Task 2.1

R6:

```
key chain EIGRP
 key 1
  key-string CISCO
!
interface Serial0/0
 ip authentication mode eigrp 10 md5
 ip authentication key-chain eigrp 10 EIGRP
```

Task 2.1 Verification

Verify EIGRP authentication:

```
Rack1R6#show ip eigrp interfaces detail s0/0/0
IP-EIGRP interfaces for process 10

                  Xmit Queue   Mean   Pacing Time   Multicast    Pending
Interface Peers  Un/Reliable  SRTT   Un/Reliable   Flow Timer   Routes
Se0/0/0     1        0/0        70       0/15          50           0
  Hello interval is 60 sec
  Next xmit serial <none>
  Un/reliable mcasts: 0/0  Un/reliable ucasts: 1/4
  Mcast exceptions: 0  CR packets: 0  ACKs suppressed: 0
  Retransmissions sent: 1  Out-of-sequence rcvd: 0
  Authentication mode is md5,  key-chain is "EIGRP"
```

Check EIGRP neighbors:

```
Rack1R6#show ip eigrp neighbor
IP-EIGRP neighbors for process 10
H   Address          Interface       Hold Uptime   SRTT   RTO  Q  Seq
                                     (sec)         (ms)       Cnt Num
1   54.1.1.254       Se0/0/0           13 00:00:39   70   420  0  51
0   156.1.67.7       Gi0/0             14 00:08:26    1   200  0  7
```

Check EIGRP routes:

```
Rack1R6#show ip route eigrp
D    200.0.0.0/24 [90/2297856] via 54.1.1.254, 00:01:48, Serial0/0/0
D    200.0.1.0/24 [90/2297856] via 54.1.1.254, 00:01:48, Serial0/0/0
     156.1.0.0/24 is subnetted, 9 subnets
D       156.1.27.0 [90/28416] via 156.1.67.7, 00:09:31, FastEthernet0/0
D       156.1.23.0 [90/2172672] via 156.1.67.7, 00:04:09,
FastEthernet0/0
D       156.1.18.0 [90/4735232] via 156.1.67.7, 00:04:09,
FastEthernet0/0
D       156.1.13.0 [90/4732672] via 156.1.67.7, 00:04:09,
FastEthernet0/0
D       156.1.8.0 [90/4735488] via 156.1.67.7, 00:04:09,
FastEthernet0/0
D       156.1.3.0 [90/2198272] via 156.1.67.7, 00:04:09,
FastEthernet0/0
```



```
D       156.1.58.0 [90/4735488] via 156.1.67.7, 00:04:09,
FastEthernet0/0
D       156.1.35.0 [90/4732672] via 156.1.67.7, 00:04:09,
FastEthernet0/0
D    200.0.2.0/24 [90/2297856] via 54.1.1.254, 00:01:48, Serial0/0/0
D    200.0.3.0/24 [90/2297856] via 54.1.1.254, 00:01:48, Serial0/0/0
     150.1.0.0/24 is subnetted, 7 subnets
D       150.1.7.0 [90/156160] via 156.1.67.7, 00:09:32, FastEthernet0/0
D       150.1.5.0 [90/4860672] via 156.1.67.7, 00:04:10,
FastEthernet0/0
D       150.1.3.0 [90/2300672] via 156.1.67.7, 00:04:10,
FastEthernet0/0
D       150.1.2.0 [90/156416] via 156.1.67.7, 00:04:10, FastEthernet0/0
D       150.1.1.0 [90/4860672] via 156.1.67.7, 00:04:10,
FastEthernet0/0
D       150.1.8.0 [90/4863232] via 156.1.67.7, 00:04:10,
FastEthernet0/0
```

Task 2.2

R1:

```
interface FastEthernet0/0
 ip hello-interval eigrp 10 1
 ip hold-time eigrp 10 5
```

R5:

```
interface FastEthernet0/1
 ip hello-interval eigrp 10 1
 ip hold-time eigrp 10 5
```

SW2:

```
interface Vlan18
 ip hello-interval eigrp 10 1
 ip hold-time eigrp 10 5
!
interface Vlan58
 ip hello-interval eigrp 10 1
 ip hold-time eigrp 10 5
!
router eigrp 10
 offset-list ODD_THIRD_OCTET in 111111111 Vlan18
 offset-list EVEN_THIRD_OCTET in 111111111 Vlan58
!
ip access-list standard EVEN_THIRD_OCTET
 permit 0.0.0.0 255.255.254.255
ip access-list standard ODD_THIRD_OCTET
 permit 0.0.1.0 255.255.254.255
```

Task 2.2 Verification

Check hello timer at R5 (output available in recent IOS versions):

```
Rack1R5#show ip eigrp interfaces detail e0/1
IP-EIGRP interfaces for process 10

                Xmit Queue   Mean   Pacing Time   Multicast    Pending
Interface Peers  Un/Reliable  SRTT   Un/Reliable   Flow Timer   Routes
Et0/1      1        0/0      1254       0/10        6260           0
  Hello interval is 1 sec
  Next xmit serial <none>
  Un/reliable mcasts: 0/7  Un/reliable ucasts: 8/9
  Mcast exceptions: 3  CR packets: 3  ACKs suppressed: 2
  Retransmissions sent: 4  Out-of-sequence rcvd: 1
  Authentication mode is not set
```

Check paths to EIGRP prefixes with even third octet:

```
Rack1SW2#show ip route eigrp | include Vlan18
D    200.0.0.0/24 [90/23717376] via 156.1.18.1, 00:00:14, Vlan18
D    200.0.2.0/24 [90/23717376] via 156.1.18.1, 00:00:14, Vlan18
D       150.1.6.0 [90/23205376] via 156.1.18.1, 00:00:14, Vlan18
D       150.1.2.0 [90/23200256] via 156.1.18.1, 00:00:14, Vlan18
```

Check paths to EIGRP prefixes with odd third octect:

```
Rack1SW2#show ip route eigrp | include Vlan58
D       54.1.1.0 [90/23589376] via 156.1.58.5, 00:00:20, Vlan58
D    200.0.1.0/24 [90/23717376] via 156.1.58.5, 00:00:20, Vlan58
D       156.1.27.0 [90/23074816] via 156.1.58.5, 00:00:20, Vlan58
D       156.1.23.0 [90/23072256] via 156.1.58.5, 00:00:20, Vlan58
D       156.1.13.0 [90/5145856] via 156.1.58.5, 00:00:20, Vlan58
D       156.1.3.0 [90/2841856] via 156.1.58.5, 00:00:20, Vlan58
D       156.1.35.0 [90/2585856] via 156.1.58.5, 00:00:17, Vlan58
D       156.1.67.0 [90/23077376] via 156.1.58.5, 00:00:20, Vlan58
D    200.0.3.0/24 [90/23717376] via 156.1.58.5, 00:00:20, Vlan58
D       150.1.7.0 [90/23202816] via 156.1.58.5, 00:00:20, Vlan58
D       150.1.5.0 [90/130816] via 156.1.58.5, 00:00:18, Vlan58
D       150.1.3.0 [90/2713856] via 156.1.58.5, 00:00:20, Vlan58
D       150.1.1.0 [90/5273856] via 156.1.58.5, 00:00:20, Vlan58
```

Task 2.3

R1:
```
interface Virtual-Template1
 ip bandwidth-percent eigrp 10 10
```

R3:
```
interface Virtual-Template1
 ip bandwidth-percent eigrp 10 10
!
interface Virtual-Template2
 ip bandwidth-percent eigrp 10 10
```

R5:
```
interface Virtual-Template1
 ip bandwidth-percent eigrp 10 10
```

Task 2.4

R1, R2, R3, R5, R6, SW1 and SW2:
```
router eigrp 10
 timers active-time 5
```

Task 2.5

R5:
```
router odr
!
router eigrp 10
redistribute connected
redistribute odr metric 1500 1000 255 1 1500
```

Task 2.5 Verification

Verify CDP configuration:

```
Rack1R4#show cdp neighbors
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
                  S - Switch, H - Host, I - IGMP, r - Repeater

Device ID    Local Intrfce     Holdtme    Capability  Platform  Port ID
Rack1SW2     Eth 0/1            160         R S I      WS-C3550-2Fas 0/4
Rack1SW1     Eth 0/0            155         R S I      WS-C3550-2Fas 0/4
Rack1R5      Ser 0/1            160         R S I      3640      Ser 0/1

Rack1R4#show ip protocols

Rack1R4#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
```



```
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS
level-2
       ia - IS-IS inter area, * - candidate default, U - per-user
static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is 156.1.45.5 to network 0.0.0.0

     156.1.0.0/24 is subnetted, 3 subnets
C       156.1.4.0 is directly connected, FastEthernet0/0
C       156.1.45.0 is directly connected, Serial0/1
C       156.1.44.0 is directly connected, FastEthernet0/1
     150.1.0.0/24 is subnetted, 1 subnets
C       150.1.4.0 is directly connected, Loopback0
o*   0.0.0.0/0 [160/1] via 156.1.45.5, 00:00:26, Serial0/1

Rack1R4#debug cdp packets
CDP packet info debugging is on
Rack1R4#debug cdp events
CDP events debugging is on
Rack1R4#debug cdp ip
CDP IP info debugging is on

Rack1R4#
 CDP-EV: Unrecognized type (16) seen in TLV
 CDP-PA: Packet received from Rack1SW1 on interface FastEthernet0/0
 **Entry  found in cache**
 CDP-EV: Lookup for ip phone with idb= FastEthernet0/0 ip= 156.1.27.7
mac= 000f.8fe0.3504 platform= Cisco WS-C3550-24
 CDP-IP: Writing prefix 150.1.4.0/24
 CDP-IP: Writing prefix 156.1.45.0/24
 CDP-IP: Writing prefix 156.1.44.0/24
 CDP-PA: version 2 packet sent out on FastEthernet0/0
 CDP-IP: Writing prefix 150.1.4.0/24
 CDP-IP: Writing prefix 156.1.4.0/24
 CDP-IP: Writing prefix 156.1.45.0/24
 CDP-PA: version 2 packet sent out on FastEthernet0/1
 CDP-IP: Writing prefix 150.1.4.0/24
 CDP-IP: Writing prefix 156.1.4.0/24
 CDP-IP: Writing prefix 156.1.44.0/24
 CDP-PA: version 2 packet sent out on Serial0/1
 CDP-PA: Packet received from Rack1R5 on interface Serial0/1
 **Entry  found in cache**
 CDP-EV: Lookup for ip phone with idb= Serial0/1 ip= 156.1.45.5 mac=
0000.0000.0000 platform= Cisco 3640
CDP-IP: Reading default route 156.1.45.5 via Serial0/1
CDP-IP: Updating default route 156.1.45.5 in routing table

Rack1R5#show ip route odr
     156.1.0.0/24 is subnetted, 12 subnets
o       156.1.4.0 [160/1] via 156.1.45.4, 00:00:10, Serial0/1
o       156.1.44.0 [160/1] via 156.1.45.4, 00:00:10, Serial0/1
     150.1.0.0/24 is subnetted, 8 subnets
o       150.1.4.0 [160/1] via 156.1.45.4, 00:00:10, Serial0/1
```

Test connectivity between ODR/EIGRP domains:


```
Rack1R1#ping 150.1.4.4

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 150.1.4.4, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 116/119/120
ms
```

Task 2.6

R5:

```
router bgp 100
 neighbor 192.10.1.254 remote-as 254
 neighbor 192.10.1.254 local-as 200 no-prepend
 neighbor 192.10.1.254 password CISCO
```

Task 2.6 Verification

Verify BGP peering:

```
Rack1R5#show ip bgp neighbors 192.10.1.254
BGP neighbor is 192.10.1.254,  remote AS 254,  local AS 200 no-prepend,
external link
  BGP version 4, remote router ID 222.22.2.1
  BGP state = Established, up for 00:00:14
  Last read 00:00:14, last write 00:00:14, hold time is 180, keepalive
interval is 60 seconds
<output omitted>
```

Verify BGP routes:

```
Rack1R5#show ip bgp q _254$
BGP table version is 14, 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      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 2.7

R5:

```
router bgp 100
redistribute connected route-map INTERNAL_TO_BGP
redistribute eigrp 10 route-map INTERNAL_TO_BGP
!
ip prefix-list INTERNAL seq 5 permit 156.1.0.0/16 le 32
ip prefix-list INTERNAL seq 10 permit 150.1.0.0/16 le 32
!
```

```
route-map INTERNAL_TO_BGP permit 10
match ip address prefix-list INTERNAL
```

R6:

```
router bgp 100
redistribute eigrp 10 route-map INTERNAL_TO_BGP
!
ip prefix-list INTERNAL seq 5 permit 156.1.0.0/16 le 32
ip prefix-list INTERNAL seq 10 permit 150.1.0.0/16 le 32
!
route-map INTERNAL_TO_BGP permit 10
match ip address prefix-list INTERNAL
```

Task 2.7 Verification

Verify BGP prefixes advertisement:

```
Rack1R6#show ip bgp q ^$
BGP table version is 68, 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
*> 150.1.1.0/24     156.1.67.7         4860672         32768 ?
* i                 150.1.5.5          5273600    100      0 ?
*> 150.1.2.0/24     156.1.67.7          156416         32768 ?
* i                 150.1.5.5         23200000    100      0 ?
*> 150.1.3.0/24     156.1.67.7         2300672         32768 ?
* i                 150.1.5.5          2713600    100      0 ?
*> 150.1.4.0/24     156.1.67.7         5037312         32768 ?
*> 150.1.5.0/24     156.1.67.7         4860672         32768 ?
* i                 150.1.5.5                0    100      0 ?
*> 150.1.6.0/24     0.0.0.0                  0         32768 ?
* i                 150.1.5.5          23205120    100      0 ?
*> 150.1.7.0/24     156.1.67.7          156160         32768 ?
* i                 150.1.5.5          23202560    100      0 ?
*> 150.1.8.0/24     156.1.67.7         4863232         32768 ?
* i                 150.1.5.5           409600    100      0 ?
*> 156.1.3.0/24     156.1.67.7         2198272         32768 ?
* i                 150.1.5.5          2841600    100      0 ?
*> 156.1.4.0/24     156.1.67.7         5037312         32768 ?
*> 156.1.8.0/24     156.1.67.7         4735488         32768 ?
* i                 150.1.5.5           281856    100      0 ?
*> 156.1.13.0/24    156.1.67.7         4732672         32768 ?
* i                 150.1.5.5          5145600    100      0 ?
*> 156.1.18.0/24    156.1.67.7         4735232         32768 ?
* i                 150.1.5.5           281856    100      0 ?
*> 156.1.23.0/24    156.1.67.7         2172672         32768 ?
* i                 150.1.5.5          23072000    100      0 ?
*> 156.1.27.0/24    156.1.67.7           28416         32768 ?
* i                 150.1.5.5          23074560    100      0 ?
*> 156.1.35.0/24    156.1.67.7         4732672         32768 ?
* i                 150.1.5.5                0    100      0 ?
*> 156.1.44.0/24    156.1.67.7         5037312         32768 ?
```



```
*> 156.1.45.0/24    156.1.67.7         5244672         32768 ?
* i                 150.1.5.5                0    100      0 ?
*> 156.1.58.0/24    156.1.67.7         4735488         32768 ?
* i                 150.1.5.5                0    100      0 ?
*> 156.1.67.0/24    0.0.0.0                  0         32768 ?
* i                 150.1.5.5         23077120    100      0 ?

Rack1R5#show ip bgp q ^$
BGP table version is 37, 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
* i150.1.1.0/24     150.1.6.6          4860672    100      0 ?
*>                  156.1.35.3         5273600         32768 ?
* i150.1.2.0/24     150.1.6.6           156416    100      0 ?
*>                  156.1.35.3        23200000         32768 ?
* i150.1.3.0/24     150.1.6.6          2300672    100      0 ?
*>                  156.1.35.3         2713600         32768 ?
r>i150.1.4.0/24     150.1.6.6          5037312    100      0 ?
* i150.1.5.0/24     150.1.6.6          4860672    100      0 ?
*>                  0.0.0.0                  0         32768 ?
* i150.1.6.0/24     150.1.6.6                0    100      0 ?
*>                  156.1.35.3        23205120         32768 ?
* i150.1.7.0/24     150.1.6.6           156160    100      0 ?
*>                  156.1.35.3        23202560         32768 ?
* i150.1.8.0/24     150.1.6.6          4863232    100      0 ?
*>                  156.1.58.8          409600         32768 ?
* i156.1.3.0/24     150.1.6.6          2198272    100      0 ?
*>                  156.1.35.3         2841600         32768 ?
r>i156.1.4.0/24     150.1.6.6          5037312    100      0 ?
* i156.1.8.0/24     150.1.6.6          4735488    100      0 ?
*>                  156.1.58.8          281856         32768 ?
* i156.1.13.0/24    150.1.6.6          4732672    100      0 ?
*>                  156.1.35.3         5145600         32768 ?
* i156.1.18.0/24    150.1.6.6          4735232    100      0 ?
*>                  156.1.58.8          281856         32768 ?
* i156.1.23.0/24    150.1.6.6          2172672    100      0 ?
*>                  156.1.35.3        23072000         32768 ?
* i156.1.27.0/24    150.1.6.6            28416    100      0 ?
*>                  156.1.35.3        23074560         32768 ?
* i156.1.35.0/24    150.1.6.6          4732672    100      0 ?
*>                  0.0.0.0                  0         32768 ?
r>i156.1.44.0/24    150.1.6.6          5037312    100      0 ?
* i156.1.45.0/24    150.1.6.6          5244672    100      0 ?
*>                  0.0.0.0                  0         32768 ?
* i156.1.58.0/24    150.1.6.6          4735488    100      0 ?
*>                  0.0.0.0                  0         32768 ?
* i156.1.67.0/24    150.1.6.6                0    100      0 ?
*>                  156.1.35.3        23077120         32768 ?
```

Task 2.8

R5:

```
interface FastEthernet0/1
 ip summary-address eigrp 10 0.0.0.0 0.0.0.0 5 leak-map LEAK
!
interface Virtual-Template1
 ip summary-address eigrp 10 0.0.0.0 0.0.0.0 5 leak-map LEAK
!
ip prefix-list BACKBONES seq 5 permit 192.10.1.0/24
ip prefix-list BACKBONES seq 10 permit 204.12.1.0/24
!
ip prefix-list INTERNAL seq 5 permit 156.1.0.0/16 le 32
ip prefix-list INTERNAL seq 10 permit 150.1.0.0/16 le 32
!
route-map LEAK permit 10
 match ip address prefix-list INTERNAL
!
route-map LEAK permit 20
 match ip address prefix-list BACKBONES
```

R6:

```
interface FastEthernet0/0
 ip summary-address eigrp 10 0.0.0.0 0.0.0.0 5 leak-map LEAK
!
ip prefix-list EIGRP_LEARNED_FROM_BB1 seq 5 permit 200.0.0.0/21 le 24
ip prefix-list EIGRP_LEARNED_FROM_BB1 seq 10 permit 54.1.1.0/24
!
ip prefix-list INTERNAL seq 5 permit 156.1.0.0/16 le 32
ip prefix-list INTERNAL seq 10 permit 150.1.0.0/16 le 32
!
route-map LEAK permit 10
 match ip address prefix-list INTERNAL
!
route-map LEAK permit 20
 match ip address prefix-list EIGRP_LEARNED_FROM_BB1
```

Task 2.8 Verification

Verify EIGRP routes:

```
Rack1R3#show ip route eigrp
D EX 204.12.1.0/24 [170/2841600] via 156.1.35.5, 00:00:18, Virtual-
Access2
D    200.0.0.0/24 [90/21157120] via 156.1.23.2, 00:00:02, Serial1/3
     54.0.0.0/24 is subnetted, 1 subnets
D       54.1.1.0 [90/21029120] via 156.1.23.2, 00:00:02, Serial1/3
D    200.0.1.0/24 [90/21157120] via 156.1.23.2, 00:00:02, Serial1/3
     156.1.0.0/24 is subnetted, 12 subnets
D       156.1.27.0 [90/20514560] via 156.1.23.2, 00:54:26, Serial1/3
D       156.1.18.0 [90/2588160] via 156.1.13.1, 00:00:18, Virtual-
Access1
D       156.1.8.0 [90/2588416] via 156.1.13.1, 00:00:18, Virtual-
Access1
D EX    156.1.4.0 [170/4522496] via 156.1.35.5, 00:00:18, Virtual-
Access2
D       156.1.58.0 [90/2588416] via 156.1.13.1, 00:00:18, Virtual-
Access1
```

```
D EX    156.1.45.0 [170/4729856] via 156.1.35.5, 00:00:18, Virtual-
Access2
D EX    156.1.44.0 [170/4522496] via 156.1.35.5, 00:00:18, Virtual-
Access2
D       156.1.67.0 [90/20517120] via 156.1.23.2, 00:48:26, Serial1/3
D    200.0.2.0/24 [90/21157120] via 156.1.23.2, 00:00:02, Serial1/3
D    200.0.3.0/24 [90/21157120] via 156.1.23.2, 00:00:04, Serial1/3
D EX 192.10.1.0/24 [170/2841600] via 156.1.35.5, 00:00:19, Virtual-
Access2
     150.1.0.0/24 is subnetted, 8 subnets
D       150.1.7.0 [90/20642560] via 156.1.23.2, 00:48:27, Serial1/3
D       150.1.6.0 [90/20645120] via 156.1.23.2, 00:00:04, Serial1/3
D       150.1.5.0 [90/2713600] via 156.1.35.5, 00:00:19, Virtual-
Access2
D EX    150.1.4.0 [170/4522496] via 156.1.35.5, 00:00:19, Virtual-
Access2
D       150.1.2.0 [90/20640000] via 156.1.23.2, 00:54:27, Serial1/3
D       150.1.1.0 [90/2713600] via 156.1.13.1, 00:53:34, Virtual-
Access1
D       150.1.8.0 [90/2716160] via 156.1.13.1, 00:00:21, Virtual-
Access1
D*   0.0.0.0/0 [90/2713600] via 156.1.35.5, 00:00:06, Virtual-Access2
```

Test connectivity with external BGP prefixes:

```
Rack1R3#traceroute 112.0.0.1

Type escape sequence to abort.
Tracing the route to 112.0.0.1

  1 156.1.35.5 32 msec 28 msec 28 msec
  2 204.12.1.254 36 msec 32 msec 32 msec
  3 172.16.4.1 44 msec *  168 msec

Rack1R3#trace  205.90.31.1

Type escape sequence to abort.
Tracing the route to 205.90.31.1

  1 156.1.35.5 32 msec 32 msec 32 msec
  2 192.10.1.254 32 msec *  32 msec
```

Task 3.1

R3:

```
interface FastEthernet0/0
 ipv6 nat
!
interface FastEthernet0/1
ipv6 nat
!
ipv6 nat v4v6 source 156.1.8.100 2001:CC1E:FFFF::100
ipv6 nat v6v4 source 2001:CC1E:1:3::100 156.1.8.50
ipv6 nat prefix 2001:CC1E:FFFF::/96
```


Task 3.1 Verification

Simulate IPv6 host on VLAN3 with R6 Gig0/1:

R6:
```
interface FastEthernet0/1
 no shutdown
 ipv6 address 2001:CC1E:1:3::100/64
```

R3:
```
interface FastEthernet0/1
 no shutdown
 ip address 156.1.8.3 255.255.255.0
!
router eigrp 10
 passive-interface FastEthernet0/1
```

SW2:
```
interface FastEthernet0/6
 switchport access vlan 3
!
interface FastEthernet0/3
 switchport access vlan 8
```

Test basic configuration:

```
Rack1R3#ping 156.1.8.8

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 156.1.8.8, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/4 ms

Rack1R3#ping 2001:CC1E:1:3::100

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2001:CC1E:1:3::100, timeout is 2
seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/1/4 ms
```

Check local IP aliases:

```
Rack1R3#show ip aliases
Address Type             IP Address      Port
Interface                156.1.23.3
Interface                156.1.13.3
Interface                156.1.13.3
Interface                156.1.8.3
Interface                150.1.3.3
Interface                156.1.3.3
Interface                156.1.35.3
Interface                156.1.35.3

Rack1SW2#ping 156.1.8.50
```



```
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 156.1.8.50, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)
```

Note that 156.1.8.50 is NOT listed in IP aliases. That is, IPv6 NAT-PT does not create IPv4 alias automatically. There are three ways to remedy this situation:

1. *Assign 156.1.8.50 as the secondary IP to FastEthernet 0/1 of R3*
2. *Create static ARP entry at SW2, pointing at R3*
3. *Create static route at SW2 for 156.1.8.50/32, pointing at R3*

Following the first one, assign 156.1.8.50 as secondary IP:

R3:

```
interface FastEthernet0/1
 ip address 156.1.8.50 255.255.255.0 secondary
```

Test the new configuration:

```
Rack1R3#debug ipv6 nat
IPv6 NAT-PT debugging is on

Rack1R6#debug ipv6 icmp
ICMP packet debugging is on

Rack1SW2#ping 156.1.8.50

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 156.1.8.50, timeout is 2 seconds:
.!!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 4/4/4 ms

Rack1R3#
IPv6 NAT:  src (156.1.8.8) -> (2001:CC1E:FFFF::9C01:808), dst
(156.1.8.50) -> (2001:CC1E:1:3::100)
IPv6 NAT: icmp src (2001:CC1E:1:3::100) -> (156.1.8.50), dst
(2001:CC1E:FFFF::9C01:808) -> (156.1.8.8)
IPv6 NAT:  src (156.1.8.8) -> (2001:CC1E:FFFF::9C01:808), dst
(156.1.8.50) -> (2001:CC1E:1:3::100)
IPv6 NAT: icmp src (2001:CC1E:1:3::100) -> (156.1.8.50), dst
(2001:CC1E:FFFF::9C01:808) -> (156.1.8.8)
IPv6 NAT:  src (156.1.8.8) -> (2001:CC1E:FFFF::9C01:808), dst
(156.1.8.50) -> (2001:CC1E:1:3::100)
IPv6 NAT: icmp src (2001:CC1E:1:3::100) -> (156.1.8.50), dst
(2001:CC1E:FFFF::9C01:808) -> (156.1.8.8)
IPv6 NAT:  src (156.1.8.8) -> (2001:CC1E:FFFF::9C01:808), dst
(156.1.8.50) -> (2001:CC1E:1:3::100)
IPv6 NAT: icmp src (2001:CC1E:1:3::100) -> (156.1.8.50), dst
(2001:CC1E:FFFF::9C01:808) -> (156.1.8.8)

Rack1R6#
ICMPv6: Received ICMPv6 packet from 2001:CC1E:FFFF::9C01:808, type 128
ICMPv6: Received echo request from 2001:CC1E:FFFF::9C01:808
ICMPv6: Sending echo reply to 2001:CC1E:FFFF::9C01:808
ICMPv6: Received ICMPv6 packet from 2001:CC1E:FFFF::9C01:808, type 128
```

```
ICMPv6: Received echo request from 2001:CC1E:FFFF::9C01:808
ICMPv6: Sending echo reply to 2001:CC1E:FFFF::9C01:808
ICMPv6: Received ICMPv6 packet from 2001:CC1E:FFFF::9C01:808, type 128
ICMPv6: Received echo request from 2001:CC1E:FFFF::9C01:808
ICMPv6: Sending echo reply to 2001:CC1E:FFFF::9C01:808
ICMPv6: Received ICMPv6 packet from 2001:CC1E:FFFF::9C01:808, type 128
ICMPv6: Received echo request from 2001:CC1E:FFFF::9C01:808
ICMPv6: Sending echo reply to 2001:CC1E:FFFF::9C01:808
ICMPv6: Received ICMPv6 packet from 2001:CC1E:FFFF::9C01:808, type 128
ICMPv6: Received echo request from 2001:CC1E:FFFF::9C01:808
ICMPv6: Sending echo reply to 2001:CC1E:FFFF::9C01:808
```

Task 5.1

R1:

```
ip pim autorp listener
!
ip pim send-rp-announce FastEthernet0/0 scope 16 group-list 1
!
access-list 1 permit 224.0.0.0 7.255.255.255
```

R3:

```
ip pim autorp listener
```

R5:

```
ip pim autorp listener
!
ip pim send-rp-announce FastEthernet0/1 scope 16 group-list 1
!
access-list 1 permit 232.0.0.0 7.255.255.255
```

SW2:

```
interface loopback0
 ip pim sparse-mode
!
ip pim autorp listener
!
ip pim send-rp-discovery loopback0 scope 16
```

Task 5.1 Verification

Verify RP mappings:

```
Rack1R3#show ip pim rp mapping
PIM Group-to-RP Mappings

Group(s) 224.0.0.0/5
  RP 156.1.18.1 (?), v2v1
    Info source: 150.1.8.8 (?), elected via Auto-RP
         Uptime: 00:07:37, expires: 00:02:41
Group(s) 232.0.0.0/5
  RP 156.1.58.5 (?), v2v1
    Info source: 150.1.8.8 (?), elected via Auto-RP
         Uptime: 00:07:13, expires: 00:02:40
```

```
Rack1R5#show ip pim rp mapping
PIM Group-to-RP Mappings
This system is an RP (Auto-RP)

Group(s) 224.0.0.0/5
  RP 156.1.18.1 (?), v2v1
    Info source: 150.1.8.8 (?), elected via Auto-RP
         Uptime: 00:13:20, expires: 00:02:56
Group(s) 232.0.0.0/5
  RP 156.1.58.5 (?), v2v1
    Info source: 150.1.8.8 (?), elected via Auto-RP
         Uptime: 00:12:56, expires: 00:02:56

Rack1R1#show ip pim rp map
PIM Group-to-RP Mappings
This system is an RP (Auto-RP)

Group(s) 224.0.0.0/5
  RP 156.1.18.1 (?), v2v1
    Info source: 150.1.8.8 (?), elected via Auto-RP
         Uptime: 00:13:30, expires: 00:02:43
Group(s) 232.0.0.0/5
  RP 156.1.58.5 (?), v2v1
    Info source: 150.1.8.8 (?), elected via Auto-RP
         Uptime: 00:13:06, expires: 00:02:47
```

Task 5.2

R3:

```
interface FastEthernet0/0
 ip igmp join-group 224.24.24.24
 ip igmp join-group 232.32.32.32
```

Task 5.2 Verification

Ping multicast groups from SW2:

```
Rack1SW2#debug ip icmp
ICMP packet debugging is on

Rack1SW2#ping 224.24.24.24

Type escape sequence to abort.
Sending 1, 100-byte ICMP Echos to 224.24.24.24, timeout is 2 seconds:

02:32:35: ICMP: echo reply rcvd, src 156.1.13.3, dst 156.1.18.8
02:32:35: ICMP: echo reply rcvd, src 156.1.13.3, dst 156.1.8.8
02:32:35: ICMP: echo reply rcvd, src 156.1.13.3, dst 156.1.58.8
02:32:35: ICMP: echo reply rcvd, src 156.1.13.3, dst 150.1.8.8
Reply to request 0 from 156.1.13.3, 40 ms
Reply to request 0 from 156.1.13.3, 112 ms
Reply to request 0 from 156.1.13.3, 84 ms
Reply to request 0 from 156.1.13.3, 68 ms
```



```
Rack1SW2#ping 232.32.32.32

Type escape sequence to abort.
Sending 1, 100-byte ICMP Echos to 232.32.32.32, timeout is 2 seconds:

02:32:52: ICMP: echo reply rcvd, src 156.1.13.3, dst 156.1.18.8
02:32:52: ICMP: echo reply rcvd, src 156.1.13.3, dst 156.1.8.8
02:32:52: ICMP: echo reply rcvd, src 156.1.13.3, dst 156.1.58.8
02:32:52: ICMP: echo reply rcvd, src 156.1.13.3, dst 150.1.8.8
Reply to request 0 from 156.1.13.3, 36 ms
Reply to request 0 from 156.1.13.3, 108 ms
Reply to request 0 from 156.1.13.3, 80 ms
Reply to request 0 from 156.1.13.3, 64 ms
```

Task 5.3

R5:

```
access-list 10 deny 224.0.1.39
access-list 10 deny 224.0.1.40
access-list 10 permit any
!
interface FastEthernet0/0.2
ip multicast boundary 10
```

Task 5.3 Verification

Temporarily enable PIM on FastEthernet interface of BB3. Check mroutes on R5 before applying the solution:

```
Rack1R5#show ip mroute 224.0.1.39
IP Multicast Routing Table
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C -
Connected,
       L - Local, P - Pruned, R - RP-bit set, F - Register flag,
       T - SPT-bit set, J - Join SPT, M - MSDP created entry,
       X - Proxy Join Timer Running, A - Candidate for MSDP
Advertisement,
       U - URD, I - Received Source Specific Host Report,
       Z - Multicast Tunnel, z - MDT-data group sender,
       Y - Joined MDT-data group, y - Sending to MDT-data group
Outgoing interface flags: H - Hardware switched, A - Assert winner
 Timers: Uptime/Expires
 Interface state: Interface, Next-Hop or VCD, State/Mode

(*, 224.0.1.39), 00:02:19/stopped, RP 0.0.0.0, flags: DC
  Incoming interface: Null, RPF nbr 0.0.0.0
  Outgoing interface list:
    FastEthernet0/0.2, Forward/Sparse, 00:00:07/00:00:00
    FastEthernet0/1, Forward/Sparse, 00:02:19/00:00:00
    Virtual-Access1, Forward/Sparse, 00:02:19/00:00:00

(156.1.18.1, 224.0.1.39), 00:02:19/00:02:44, flags: T
  Incoming interface: FastEthernet0/1, RPF nbr 156.1.58.8
  Outgoing interface list:
```



```
    FastEthernet0/0.2, Forward/Sparse, 00:00:08/00:00:00
    Virtual-Access1, Prune/Sparse, 00:00:19/00:02:43, A

(156.1.58.5, 224.0.1.39), 00:01:56/00:02:03, flags: T
  Incoming interface: FastEthernet0/1, RPF nbr 0.0.0.0
  Outgoing interface list:
    FastEthernet0/0.2, Forward/Sparse, 00:00:08/00:00:00
    Virtual-Access1, Forward/Sparse, 00:01:56/00:00:00

Rack1R5#show ip mroute 224.0.1.40
IP Multicast Routing Table
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C -
Connected,
       L - Local, P - Pruned, R - RP-bit set, F - Register flag,
       T - SPT-bit set, J - Join SPT, M - MSDP created entry,
       X - Proxy Join Timer Running, A - Candidate for MSDP
Advertisement,
       U - URD, I - Received Source Specific Host Report,
       Z - Multicast Tunnel, z - MDT-data group sender,
       Y - Joined MDT-data group, y - Sending to MDT-data group
Outgoing interface flags: H - Hardware switched, A - Assert winner
 Timers: Uptime/Expires
 Interface state: Interface, Next-Hop or VCD, State/Mode

(*, 224.0.1.40), 00:03:56/stopped, RP 0.0.0.0, flags: DCL
  Incoming interface: Null, RPF nbr 0.0.0.0
  Outgoing interface list:
    FastEthernet0/1, Forward/Sparse, 00:03:56/00:00:00
    FastEthernet0/0.2, Forward/Sparse, 00:03:56/00:00:00
    Virtual-Access1, Forward/Sparse, 00:03:56/00:00:00

(150.1.8.8, 224.0.1.40), 00:03:14/00:02:50, flags: LT
  Incoming interface: FastEthernet0/1, RPF nbr 156.1.58.8
  Outgoing interface list:
    FastEthernet0/0.2, Forward/Sparse, 00:03:15/00:00:00
    Virtual-Access1, Prune/Sparse, 00:02:13/00:00:49, A
```

Apply the solution and check mroutes again:

```
Rack1R5#show ip mroute 224.0.1.39
IP Multicast Routing Table
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C -
Connected,
       L - Local, P - Pruned, R - RP-bit set, F - Register flag,
       T - SPT-bit set, J - Join SPT, M - MSDP created entry,
       X - Proxy Join Timer Running, A - Candidate for MSDP
Advertisement,
       U - URD, I - Received Source Specific Host Report,
       Z - Multicast Tunnel, z - MDT-data group sender,
       Y - Joined MDT-data group, y - Sending to MDT-data group
Outgoing interface flags: H - Hardware switched, A - Assert winner
 Timers: Uptime/Expires
 Interface state: Interface, Next-Hop or VCD, State/Mode

(*, 224.0.1.39), 00:05:33/stopped, RP 0.0.0.0, flags: DC
  Incoming interface: Null, RPF nbr 0.0.0.0
  Outgoing interface list:
```



```
    FastEthernet0/1, Forward/Sparse, 00:05:33/00:00:00
    Virtual-Access1, Forward/Sparse, 00:05:33/00:00:00

(156.1.18.1, 224.0.1.39), 00:05:33/00:00:26, flags: T
  Incoming interface: FastEthernet0/1, RPF nbr 156.1.58.8
  Outgoing interface list:
    Virtual-Access1, Forward/Sparse, 00:00:30/00:00:00, A

(156.1.58.5, 224.0.1.39), 00:05:10/00:02:49, flags: T
  Incoming interface: FastEthernet0/1, RPF nbr 0.0.0.0
  Outgoing interface list:
    Virtual-Access1, Forward/Sparse, 00:00:05/00:00:00, A

Rack1R5#show ip mroute 224.0.1.40
IP Multicast Routing Table
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C -
Connected,
       L - Local, P - Pruned, R - RP-bit set, F - Register flag,
       T - SPT-bit set, J - Join SPT, M - MSDP created entry,
       X - Proxy Join Timer Running, A - Candidate for MSDP
Advertisement,
       U - URD, I - Received Source Specific Host Report,
       Z - Multicast Tunnel, z - MDT-data group sender,
       Y - Joined MDT-data group, y - Sending to MDT-data group
Outgoing interface flags: H - Hardware switched, A - Assert winner
 Timers: Uptime/Expires
 Interface state: Interface, Next-Hop or VCD, State/Mode

(*, 224.0.1.40), 00:06:04/stopped, RP 0.0.0.0, flags: DCL
  Incoming interface: Null, RPF nbr 0.0.0.0
  Outgoing interface list:
    FastEthernet0/1, Forward/Sparse, 00:06:04/00:00:00
    Virtual-Access1, Forward/Sparse, 00:06:04/00:00:00

(150.1.8.8, 224.0.1.40), 00:05:22/00:02:45, flags: PLT
  Incoming interface: FastEthernet0/1, RPF nbr 156.1.58.8
  Outgoing interface list:
    Virtual-Access1, Prune/Sparse, 00:00:23/00:02:39, A
```


Task 6.1

SW1 & SW2:

```
username SSH password 0 CISCO
!
ip domain-name Ine.com
!
crypto key generate rsa usage-keys modulus 2048
!
line vty 0 15
login local
transport input ssh
```

Taks 6.1 Verification

Verify SSH status:

```
Rack1SW1#show ip ssh
SSH Enabled - version 1.99
Authentication timeout: 120 secs; Authentication retries: 3

Rack1R6#ssh -l SSH 150.1.7.7

Password: <CISCO>

Rack1SW1>exit

Rack1R6#telnet 150.1.7.7
Trying 150.1.7.7 ...
% Connection refused by remote host
```

Task 6.2

R4:

```
interface FastEthernet0/0
 ip access-group VLAN4 in
!
interface FastEthernet0/1
 ip access-group VLAN44 in
!
ip access-list extended VLAN4
 permit ip 156.1.4.0 0.0.0.255 156.1.44.0 0.0.0.255
 permit tcp 156.1.4.0 0.0.0.255 any eq www
 permit tcp 156.1.4.0 0.0.0.255 any eq 443
 permit tcp 156.1.4.0 0.0.0.255 any eq 8080
 permit tcp host 156.1.4.40 eq ftp-data any gt 1023
 permit tcp host 156.1.4.40 eq ftp any gt 1023
 permit tcp 156.1.4.0 0.0.0.255 any eq 1720
 permit udp 156.1.4.0 0.0.0.255 range 16384 32767 any range 16384 32767
 deny   ip any any
ip access-list extended VLAN44
 permit ip 156.1.44.0 0.0.0.255 156.1.4.0 0.0.0.255
 permit tcp 156.1.44.0 0.0.0.255 any eq www
```



```
 permit tcp 156.1.44.0 0.0.0.255 any eq 443
 permit tcp 156.1.44.0 0.0.0.255 any eq 8080
 permit tcp 156.1.44.0 0.0.0.255 any eq 1720
 permit udp 156.1.44.0 0.0.0.255 range 16384 32767 any range 16384
32767
 deny   ip any any
```

Task 6.3

R4:

```
interface Serial0/1
 encapsulation ppp
 ppp chap refuse
 ppp pap sent-username ROUTER4 password 0 CISCO
 no peer neighbor-route
```

R5:

```
username ROUTER4 password 0 CISCO
!
interface Serial0/1
 encapsulation ppp
 clockrate 64000
 ppp authentication chap pap
 no peer neighbor-route
```


Task 6.3 Verification

Verify PPP authentication process:

```
Rack1R4#debug ppp negotiation
PPP protocol negotiation debugging is on
Rack1R4#debug ppp authentication
PPP authentication debugging is on
Rack1R4#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Rack1R4(config)#interface s0/1
Rack1R4(config-if)#shutdown
Rack1R4(config-if)#
%LINK-5-CHANGED: Interface Serial0/1, changed state to administratively
down
 Se0/1 PPP: Sending Acct Event[Down] id[5]
 Se0/1 CDPCP: State is Closed
 Se0/1 IPCP: Remove link info for cef entry 156.1.45.5
 Se0/1 IPCP: State is Closed
 Se0/1 PPP: Phase is TERMINATING
 Se0/1 LCP: State is Closed
 Se0/1 PPP: Phase is DOWN
 Se0/1 IPCP: Remove route to 156.1.45.5
 Se0/1 IPCP: Remove default route thru 156.1.45.5
 %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1, changed
state to down
Rack1R4(config-if)#no shutdown

Se0/1 PPP: Outbound cdp packet dropped
Se0/1 PPP: Outbound cdp packet dropped
Se0/1 PPP: Outbound cdp packet dropped
%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[95000005] Session id[4]
Se0/1 PPP: Phase is ESTABLISHING, Active Open
Se0/1 PPP: Authorization required
Se0/1 LCP: O CONFREQ [Closed] id 14 len 10
Se0/1 LCP:    MagicNumber 0x30D0BD58 (0x050630D0BD58)
 Se0/1 LCP: I CONFREQ [REQsent] id 7 len 15
 Se0/1 LCP:    AuthProto CHAP (0x0305C22305)
 Se0/1 LCP:    MagicNumber 0x08281AF9 (0x050608281AF9)
 Se0/1 LCP: O CONFNAK [REQsent] id 7 len 9
 Se0/1 LCP:    AuthProto MS-CHAP (0x0305C22380)
 Se0/1 LCP: I CONFACK [REQsent] id 14 len 10
 Se0/1 LCP:    MagicNumber 0x30D0BD58 (0x050630D0BD58)
 Se0/1 LCP: I CONFREQ [ACKrcvd] id 8 len 14
 Se0/1 LCP:    AuthProto PAP (0x0304C023)
 Se0/1 LCP:    MagicNumber 0x08281AF9 (0x050608281AF9)
 Se0/1 LCP: O CONFACK [ACKrcvd] id 8 len 14
 Se0/1 LCP:    AuthProto PAP (0x0304C023)
 Se0/1 LCP:    MagicNumber 0x08281AF9 (0x050608281AF9)
 Se0/1 LCP: State is Open
 Se0/1 PPP: No authorization without authentication
Se0/1 PPP: Phase is AUTHENTICATING, by the peer
 Se0/1 PAP: Using hostname from interface PAP
```



```
 Se0/1 PAP: Using password from interface PAP
 Se0/1 PAP: O AUTH-REQ id 3 len 18 from "ROUTER4"
 Se0/1 PAP: I AUTH-ACK id 3 len 5
Se0/1 PPP: Phase is FORWARDING, Attempting Forward
 Se0/1 PPP: Phase is ESTABLISHING, Finish LCP
 Se0/1 PPP: Phase is UP
 Se0/1 IPCP: O CONFREQ [Closed] id 1 len 10
 Se0/1 IPCP:    Address 156.1.45.4 (0x03069C012D04)
 Se0/1 CDPCP: O CONFREQ [Closed] id 1 len 4
 Se0/1 PPP: Process pending ncp packets
 Se0/1 CDPCP: I CONFREQ [REQsent] id 1 len 4
 Se0/1 CDPCP: O CONFACK [REQsent] id 1 len 4
 Se0/1 IPCP: I CONFREQ [REQsent] id 1 len 10
 Se0/1 IPCP:    Address 156.1.45.5 (0x03069C012D05)
 Se0/1 IPCP: O CONFACK [REQsent] id 1 len 10
 Se0/1 IPCP:    Address 156.1.45.5 (0x03069C012D05)
 Se0/1 CDPCP: I CONFACK [ACKsent] id 1 len 4
 Se0/1 CDPCP: State is Open
 Se0/1 IPCP: I CONFACK [ACKsent] id 1 len 10
 Se0/1 IPCP:    Address 156.1.45.4 (0x03069C012D04)
 Se0/1 IPCP: State is Open
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1, changed
      state to up
```


Task 6.4

SW2:

```
!
! PPPoE uses two Ethertypes for discovery (0x8863)
! an session (0x8864)
!
mac access-list extended PPPOE
 permit any any 0x8863 0x0
 permit any any 0x8864 0x0
!
vlan access-map VLAN8_FITLTER 10
 match mac address PPPOE
 action forward
!
vlan access-map VLAN8_FILTER 20
 action drop
!
vlan filter VLAN8_FILTER vlan-list 8
```

Task 7.1

R2:

```
logging 156.1.8.100
logging facility local2
logging trap critical
!
service sequence-numbers
```

Task 7.2

R2:

```
logging count
```

Tasks 7.1 – 7.2 Verification

Verify sequence numbers:

```
Rack1R2(config)#interface fastEthernet 0/0
Rack1R2(config-if)#shutdown
Rack1R2(config-if)#
000035: *Mar  1 04:14:01.854: %DUAL-5-NBRCHANGE: IP-EIGRP(0) 10:
Neighbor 156.1.27.7 (FastEthernet0/0) is down: interface down
Rack1R2(config-if)#
000036: *Mar  1 04:14:01.858: destroy peer: 156.1.27.7
Rack1R2(config-if)#
000037: *Mar  1 04:14:03.834: %LINK-5-CHANGED: Interface
FastEthernet0/0, changed state to administratively down
000038: *Mar  1 04:14:04.834: %LINEPROTO-5-UPDOWN: Line protocol on
Interface FastEthernet0/0, changed state to down
```


Verify logging count:

```
Rack1R2#show logging count
Facility       Message Name                        Sev Occur   Last Time
=============================================================================
SYS            CONFIG_I                              5     1 *Mar  1
04:15:06.830
-------------  ------------------------------  ----------------------
SYS TOTAL
```

Task 7.3

R1, R2, R3, R4, R5, R6, SW1, SW2, SW3, SW4:

```
ip domain-lookup
!
ip name-server 150.1.6.6
ip domain-name ine.com
```

R6:

```
ip dns server
!
ip host Rack1R1.ine.com 150.1.1.1
ip host Rack1R2.ine.com 150.1.2.2
ip host Rack1R3.ine.com 150.1.3.3
ip host Rack1R4.ine.com 150.1.4.4
ip host Rack1R5.ine.com 150.1.5.5
ip host Rack1R6.ine.com 150.1.6.6
ip host Rack1SW1.ine.com 150.1.7.7
ip host Rack1SW2.ine.com 150.1.8.8
ip host Rack1SW2.ine.com 150.1.9.9
ip host Rack1SW2.ine.com 150.1.10.10
```

Task 7.3 Verification

```
Rack1R3#debug domain
Domain Name System debugging is on
Rack1R3#
Rack1R3#ping Rack1R1

Translating "Rack1R1"...domain server (150.1.6.6) [OK]

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 150.1.1.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/4 ms
Rack1R3#
Domain: query for Rack1R1.ine.com type 1 to 150.1.6.6
DOM: dom2cache: hostname is Rack1R1.ine.com, RR type=1, class=1,
ttl=10, n=4Reply received ok
Rack1R3#

Rack1R6#debug domain
Domain Name System debugging is on
Rack1R6#
DNS: Incoming UDP query (id#31)
DNS: Type 1 DNS query (id#31) for host 'Rack1R1.ine.com' from
156.1.23.3(53481)
DNS: Finished processing query (id#31) in 0.004 secs

Rack1R3#show host
Default domain is ine.com
Name/address lookup uses domain service
Name servers are 150.1.6.6
```



```
Codes: UN - unknown, EX - expired, OK - OK, ?? - revalidate
       temp - temporary, perm - permanent
       NA - Not Applicable None - Not defined

Host                      Port  Flags      Age Type   Address(es)
Rack1R1.ine.com           None  (temp, OK)  0   IP    150.1.1.1
Rack1R3#
```

Task 7.4

R1:

```
interface Loopback0
 ip nat outside
!
interface Loopback1
 description arbitrary address
 ip address 1.1.1.1 255.255.255.255
 ip nat inside
 ip policy route-map POLICY1
!
route-map POLICY permit 10
 match ip address 100
 set interface Loopback1
!
route-map POLICY1 permit 10
 set interface Loopback0
!
access-list 100 permit icmp any any time-exceeded
access-list 100 permit icmp any any port-unreachable
!
ip nat inside source list 100 interface Loopback0 overload
!
ip local policy route-map POLICY
```

Task 7.4 Verification

Confirm that R1 will always reply to traceroute with Loopback0 source address:

```
Rack1R5#traceroute 150.1.1.1

Type escape sequence to abort.
Tracing the route to 150.1.1.1

  1 156.1.35.3 32 msec 32 msec 32 msec
  2 150.1.1.1 24 msec *  20 msec


Rack1SW1#traceroute 150.1.1.1

Type escape sequence to abort.
Tracing the route to 150.1.1.1

  1 156.1.27.2 0 msec 4 msec 0 msec
```



```
  2 156.1.23.3 16 msec 16 msec 16 msec
  3 150.1.1.1 32 msec *  28 msec


Rack1SW2#traceroute 150.1.1.1

Type escape sequence to abort.
Tracing the route to 150.1.1.1

  1 156.1.58.5 0 msec 4 msec 0 msec
  2 156.1.35.3 24 msec 24 msec 24 msec
  3 150.1.1.1 20 msec *  16 msec
```

Task 7.5

R6

```
snmp-server chassis-id Rack1-R6

rmon alarm 1 ifOutOctets.3 4 delta rising 1000 1 fall 1000
rmon event 1 log description Whoah!

event manager applet EIGRP-Load
 event syslog pattern "RMON-5-RISINGTRAP: Rising trap is generated
because the value of ifOutOctets.3 exceeded the rising-threshold value
1000"
 action 1.0 cli command "enable"
 action 1.1 cli command "configure terminal"
 action 1.2 cli command "router eigrp 100"
 action 1.3 cli command "metric weights 0 1 1 1 0 0"
exit
```

Task 7.6

R1, R2, R3, R5, SW1, SW2

```
event manager applet EIGRP-Load
 event syslog pattern "K-value mismatch"
 action 1.0 cli command "enable"
 action 1.1 cli command "configure terminal"
 action 1.2 cli command "router eigrp 100"
 action 1.3 cli command "metric weights 0 1 1 1 0 0"
exit
```

Tasks 7.5 - 7.6 Breakdown

The best thing to do is to run “ping 54.X.1.254 size 1500 time 0 repeat 1000” from R6. That will be enough to trigger the RMON. You should then see every router lose EIGRP after R6 makes the change, and the cascading effect of the drop/modify/restore EIGRP functionality.

Task 8.1

```
R5:
policy-map 2.5Mbps
  class class-default
   shape average 2500000
!
policy-map 3Mbps
  class class-default
   shape average 3000000
!
interface FastEthernet0/0.1
 service-policy output 2.5Mbps
!
interface FastEthernet0/0.2
 service-policy output 3Mbps
```

Task 8.1 Verification

Verify policy-map configuration:

```
Rack1R5#show policy-map interface Fa0/0.1
 FastEthernet0/0.1

  Service-policy output: 2.5Mbps

    Class-map: class-default (match-any)
      5 packets, 546 bytes
      5 minute offered rate 0 bps, drop rate 0 bps
      Match: any
      Traffic Shaping
           Target/Average Byte Sustain   Excess    Interval  Increment
             Rate        Limit bits/int  bits/int  (ms)      (bytes)
          2500000/2500000 15000  60000     60000    24         7500

        Adapt  Queue    Packets   Bytes     Packets   Bytes     Shaping
        Active Depth                        Delayed   Delayed   Active
        -      0         5         546       0         0         no

Rack1R5#show policy-map interface Fa0/0.2
 FastEthernet0/0.2

  Service-policy output: 3Mbps

    Class-map: class-default (match-any)
      16 packets, 1082 bytes
      5 minute offered rate 0 bps, drop rate 0 bps
      Match: any
      Traffic Shaping
           Target/Average Byte Sustain   Excess    Interval  Increment
             Rate         Limit bits/int bits/int  (ms)      (bytes)
          3000000/3000000 18750  75000     75000     25         9375

        Adapt  Queue    Packets   Bytes     Packets   Bytes     Shaping
        Active Depth                        Delayed   Delayed   Active
```



```
        -      0         16        1082      0         0         no
```

Task 8.2

R4:

```
class-map VoIP
 match access-group name VoIP
!
policy-map VOIP_PRIORITY
 class VoIP
 priority 64
!
interface Serial0/1
 service-policy output VOIP_PRIORITY
!
ip access-list extended VoIP
 permit tcp any any eq 1720
 permit udp any any range 16384 32767
```

R5:

```
class-map VoIP
 match access-group name VoIP
!
policy-map VOIP_PRIORITY
 class VoIP
  priority 64
!
policy-map QOS_BB2
 class VoIP
  priority 64
!
policy-map 2.5Mbps
 class class-default
  service-policy QOS_BB2
!
interface Serial0/1
 service-policy output VOIP_PRIORITY
!
ip access-list extended VoIP
 permit tcp any any eq 1720
 permit udp any any range 16384 32767
```

Task 8.2 Verification

Verify QoS configuration:

```
Rack1R5#show policy-map interface s0/1
 Serial0/1

  Service-policy output: VOIP_PRIORITY

    Class-map: VoIP (match-all)
      0 packets, 0 bytes
      5 minute offered rate 0 bps, drop rate 0 bps
      Match: access-group name VoIP
```



```
      Queueing
        Strict Priority
        Output Queue: Conversation 264
        Bandwidth 64 (kbps) Burst 1600 (Bytes)
        (pkts matched/bytes matched) 0/0
        (total drops/bytes drops) 0/0

    Class-map: class-default (match-any)
      9 packets, 446 bytes
      5 minute offered rate 0 bps, drop rate 0 bps
      Match: any

Rack1R5#show policy-map interface e0/0.1
 FastEthernet0/0.1

  Service-policy output: 2.5Mbps

    Class-map: class-default (match-any)
      13 packets, 1523 bytes
      5 minute offered rate 0 bps, drop rate 0 bps
      Match: any
      Traffic Shaping
           Target/Average  Byte  Sustain  Excess    Interval  Increment
             Rate          Limit bits/int bits/int  (ms)      (bytes)
          2500000/2500000  15000  60000    60000     24        7500

        Adapt  Queue    Packets   Bytes     Packets   Bytes     Shaping
        Active Depth                        Delayed   Delayed   Active
        -      0         13        1523      0         0         no

      Service-policy : QOS_BB2

        Class-map: VoIP (match-all)
          0 packets, 0 bytes
          5 minute offered rate 0 bps, drop rate 0 bps
          Match: access-group name VoIP
          Queueing
            Strict Priority
            Output Queue: Conversation 136
            Bandwidth 64 (kbps) Burst 1600 (Bytes)
            (pkts matched/bytes matched) 0/0
            (total drops/bytes drops) 0/0

        Class-map: class-default (match-any)
          3 packets, 480 bytes
          5 minute offered rate 0 bps, drop rate 0 bps
          Match: any
```


Task 8.3

```
R5:
class-map ICMP
 match protocol icmp
!
policy-map QOS_BB2
  class ICMP
   police cir 16000
!
policy-map QOS_BB3
 class ICMP
   police cir 16000
!
policy-map 3Mbps
  class class-default
    service-policy QOS_BB3
```

Task 8.3 Verification

Simulate ping flood from SW2:

```
Rack1SW2#ping
Protocol [ip]:
Target IP address: 204.12.1.254
Repeat count [5]: 10000
Datagram size [100]: 1400
Timeout in seconds [2]: 0
Extended commands [n]:
Sweep range of sizes [n]:
Type escape sequence to abort.
Sending 10000, 1400-byte ICMP Echos to 204.12.1.254, timeout is 0
seconds:
.....................................................................
<output omitted>
```

Check policy-map at R5:

```
Rack1R5#show policy-map interface FastEthernet 0/0.2
 FastEthernet0/0.2

  Service-policy output: 3Mbps

    Class-map: class-default (match-any)
      1847 packets, 2517431 bytes
      5 minute offered rate 71000 bps, drop rate 0 bps
      Match: any
      Traffic Shaping
           Target/Average  Byte  Sustain  Excess    Interval  Increment
             Rate          Limit bits/int bits/int  (ms)      (bytes)
          3000000/3000000  18750 75000    75000     25        9375

        Adapt  Queue    Packets   Bytes     Packets   Bytes     Shaping
        Active Depth                        Delayed   Delayed   Active
        -      0         80        11825     0         0         no
```



```
      Service-policy : QOS_BB3

        Class-map: ICMP (match-all)
          1771 packets, 2511278 bytes
          5 minute offered rate 71000 bps, drop rate 71000 bps
          Match: protocol icmp
          police:
              cir 16000 bps, bc 1500 bytes
            conformed 4 packets, 5672 bytes; actions:
              transmit
            exceeded 1767 packets, 2505606 bytes; actions:
              drop
            conformed 2000 bps, exceed 71000 bps

        Class-map: class-default (match-any)
          7 packets, 490 bytes
          5 minute offered rate 0 bps, drop rate 0 bps
          Match: any
```

Task 8.4

R5:

```
policy-map 2.5Mbps
  class class-default
   set dscp ef
!
policy-map 3Mbps
  class class-default
   set dscp ef
```

Task 8.4 Verification

Verify marking:

```
Rack1R5#show policy-map interface FastEthernet 0/0.1
 FastEthernet0/0.1

  Service-policy output: 2.5Mbps

    Class-map: class-default (match-any)
      28 packets, 3007 bytes
      5 minute offered rate 0 bps, drop rate 0 bps
      Match: any
      Traffic Shaping
           Target/Average  Byte  Sustain  Excess    Interval  Increment
             Rate          Limit bits/int bits/int  (ms)      (bytes)
          2500000/2500000  15000 60000    60000     24        7500

        Adapt  Queue    Packets   Bytes     Packets   Bytes     Shaping
        Active Depth                        Delayed   Delayed   Active
        -      0         28        3007      0         0         no
      QoS Set
        dscp ef
          Packets marked 7
```



```
<output omitted>
```

Task 8.5

SW1:

```
mls qos
!
class-map match-any EF_AND_CS5
match ip dscp ef cs5
!
policy-map RATE_LIMIT
class EF_AND_CS5
police 1000000 16000 exceed-action drop
!
interface FastEthernet0/10
service-policy input RATE_LIMIT
!
interface FastEthernet0/11
service-policy input RATE_LIMIT
```

Task 8.5 Verification

Temporarily apply policy map to Fa 0/5 at SW1 and configure dscp monitoring:

SW1:

```
interface FastEthernet0/5
 service-policy input RATE_LIMIT
 mls qos monitor dscp 46 40
```

Verify statistics:

```
Rack1SW1#show mls qos interface fastEthernet 0/5 statistics
FastEthernet0/5
Ingress
  dscp: incoming   no_change  classified policed    dropped (in bytes)
    46: 920        0          0          0          0
    40: 0          0          0          0          0
Others: 2501       2041       1380       0          0
Egress
  dscp: incoming   no_change  classified policed    dropped (in bytes)
    46: 0             n/a        n/a      0          0
    40: 0             n/a        n/a      0          0
Others: 149787        n/a        n/a      0          0
```

Task 8.6

SW1:

```
!
! Enable QoS and change markdown settings
!
mls qos
mls qos map policed-dscp 0 to 8
!
! Class-map to match the specific port
```



```
!
class-map PORT_TO_R5
 match input-interface FastEthernet 0/5
!
! Access-lists and class-maps to match the traffic
!
ip access-list extended ICMP
 permit icmp any any
!
ip access-list extended TCP
 permit tcp any any
!
class-map ICMP
 match access-group name ICMP
!
class-map TCP
 match access-group name TCP

!
! Interface-level policers – policing only
!
policy-map POLICE_256
 class PORT_TO_R5
  police 256000 16000
!
policy-map POLICE_512
 class PORT_TO_R5
  police 512000 32000 exceed policed-dscp-transmit
!
! VLAN level policers – marking only
!
policy-map VLAN_52_POLICY
 class ICMP
  set ip precedence 3
  service-policy POLICE_256
!
policy-map VLAN_53_POLICY
 class TCP
  set ip precedence 4
  service-policy POLICE_512
!
interface Vlan 52
 service-policy input VLAN_52_POLICY
!
interface Vlan 53
 service-policy input VLAN_53_POLICY

!
! Enable VLAN-based QoS on the port
!
interface FastEthernet 0/5
 mls qos vlan-based
```


