task 2.3

SW1:

```
vlan dot1q tag native
!
interface FastEthernet0/13
 switchport access vlan 1000
 switchport mode dot1q-tunnel
```

SW2:

```
interface FastEthernet0/13
 switchport access vlan 48
```

SW3:

```
vlan dot1q tag native
!
interface FastEthernet0/21
 switchport access vlan 1000
 switchport mode dot1q-tunnel
```

SW4:

```
interface FastEthernet0/21
 switchport access vlan 48
```

Task 2.3 Verification

```
Rack1SW1#show dot1q-tunnel interface f0/13

dot1q-tunnel mode LAN Port(s)
-----------------------------
Fa0/13

Rack1SW1#show vlan dot1q tag native
dot1q native vlan tagging is enabled


Rack1SW3#show dot1q-tunnel interface f0/21

dot1q-tunnel mode LAN Port(s)
-----------------------------
Fa0/21

Rack1SW3#show vlan dot1q tag native
dot1q native vlan tagging is enabled
```



```
Rack1R4#ping 157.1.48.8

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 157.1.48.8, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/4 ms
```

Task 3.1

R1:

```
interface Serial0/0
 ip address 157.1.123.1 255.255.255.0
 encapsulation frame-relay
 frame-relay map ip 157.1.123.2 103
 frame-relay map ip 157.1.123.3 103 broadcast
 no frame-relay inverse-arp
```

R2:

```
interface Serial0/0
 ip address 157.1.123.2 255.255.255.0
 encapsulation frame-relay
 frame-relay map ip 157.1.123.1 203
 frame-relay map ip 157.1.123.3 203 broadcast
 no frame-relay inverse-arp
```

R3:

```
interface Serial1/0
 encapsulation frame-relay
!
interface Serial1/0.123 multipoint
 ip address 157.1.123.3 255.255.255.0
 frame-relay map ip 157.1.123.1 301 broadcast
 frame-relay map ip 157.1.123.2 302 broadcast
```


Task 3.1 Verification

Verify L3 to L2 mappings:

```
Rack1R1#show frame-relay map
Serial0/0 (up): ip 157.1.123.2 dlci 103(0x67,0x1870), static,
              CISCO, status defined, active
Serial0/0 (up): ip 157.1.123.3 dlci 103(0x67,0x1870), static,
              broadcast,
              CISCO, status defined, active

Rack1R2#show frame-relay map
Serial0/0 (up): ip 157.1.123.1 dlci 203(0xCB,0x30B0), static,
              CISCO, status defined, active
Serial0/0 (up): ip 157.1.123.3 dlci 203(0xCB,0x30B0), static,
              broadcast,
              CISCO, status defined, active

Rack1R3#show frame-relay map
Serial1/0.123 (up): ip 157.1.123.1 dlci 301(0x12D,0x48D0), static,
              broadcast,
              CISCO, status defined, active
Serial1/0.123 (up): ip 157.1.123.2 dlci 302(0x12E,0x48E0), static,
              broadcast,
              CISCO, status defined, active
```

Confirm connectivity over FR cloud:

```
Rack1R1#ping 157.1.123.3

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 157.1.123.3, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 56/59/60 ms

Rack1R1#ping 157.1.123.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 157.1.123.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5),round-trip min/avg/max=112/116/124 ms
```


Task 3.2

R6:

```
interface Serial0/0/0
 encapsulation frame-relay
!
interface Serial0/0/0.101 multipoint
 ip address 54.1.1.6 255.255.255.0
 frame-relay interface-dlci 101
```

Task 3.2 Verification

Verify dynamic L3 to L2 mappings:

```
Rack1R6#show frame-relay map
Serial0/0/0.101 (up): ip 54.1.1.254 dlci 101(0x65,0x1850), dynamic,
              broadcast,, status defined, active
```

Confirm connectivity:

```
Rack1R6#ping 54.1.1.254

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 54.1.1.254, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 32/32/32 ms
```

Task 3.3

R3:

```
interface Serial1/1
 encapsulation frame-relay
 frame-relay interface-dlci 315 ppp Virtual-Template1
!
interface Virtual-Template1
 ip address 157.1.35.3 255.255.255.0
```

R5:

```
interface Serial0/0
 encapsulation frame-relay
 frame-relay interface-dlci 513 ppp Virtual-Template1
!
interface Virtual-Template1
 ip address 157.1.35.5 255.255.255.0
```


Task 3.3 Verification

Verify PVC status:

```
Rack1R3#show frame-relay pvc 315

PVC Statistics for interface Serial1/1 (Frame Relay DTE)

DLCI = 315, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE =
Serial1/1

  input pkts 9             output pkts 13           in bytes 156
  out bytes 226            dropped pkts 0           in pkts dropped 0
  out pkts dropped 0                 out bytes dropped 0
  in FECN pkts 0           in BECN pkts 0           out FECN pkts 0
  out BECN pkts 0          in DE pkts 0             out DE pkts 0
  out bcast pkts 0         out bcast bytes 0
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
  pvc create time 00:02:37, last time pvc status changed 00:00:31
  Bound to Virtual-Access1 (up, cloned from Virtual-Template1)
```

Confirm connectivity:

```
Rack1R3#ping 157.1.35.5

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 157.1.35.5, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 60/60/64 ms
```

Task 3.4

R3:

```
username Rack1R5 password 0 CISCO
!
interface Virtual-Template1
 ppp authentication chap
```

R5:

```
username Rack1R3 password 0 CISCO
!
interface Virtual-Template1
 ppp authentication chap
```


Task 3.4 Verification

Verify PPP authentication:

```
Rack1R3#debug ppp authentication
PPP authentication debugging is on
Rack1R3#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Rack1R3(config)#int se 1/1
Rack1R3(config-if)#shut
Rack1R3(config-if)#
*Jun  4 00:58:33.775: %LINK-5-CHANGED: Interface Serial1/1, changed
state to administratively down
*Jun  4 00:58:33.779: %LINK-3-UPDOWN: Interface Virtual-Access1,
changed state to down
*Jun  4 00:58:34.775: %LINEPROTO-5-UPDOWN: Line protocol on Interface
Serial1/1, changed state to down
*Jun  4 00:58:34.779: %LINEPROTO-5-UPDOWN: Line protocol on Interface
Virtual-Access1, changed state to down
Rack1R3(config-if)#no shut

*Jun  4 00:58:38.439: %LINK-3-UPDOWN: Interface Serial1/1, changed
state to up
*Jun  4 00:58:38.443: %LINK-3-UPDOWN: Interface Virtual-Access1,
changed state to up
*Jun  4 00:58:38.443: Vi1 PPP: Using default call direction
*Jun  4 00:58:38.443: Vi1 PPP: Treating connection as a dedicated line
*Jun  4 00:58:38.447: Vi1 PPP: Session handle[EC000008] Session id[13]
*Jun  4 00:58:38.447: Vi1 PPP: Authorization required
*Jun  4 00:58:38.607: %LINK-3-UPDOWN: Interface Virtual-Access1,
changed state to down
*Jun  4 00:58:39.439: %LINEPROTO-5-UPDOWN: Line protocol on Interface
Serial1/1, changed state to up
*Jun  4 00:58:58.455: %LINK-3-UPDOWN: Interface Virtual-Access1,
changed state to up
*Jun  4 00:58:58.455: Vi1 PPP: Using default call direction
*Jun  4 00:58:58.455: Vi1 PPP: Treating connection as a dedicated line
*Jun  4 00:58:58.455: Vi1 PPP: Session handle[B1000009] Session id[14]
*Jun  4 00:58:58.455: Vi1 PPP: Authorization required
*Jun  4 00:58:58.559: Vi1 CHAP: O CHALLENGE id 12 len 28 from "Rack1R3"
*Jun  4 00:58:58.579: Vi1 CHAP: I CHALLENGE id 2 len 28 from "Rack1R5"
*Jun  4 00:58:58.583: Vi1 CHAP: Using hostname from unknown source
*Jun  4 00:58:58.583: Vi1 CHAP: Using password from AAA
*Jun  4 00:58:58.583: Vi1 CHAP: O RESPONSE id 2 len 28 from "Rack1R3"
*Jun  4 00:58:58.587: Vi1 CHAP: I RESPONSE id 12 len 28 from "Rack1R5"
Rack1R3(config-if)#
*Jun  4 00:58:58.591: Vi1 PPP: Sent CHAP LOGIN Request
*Jun  4 00:58:58.591: Vi1 PPP: Received LOGIN Response PASS
*Jun  4 00:58:58.595: Vi1 PPP: Sent LCP AUTHOR Request
*Jun  4 00:58:58.595: Vi1 PPP: Sent IPCP AUTHOR Request
*Jun  4 00:58:58.599: Vi1 LCP: Received AAA AUTHOR Response PASS
*Jun  4 00:58:58.599: Vi1 IPCP: Received AAA AUTHOR Response PASS
*Jun  4 00:58:58.599: Vi1 CHAP: O SUCCESS id 12 len 4
*Jun  4 00:58:58.607: Vi1 CHAP: I SUCCESS id 2 len 4
*Jun  4 00:58:58.615: Vi1 PPP: Sent IPCP AUTHOR Request
```



```
*Jun  4 00:58:59.607: %LINEPROTO-5-UPDOWN: Line protocol on Interface
Virtual-Access1, changed state to up
```

Task 3.5

R4:

```
interface Serial0/1
 ip unnumbered Loopback0
 encapsulation ppp
 no peer neighbor-route
```

R5:

```
interface Serial0/1
 ip unnumbered Loopback0
 encapsulation ppp
 no peer neighbor-route
 clockrate 64000
```

Task 3.5 Verification

Verify link status:

```
Rack1R4#show interfaces serial 0/1
Serial0/1 is up, line protocol is up
  Hardware is QUICC Serial
  Interface is unnumbered. Using address of Loopback0 (150.1.4.4)
  MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation PPP, LCP Open
  Open: CDPCP, IPCP, loopback not set
```

Confirm that no additional /32 prefixes appear in routing tables:

```
Rack1R5#show ip route | beg Gate
Gateway of last resort is not set

C    204.12.1.0/24 is directly connected, Ethernet0/0
     157.1.0.0/16 is variably subnetted, 3 subnets, 2 masks
C       157.1.5.0/24 is directly connected, Ethernet0/1
C       157.1.35.3/32 is directly connected, Virtual-Access1
C       157.1.35.0/24 is directly connected, Virtual-Access1
     150.1.0.0/24 is subnetted, 1 subnets
C       150.1.5.0 is directly connected, Loopback0
```


Task 4.1

R1:

```
router rip
 version 2
 passive-interface default
 no passive-interface Serial0/0
 network 157.1.0.0
 no auto-summary
```

R2:

```
key chain RIP
 key 1
  key-string CISCO
!
interface FastEthernet0/0
 ip rip authentication mode md5
 ip rip authentication key-chain RIP
!
router rip
 version 2
 network 150.1.0.0
 network 157.1.0.0
 network 192.10.1.0
 no auto-summary
```

R3:

```
router rip
 version 2
 passive-interface default
 no passive-interface Serial1/0.123
 network 157.1.0.0
 no auto-summary
```

R6:

```
router rip
 version 2
 network 54.0.0.0
 no auto-summary
```


Task 4.1 Verification

Verify RIP routes at R6:

```
Rack1R6#show ip route rip
R    212.18.1.0/24 [120/1] via 54.1.1.254, 00:00:03, Serial0/0/0.101
R    212.18.0.0/24 [120/1] via 54.1.1.254, 00:00:03, Serial0/0/0.101
R    212.18.3.0/24 [120/1] via 54.1.1.254, 00:00:03, Serial0/0/0.101
R    212.18.2.0/24 [120/1] via 54.1.1.254, 00:00:03, Serial0/0/0.101
```

Verify RIP configuration and routes at R2:

```
Rack1R2#show ip protocols
Routing Protocol is "rip"
  Sending updates every 30 seconds, next due in 9 seconds
  Invalid after 180 seconds, hold down 180, flushed after 240
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Redistributing: rip
  Default version control: send version 2, receive version 2
    Interface             Send  Recv  Triggered RIP  Key-chain
    FastEthernet0/0       2     2                   RIP
    Serial0/0             2     2
  Automatic network summarization is not in effect
  Maximum path: 4
  Routing for Networks:
    150.1.0.0
    157.1.0.0
    192.10.1.0
  Passive Interface(s):
    VoIP-Null0
    Serial0/1
    Virtual-Access1
    Loopback0
  Routing Information Sources:
    Gateway         Distance      Last Update
    Gateway         Distance      Last Update
    192.10.1.254         120      00:00:09
    157.1.123.3          120      00:00:11
    157.1.123.1          120      00:00:06
  Distance: (default is 120)

Rack1R2#show ip route rip
R    222.22.2.0/24 [120/7] via 192.10.1.254, 00:00:00, FastEthernet0/0
R    220.20.3.0/24 [120/7] via 192.10.1.254, 00:00:00, FastEthernet0/0
     157.1.0.0/16 is variably subnetted, 6 subnets, 2 masks
R       157.1.148.0/24 [120/1] via 157.1.123.1, 00:00:01, Serial0/0
R       157.1.36.0/24 [120/1] via 157.1.123.3, 00:00:06, Serial0/0
R       157.1.37.0/24 [120/1] via 157.1.123.3, 00:00:06, Serial0/0
R       157.1.35.5/32 [120/1] via 157.1.123.3, 00:00:06, Serial0/0
R       157.1.35.0/24 [120/1] via 157.1.123.3, 00:00:06, Serial0/0
R    205.90.31.0/24 [120/7] via 192.10.1.254, 00:00:00, FastEthernet0/0
```


Verify RIP routes at R1 (no routes from R2 present):

```
Rack1R1#sho ip route rip
     157.1.0.0/16 is variably subnetted, 5 subnets, 2 masks
R       157.1.37.0/24 [120/1] via 157.1.123.3, 00:00:13, Serial0/0
R       157.1.35.5/32 [120/1] via 157.1.123.3, 00:00:02, Serial0/0
R       157.1.35.0/24 [120/1] via 157.1.123.3, 00:00:02, Serial0/0
```

Task 4.2

R1:

```
router rip
 neighbor 157.1.123.2
```

R2:

```
router rip
 neighbor 157.1.123.1
```

Task 4.2 Verification

Verify RIP routes at R1 and R2:

```
Rack1R1#show ip route rip
R    222.22.2.0/24 [120/8] via 157.1.123.2, 00:00:12, Serial0/0
R    220.20.3.0/24 [120/8] via 157.1.123.2, 00:00:12, Serial0/0
     157.1.0.0/16 is variably subnetted, 6 subnets, 2 masks
R       157.1.36.0/24 [120/1] via 157.1.123.3, 00:00:12, Serial0/0
R       157.1.37.0/24 [120/1] via 157.1.123.3, 00:00:12, Serial0/0
R       157.1.35.5/32 [120/1] via 157.1.123.3, 00:00:12, Serial0/0
R       157.1.35.0/24 [120/1] via 157.1.123.3, 00:00:12, Serial0/0
R    192.10.1.0/24 [120/1] via 157.1.123.2, 00:00:12, Serial0/0
     150.1.0.0/24 is subnetted, 2 subnets
R       150.1.2.0 [120/1] via 157.1.123.2, 00:00:12, Serial0/0
R    205.90.31.0/24 [120/8] via 157.1.123.2, 00:00:12, Serial0/0

Rack1R2#show ip route rip
R    222.22.2.0/24 [120/7] via 192.10.1.254, 00:00:22, FastEthernet0/0
R    220.20.3.0/24 [120/7] via 192.10.1.254, 00:00:22, FastEthernet0/0
     157.1.0.0/16 is variably subnetted, 6 subnets, 2 masks
R       157.1.148.0/24 [120/1] via 157.1.123.1, 00:00:13, Serial0/0
R       157.1.36.0/24 [120/1] via 157.1.123.3, 00:00:14, Serial0/0
R       157.1.37.0/24 [120/1] via 157.1.123.3, 00:00:14, Serial0/0
R       157.1.35.5/32 [120/1] via 157.1.123.3, 00:00:14, Serial0/0
R       157.1.35.0/24 [120/1] via 157.1.123.3, 00:00:14, Serial0/0
R    205.90.31.0/24 [120/7] via 192.10.1.254, 00:00:22, FastEthernet0/0
```


Task 4.3

```
R3:
track 1 interface Ethernet0/0 line-protocol
!
track 2 interface Ethernet0/1 line-protocol
!
track 100 list boolean and
 object 1 not
 object 2 not
!
router rip
 redistribute static metric 1
!
ip route 0.0.0.0 0.0.0.0 Null0 track 100
```

Task 4.3 Verification

Verify RIP routes at R1 when both interfaces of R3 are up:

```
Rack1R1#show ip route rip
R    222.22.2.0/24 [120/8] via 157.1.123.2, 00:00:04, Serial0/0
R    220.20.3.0/24 [120/8] via 157.1.123.2, 00:00:04, Serial0/0
     157.1.0.0/16 is variably subnetted, 6 subnets, 2 masks
R       157.1.36.0/24 [120/1] via 157.1.123.3, 00:00:20, Serial0/0
R       157.1.37.0/24 [120/1] via 157.1.123.3, 00:00:20, Serial0/0
R       157.1.35.5/32 [120/1] via 157.1.123.3, 00:00:20, Serial0/0
R       157.1.35.0/24 [120/1] via 157.1.123.3, 00:00:20, Serial0/0
R    192.10.1.0/24 [120/1] via 157.1.123.2, 00:00:04, Serial0/0
     150.1.0.0/24 is subnetted, 2 subnets
R       150.1.2.0 [120/1] via 157.1.123.2, 00:00:04, Serial0/0
R    205.90.31.0/24 [120/8] via 157.1.123.2, 00:00:04, Serial0/0
```

Verify default route generation at R3. Shutdown both Ethernet interfaces:

```
Rack1R3#debug track
Rack1R3#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Rack1R3(config)#int ethernet 0/0
Rack1R3(config-if)#shut
*Jun  4 01:50:26.599: Track: 1 Change #2 interface Et0/0, line-protocol
Up->Down
*Jun  4 01:50:28.599: %LINK-5-CHANGED: Interface Ethernet0/0, changed
state to administratively down
*Jun  4 01:50:29.599: %LINEPROTO-5-UPDOWN: Line protocol on Interface
Ethernet0/0, changed state to down
Rack1R3(config-if)#int ethernet 0/1
Rack1R3(config-if)#shut
Rack1R3(config-if)#
*Jun  4 01:50:34.827: Track: 2 Change #2 interface Et0/1, line-protocol
Up->Down
*Jun  4 01:50:34.991: Track: 100 Change #2 list, boolean and Down->Up(-
>2)
*Jun  4 01:50:36.827: %LINK-5-CHANGED: Interface Ethernet0/1, changed
state to administratively down
```



```
*Jun  4 01:50:37.827: %LINEPROTO-5-UPDOWN: Line protocol on Interface
Ethernet0/1, changed state to down
Rack1R3(config-if)#^Z
*Jun  4 01:50:42.091: %SYS-5-CONFIG_I: Configured from console by
console
Rack1R3#show ip route static
S*   0.0.0.0/0 is directly connected, Null0
```

Look at RIP routes at R1 again:

```
Rack1R1#show ip route rip
R    222.22.2.0/24 [120/8] via 157.1.123.2, 00:00:00, Serial0/0
R    220.20.3.0/24 [120/8] via 157.1.123.2, 00:00:00, Serial0/0
     157.1.0.0/16 is variably subnetted, 4 subnets, 2 masks
R       157.1.35.5/32 [120/1] via 157.1.123.3, 00:00:08, Serial0/0
R       157.1.35.0/24 [120/1] via 157.1.123.3, 00:00:08, Serial0/0
R    192.10.1.0/24 [120/1] via 157.1.123.2, 00:00:00, Serial0/0
     150.1.0.0/24 is subnetted, 2 subnets
R       150.1.2.0 [120/1] via 157.1.123.2, 00:00:00, Serial0/0
R    205.90.31.0/24 [120/8] via 157.1.123.2, 00:00:00, Serial0/0
R*   0.0.0.0/0 [120/1] via 157.1.123.3, 00:00:08, Serial0/0
```

Task 4.4

R3:

```
router ospf 1
 router-id 150.1.3.3
 network 157.1.35.3 0.0.0.0 area 35
```

R5:

```
router ospf 1
 router-id 150.1.5.5
 network 157.1.35.5 0.0.0.0 area 35
```

Task 4.4 Verification

Verify OSPF neighbors:

```
Rack1R5#show ip ospf neighbor

Neighbor ID     Pri   State     Dead Time   Address       nterface
150.1.3.3         0   FULL/  - 00:00:35    157.1.35.3    Virtual-Access1
```


Task 4.5

R3:

```
interface Ethernet0/1
 ip ospf network point-to-point
!
router ospf 1
 network 157.1.36.3 0.0.0.0 area 367
 network 157.1.37.3 0.0.0.0 area 367
```

R6:

```
router ospf 1
 router-id 150.1.6.6
 network 157.1.36.6 0.0.0.0 area 367
```

SW1:

```
ip routing
!
interface Vlan37
 ip ospf network point-to-point
!
router ospf 1
 router-id 150.1.7.7
 network 157.1.37.7 0.0.0.0 area 367
```

Task 4.5 Verification

Verify OSPF neighbors at R3:

```
Rack1R3#show ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
150.1.5.5         0   FULL/  -        00:00:30    157.1.35.5      Virtual-Access1
150.1.7.7         0   FULL/  -        00:00:38    157.1.37.7      Ethernet0/1
150.1.6.6         1   FULL/BDR        00:00:30    157.1.36.6      Ethernet0/0
```


Task 4.6

R4:
```
router ospf 1
 router-id 150.1.4.4
 network 150.1.4.4 0.0.0.0 area 0
```

R5:
```
router ospf 1
 network 150.1.5.5 0.0.0.0 area 0
```

Task 4.6 Verification

Verify OSPF neighbors:

```
Rack1R5#show ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
150.1.4.4         0   FULL/  -        00:00:36    150.1.4.4       Serial0/1
150.1.3.3         0   FULL/  -        00:00:33    157.1.35.3      Virtual-Access1
```

Task 4.7

R3:
```
router ospf 1
 area 35 virtual-link 150.1.5.5
 area 367 virtual-link 150.1.7.7
 area 367 virtual-link 150.1.6.6
 network 150.1.3.3 0.0.0.0 area 0
```

R5:
```
router ospf 1
 area 35 virtual-link 150.1.3.3
```

R6:
```
router ospf 1
 area 367 virtual-link 150.1.3.3
 network 150.1.6.6 0.0.0.0 area 0
```

SW1:
```
router ospf 1
 area 367 virtual-link 150.1.3.3
 network 150.1.7.7 0.0.0.0 area 0
```


Task 4.7 Verification

Check for routers' Loopback0 prefixes at R6:

```
Rack1R6#show ip route ospf | inc 150
     150.1.0.0/16 is variably subnetted, 5 subnets, 2 masks
O       150.1.7.7/32 [110/12] via 157.1.36.3, 00:01:14,
GigabitEthernet0/0
O       150.1.5.5/32 [110/3] via 157.1.36.3, 00:01:14,
GigabitEthernet0/0
O       150.1.4.4/32 [110/67] via 157.1.36.3, 00:01:14,
GigabitEthernet0/0
O       150.1.3.3/32 [110/2] via 157.1.36.3, 00:01:14,
GigabitEthernet0/0
```

Task 4.8

R1:

```
router eigrp 10
 redistribute connected metric 10000 10 255 1 1500 route-map
CONNECTED_TO_EIGRP
 network 157.1.148.1 0.0.0.0
 no auto-summary
 eigrp router-id 150.1.1.1
!
route-map CONNECTED_TO_EIGRP permit 10
 match interface Loopback0 Serial0/0
```

R4:

```
router eigrp 10
 redistribute connected metric 10000 10 255 1 1500 route-map
CONNECTED_TO_EIGRP
 network 157.1.48.4 0.0.0.0
 network 157.1.148.4 0.0.0.0
 no auto-summary
 eigrp router-id 150.1.4.4
!
route-map CONNECTED_TO_EIGRP permit 10
 match interface Loopback0
```

SW2:

```
ip routing
!
router eigrp 10
 redistribute connected metric 10000 10 255 1 1500 route-map
CONNECTED_TO_EIGRP
 network 157.1.8.8 0.0.0.0
 network 157.1.48.8 0.0.0.0
 network 157.1.148.8 0.0.0.0
 no auto-summary
 eigrp router-id 150.1.8.8
!
route-map CONNECTED_TO_EIGRP permit 10
 match interface Loopback0
```


Task 4.8 Verification

Verify EIGRP neighbors:

```
Rack1R4#show ip eigrp neighbors
IP-EIGRP neighbors for process 10
H   Address                 Interface       Hold Uptime   SRTT   RTO  Q  Seq
                                            (sec)         (ms)       Cnt Num
1   157.1.48.8              Et0/1             14 00:00:19  952  5000  0  12
2   157.1.148.8             Et0/0             13 00:00:24    2   200  0  11
0   157.1.148.1             Et0/0             13 00:03:54  170  1020  0  7
```

Verify networks advertisement:

```
Rack1R4#show ip route eigrp
     157.1.0.0/24 is subnetted, 6 subnets
D       157.1.8.0 [90/281856] via 157.1.148.8, 00:02:21, Ethernet0/0
                  [90/281856] via 157.1.48.8, 00:02:21, Ethernet0/1
     150.1.0.0/16 is variably subnetted, 7 subnets, 2 masks
D EX    150.1.1.0/24 [170/2560025856] via 157.1.148.1, 00:02:21,
Ethernet0/0
D EX    150.1.8.0/24 [170/2560025856] via 157.1.148.8, 00:02:09,
Ethernet0/0

Rack1R1#show ip route eigrp
     157.1.0.0/16 is variably subnetted, 8 subnets, 2 masks
D       157.1.8.0/24 [90/28416] via 157.1.148.8,00:01:50,
FastEthernet0/0
D       157.1.48.0/24 [90/284160] via 157.1.148.4, 00:01:50,
FastEthernet0/0
                      [90/284160] via 157.1.148.8, 00:01:50,
FastEthernet0/0
     150.1.0.0/24 is subnetted, 4 subnets
D EX    150.1.4.0 [170/261120] via 157.1.148.4, 00:05:20,
FastEthernet0/0
D EX    150.1.8.0 [170/261120] via 157.1.148.8, 00:01:38,
FastEthernet0/0
```

Task 4.9

R1:

```
router eigrp 10
 distance 91 157.1.148.4 0.0.0.0 48
!
access-list 48 permit 157.1.48.0
```


Task 4.9 Verification

Verify EIGRP route for 157.1.48.0/24 at R1:

```
Rack1R1#show ip route 157.1.48.0
Routing entry for 157.1.48.0/24
  Known via "eigrp 10", distance 90, metric 284160, type internal
  Redistributing via eigrp 10
  Last update from 157.1.148.8 on FastEthernet0/0, 00:00:04 ago
  Routing Descriptor Blocks:
  * 157.1.148.8, from 157.1.148.8, 00:00:04 ago, via FastEthernet0/0
      Route metric is 284160, traffic share count is 1
      Total delay is 1100 microseconds, minimum bandwidth is 10000 Kbit
      Reliability 255/255, minimum MTU 1500 bytes
      Loading 1/255, Hops 1
```

Make sure topology database contains backup path:

```
Rack1R1#show ip eigrp topology 157.1.48.0 255.255.255.0
IP-EIGRP (AS 10): Topology entry for 157.1.48.0/24
  State is Passive, Query origin flag is 1, 1 Successor(s), FD is
284160
  Routing Descriptor Blocks:
  157.1.148.8 (FastEthernet0/0), from 157.1.148.8, Send flag is 0x0
      Composite metric is (284160/281600), Route is Internal
      Vector metric:
        Minimum bandwidth is 10000 Kbit
        Total delay is 1100 microseconds
        Reliability is 255/255
        Load is 1/255
        Minimum MTU is 1500
        Hop count is 1
  157.1.148.4 (FastEthernet0/0), from 157.1.148.4, Send flag is 0x0
      Composite metric is (284160/281600), Route is Internal
      Vector metric:
        Minimum bandwidth is 10000 Kbit
        Total delay is 1100 microseconds
        Reliability is 255/255
        Load is 1/255
        Minimum MTU is 1500
        Hop count is 1
```


Task 4.10

R1:
```
router eigrp 10
 redistribute rip metric 1500 10 255 1 1500
!
router rip
 redistribute eigrp 10 metric 1
```

R3:
```
router ospf 1
 redistribute rip subnets
!
router rip
 redistribute ospf 1 metric 1
```

R4:
```
router eigrp 10
 redistribute ospf 1 metric 1500 10 255 1 1500
!
router ospf 1
 redistribute eigrp 10 subnets
```

R6:
```
router ospf 1
 redistribute rip subnets
!
router rip
 redistribute ospf 1 metric 1
```

Task 4.11

R1:
```
router eigrp 10
 redistribute rip metric 1500 10 255 1 1500 route-map RIP_TO_EIGRP
!
route-map RIP_TO_EIGRP permit 10
 set tag 1120
```

R3:
```
router rip
 redistribute ospf 1 metric 1 route-map OSPF_TO_RIP
 distance 109
!
route-map OSPF_TO_RIP deny 5
 match tag 1120
!
route-map OSPF_TO_RIP permit 10
 set tag 3110
```

R4:
```
router ospf 1
  distance ospf external 171
```


Tasks 4.10 – 4.11 Verification

Verify full connectivity with the following Tcl script:

```
foreach i {
157.1.148.1
157.1.123.1
150.1.1.1
192.10.1.2
157.1.123.2
150.1.2.2
157.1.36.3
157.1.37.3
157.1.123.3
157.1.35.3
150.1.3.3
157.1.148.4
157.1.48.4
150.1.4.4
150.1.5.5
157.1.35.5
157.1.36.6
54.1.1.6
150.1.6.6
157.1.37.7
150.1.7.7
157.1.8.8
157.1.48.8
157.1.148.8
150.1.8.8
} { ping $i }
```

Note that VLAN5, VLAN7 and VLAN53 are not part of any IGP and are excluded from connectivity test.

Task 5.1

R1:
```
router bgp 65148
 bgp router-id 150.1.1.1
 neighbor 157.1.48.4 remote-as 65148
 neighbor 157.1.48.8 remote-as 65148
 neighbor 157.1.123.2 remote-as 200
 neighbor 157.1.123.2 ebgp-multihop 255
 neighbor 157.1.123.3 remote-as 100
```

R2:
```
router bgp 200
 bgp router-id 150.1.2.2
 neighbor 157.1.123.1 remote-as 65148
 neighbor 157.1.123.1 ebgp-multihop 255
```

R3:
```
router bgp 100
 bgp router-id 150.1.3.3
 neighbor 157.1.35.5 remote-as 100
 neighbor 157.1.36.6 remote-as 100
 neighbor 157.1.37.7 remote-as 100
 neighbor 157.1.123.1 remote-as 65148
```

R4:
```
router bgp 65148
 bgp router-id 150.1.4.4
 neighbor 150.1.5.5 remote-as 100
 neighbor 150.1.5.5 ebgp-multihop 255
 neighbor 150.1.8.8 remote-as 65148
 neighbor 150.1.8.8 update-source Loopback0
 neighbor 157.1.148.1 remote-as 65148
 neighbor 157.1.148.1 update-source Ethernet0/1
```

R5:
```
router bgp 100
 bgp router-id 150.1.5.5
 neighbor 150.1.4.4 remote-as 65148
 neighbor 150.1.4.4 ebgp-multihop 255
 neighbor 157.1.35.3 remote-as 100
 neighbor 157.1.36.6 remote-as 100
 neighbor 157.1.37.7 remote-as 100
 neighbor 204.12.1.254 remote-as 54
```

R6:
```
router bgp 100
 bgp router-id 150.1.6.6
 neighbor 54.1.1.254 remote-as 54
 neighbor 157.1.35.5 remote-as 100
 neighbor 157.1.36.3 remote-as 100
 neighbor 157.1.37.7 remote-as 100
```


SW1:

```
router bgp 100
 no synchronization
 bgp router-id 150.1.7.7
 neighbor 157.1.35.5 remote-as 100
 neighbor 157.1.36.6 remote-as 100
 neighbor 157.1.37.3 remote-as 100
```

SW2:

```
router bgp 65148
 no synchronization
 bgp router-id 150.1.8.8
 neighbor 150.1.4.4 remote-as 65148
 neighbor 150.1.4.4 update-source Loopback0
 neighbor 157.1.148.1 remote-as 65148
 neighbor 157.1.148.1 update-source FastEthernet0/4
```

Task 5.1 Verification

Verify BGP neighbors:

```
Rack1R1#show ip bgp summary  | beg Nei
Neighbor     V AS  MsgRcvd MsgSent TblVer InQ OutQ Up/Down  State/PfxRcd
157.1.48.4   4 65148  17      18       21  0    0   00:12:45        10
157.1.48.8   4 65148  15      17       21  0    0   00:11:48        0
157.1.123.2  4   200  17      21       21  0    0   00:13:13        0
157.1.123.3  4   100  18      20       21  0    0   00:13:09        10

Rack1R5#show ip bgp summary  | beg Nei
Neighbor     V AS  MsgRcvd MsgSent TblVer InQ OutQ Up/Down  State/PfxRcd
150.1.4.4    4 65148  17      21       11  0    0   00:14:07        0
157.1.35.3   4   100  17      21       11  0    0   00:14:18        0
157.1.36.6   4   100  20      20       11  0    0   00:13:52        10
157.1.37.7   4   100  16      20       11  0    0   00:13:47        0
204.12.1.254 4    54  21      21       11  0    0   00:13:51        10

Rack1R6#show ip bgp summary  | beg Nei
Neighbor     V AS MsgRcvd MsgSent TblVer InQ OutQ Up/Down  State/PfxRcd
54.1.1.254   4 54   22      18       11   0    0   00:14:24        10
157.1.35.5   4 100  21      21       11   0    0   00:14:48        10
157.1.36.3   4 100  17      21       11   0    0   00:14:46        0
157.1.37.7   4 100  17      21       11   0    0   00:14:29        0
```


Task 5.2

R5:
```
router bgp 100
 network 157.1.5.0 mask 255.255.255.0
 network 204.12.1.0
```

SW1:
```
router bgp 100
 redistribute connected route-map CONNECTED_TO_BGP
!
route-map CONNECTED_TO_BGP permit 10
 match interface Vlan7
```

SW2:
```
router bgp 65148
 network 157.1.8.0 mask 255.255.255.0
```

Task 5.2 Verification

Verify prefix origination:

```
Rack1R5#show ip bgp | inc 157
*> 157.1.5.0/24     0.0.0.0                  0         32768 i
*>i157.1.7.0/24     157.1.37.7               0    100      0 ?
*> 157.1.8.0/24     150.1.4.4                              0 65148 i
* i                 157.1.123.1              0    100      0 65148 i
```

Confirm connectivity to BB3 from R5:

```
Rack1R5#ping 112.0.0.1 source ethernet 0/1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 112.0.0.1, timeout is 2 seconds:
Packet sent with a source address of 157.1.5.5
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 32/40/64 ms

Rack1R5#ping 28.119.16.1 source ethernet 0/1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 28.119.16.1, timeout is 2 seconds:
Packet sent with a source address of 157.1.5.5
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 4/5/8 ms
```

