Routing
Switching
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VRRP

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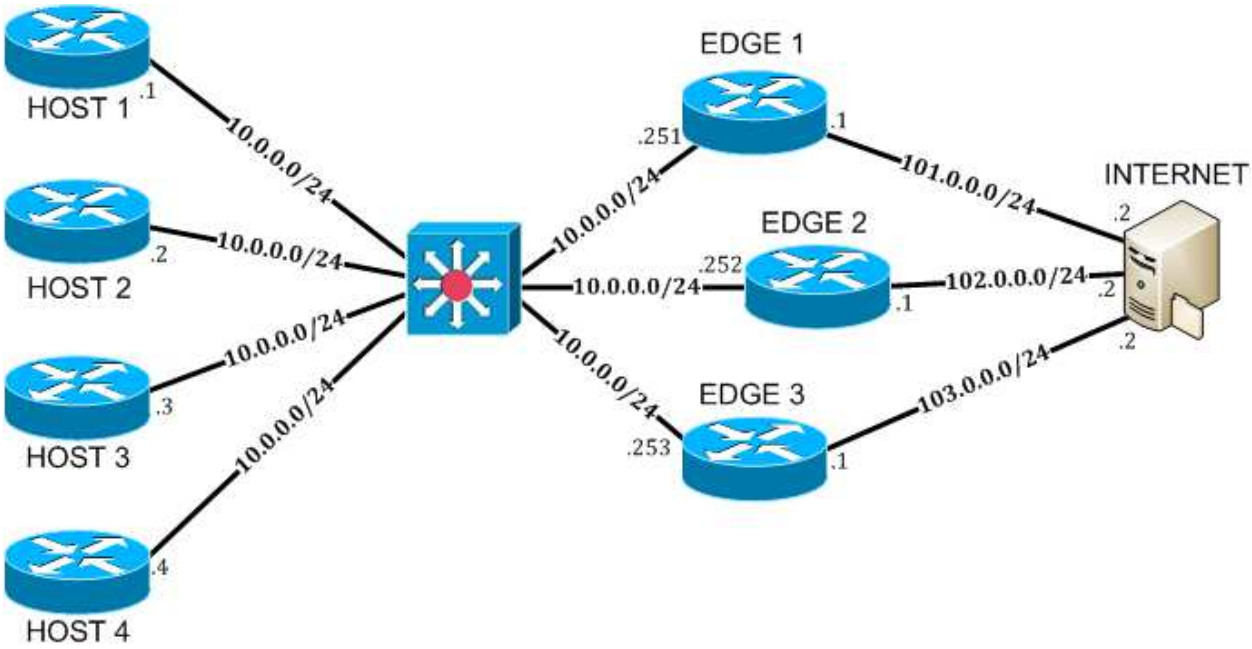
VRRP Topology



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Task 1: Configure VRRP

Step 1 Configure Initial Configuration

R1:

```
hostname EDGE_1
ip route 0.0.0.0 0.0.0.0 101.0.0.2
interface ethernet 0/0
ip address 10.0.0.251 255.255.255.0
no shutdown
ip nat inside
interface ethernet 0/1
ip address 101.0.0.1 255.255.255.0
no shutdown
ip nat outside
ip nat inside source list 1 interface ethernet 0/1 overload
access-list 1 permit any
exit
```

R2:

```
hostname EDGE_2
ip route 0.0.0.0 0.0.0.0 102.0.0.2
interface ethernet 0/0
ip address 10.0.0.252 255.255.255.0
ip nat inside
no shutdown
interface ethernet 0/1
ip address 102.0.0.1 255.255.255.0
ip nat outside
no shutdown
ip nat inside source list 1 interface ethernet 0/1 overload
access-list 1 permit any
exit
```

R4:

```
hostname INTERNET
interface ethernet 0/1
ip address 101.0.0.2 255.255.255.0
no shutdown
interface ethernet 0/2
ip address 102.0.0.2 255.255.255.0
no shutdown
interface loopback 0
ip address 200.0.0.1 255.255.255.255
exit
```

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R5:

```
hostname HOST1
interface ethernet 0/0
ip address 10.0.0.1 255.255.255.0
no shutdown
ip route 0.0.0.0 0.0.0.0 10.0.0.254
exit
```

SW9:

```
hostname ACCESS_SWITCH
no ip domain-lookup
interface range ethernet0/0-3,ethernet1/0-3
switchport mode access
switchport access vlan 10
exit
```

Step 2 Configure Basic VRRP Configuration

Configure VRRP on R1, R2 and R3. R1 should be the Master

R1:

```
interface Ethernet0/0
vrrp 10 ip 10.0.0.254
vrrp 10 priority 200
exit
```

R2:

```
interface Ethernet0/0
vrrp 10 ip 10.0.0.254
exit
```

R3:

```
interface Ethernet0/0
vrrp 10 ip 10.0.0.254
exit
```

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Task 2: Verification

Step 1 Verify Master and Backup State in VRRP

R2:

```
EDGE_1#show vrrp
Ethernet0/0 - Group 10
State is Master
Virtual IP address is 10.0.0.254
Virtual MAC address is 0000.5e00.010a
Advertisement interval is 1.000 sec
Preemption enabled
Priority is 200
Master Router is 10.0.0.251 (local), priority is 200
Master Advertisement interval is 1.000 sec
Master Down interval is 3.218 sec

EDGE_2#show vrrp
Ethernet0/0 - Group 10
State is Backup
Virtual IP address is 10.0.0.254
Virtual MAC address is 0000.5e00.010a
Advertisement interval is 1.000 sec
Preemption enabled
Priority is 100
Master Router is 10.0.0.251, priority is 200
Master Advertisement interval is 1.000 sec
Master Down interval is 3.609 sec (expires in 2.946 sec)

EDGE_3#show vrrp
Ethernet0/0 - Group 10
State is Backup
Virtual IP address is 10.0.0.254
Virtual MAC address is 0000.5e00.010a
Advertisement interval is 1.000 sec
Preemption enabled
Priority is 100
Master Router is 10.0.0.251, priority is 200
Master Advertisement interval is 1.000 sec
Master Down interval is 3.609 sec (expires in 3.107 sec)
```

Preemption is enabled in VRRP by Default

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```
EDGE_1#show vrrp brief
Interface          Grp  Pri  Time   Own  Pre State   Master addr     Group addr
Et0/0               10   200  3218    Y   Master      10.0.0.251      10.0.0.254

EDGE_2#show vrrp brief
Interface          Grp  Pri  Time   Own  Pre State   Master addr     Group addr
Et0/0               10   100  3609    Y   Backup      10.0.0.251      10.0.0.254

EDGE_3#show vrrp brief
Interface          Grp  Pri  Time   Own  Pre State   Master addr     Group addr
Et0/0               10   100  3609    Y   Backup      10.0.0.251      10.0.0.254
```

R1:

```
EDGE_1#debug vrrp
VRRP debugging is on
EDGE_1#
*Jun 16 10:46:56.373: VRRP: Grp 10 sending Advertisement checksum BF5
*Jun 16 10:46:57.190: VRRP: Grp 10 sending Advertisement checksum BF5
EDGE_1#
*Jun 16 10:46:58.014: VRRP: Grp 10 sending Advertisement checksum BF5
*Jun 16 10:46:58.914: VRRP: Grp 10 sending Advertisement checksum BF5
```

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Task 3: Understanding VRRP Failover

Step 1 Shutdown the Master router to initiate failover

R1:
interface ethernet 0/0
shutdown

*Jun 16 10:57:17.344: %VRRP-6-STATECHANGE: Et0/0 Grp 10 state Master -> Init

EDGE_3#
*Jun 16 10:57:17.954: %VRRP-6-STATECHANGE: Et0/0 Grp 10 state Backup -> Master

EDGE_3#show vrrp
Ethernet0/0 - Group 10
State is Master
Virtual IP address is 10.0.0.254
Virtual MAC address is 0000.5e00.010a
Advertisement interval is 1.000 sec
Preemption enabled
Priority is 100
Master Router is 10.0.0.253 (local), priority is 100
Master Advertisement interval is 1.000 sec
Master Down interval is 3.609 sec

R1:
interface ethernet 0/0
no shutdown

*Jun 16 11:01:50.750: %VRRP-6-STATECHANGE: Et0/0 Grp 10 state Init -> Backup
EDGE_1(config)#
*Jun 16 11:01:52.752: %LINK-3-UPDOWN: Interface Ethernet0/0, changed state to up
*Jun 16 11:01:53.756: %LINEPROTO-5-UPDOWN: Line protocol on Interface Ethernet0/0, changed state to up
EDGE_1(config)#
*Jun 16 11:01:53.973: %VRRP-6-STATECHANGE: Et0/0 Grp 10 state Backup -> Master

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Step 2 Verify VRRP Failover

```
EDGE_1#show vrrp
Ethernet0/0 - Group 10
State is Master
Virtual IP address is 10.0.0.254
Virtual MAC address is 0000.5e00.010a
Advertisement interval is 1.000 sec
Preemption enabled
Priority is 200
Master Router is 10.0.0.251 (local), priority is 200
Master Advertisement interval is 1.000 sec
Master Down interval is 3.218 sec
```

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Task 4: Verify VRRP Failover using VRRP Tracking

Configure the Topology Such That If EDGE_1's WAN Interface were to go down, EDGE_2 should become Master. If Both EDGE_1 and EDGE_2 WAN Interface is down, EDGE_3 should become Master

Step 1 Configure VRRP Track

R1:
```
interface ethernet 0/0
vrrp 10 track 1 decrement 101
track 1 interface ethernet 0/1 line-protocol
exit
```

R2:
```
interface ethernet 0/0
vrrp 10 priority 150
vrrp 10 track 1 decrement 51
track 1 interface ethernet 0/1 line-protocol
exit
```

Step 2 Verify VRRP Tracking by shutting down EDGE_1 WAN Interface

R1:
```
EDGE_1#debug vrrp
VRRP Events debugging is on
EDGE_1#conf t
EDGE_1(config)#int e0/1
EDGE_1(config-if)#shut
*Jun 16 11:46:05.472: %TRACKING-5-STATE: 1 interface Et0/1 line-protocol Up->Down
EDGE_1(config-if)#
*Jun 16 11:46:07.473: %LINK-5-CHANGED: Interface Ethernet0/1, changed state to
administratively down
*Jun 16 11:46:08.477: %LINEPROTO-5-UPDOWN: Line protocol on Interface
Ethernet0/1, changed state to down
EDGE_1(config-if)#
*Jun 16 11:46:08.680: %VRRP-6-STATECHANGE: Et0/0 Grp 10 state Master -> Backup
```

EDGE_2#debug vrrp
```
VRRP Events debugging is on
*Jun 16 11:46:08.677: VRRP: Grp 10 Event - Master down timer expired
*Jun 16 11:46:08.677: %VRRP-6-STATECHANGE: Et0/0 Grp 10 state Backup -> Master
```

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```
EDGE_1#show vrrp
Ethernet0/0 - Group 10
State is Backup
Virtual IP address is 10.0.0.254
Virtual MAC address is 0000.5e00.010a
Advertisement interval is 1.000 sec
Preemption enabled
Priority is 99  (cfgd 200)
Track object 1 state Down decrement 101
Authentication MD5, key-chain "RST"
Master Router is 10.0.0.253, priority is 100
Master Advertisement interval is 1.000 sec
Master Down interval is 3.218 sec (expires in 2.864 sec)
EDGE_1's WAN Interface goes down, EDGE_2 becomes Master
```

Step 3 Verify VRRP Tracking by shutting down EDGE_2 WAN Interface

```
EDGE_2#debug vrrp
VRRP Events debugging is on
EDGE_2(config)#interface ethernet 0/1
EDGE_2(config-if)#shut
*Jun 16 11:49:04.849: %TRACKING-5-STATE: 1 interface Et0/1 line-protocol Up->Down
*Jun 16 11:49:06.855: %LINK-5-CHANGED: Interface Ethernet0/1, changed state to
administratively down
*Jun 16 11:49:07.856: %LINEPROTO-5-UPDOWN: Line protocol on Interface
Ethernet0/1, changed state to down
*Jun 16 11:49:08.299: %VRRP-6-STATECHANGE: Et0/0 Grp 10 state Master -> Backup

EDGE_3#
*Jun 16 11:49:08.297: VRRP: Grp 10 Event - Master down timer expired
*Jun 16 11:49:08.297: %VRRP-6-STATECHANGE: Et0/0 Grp 10 state Backup -> Master


EDGE_2#show vrrp
Ethernet0/0 - Group 10
State is Backup
Virtual IP address is 10.0.0.254
Virtual MAC address is 0000.5e00.010a
Advertisement interval is 1.000 sec
Preemption enabled
Priority is 99  (cfgd 150)
Track object 1 state Down decrement 51
Authentication MD5, key-chain "RST"
Master Router is 10.0.0.253, priority is 100
Master Advertisement interval is 1.000 sec
Master Down interval is 3.414 sec (expires in 2.543 sec)
```

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```
EDGE_3#show vrrp
Ethernet0/0 - Group 10
State is Master
Virtual IP address is 10.0.0.254
Virtual MAC address is 0000.5e00.010a
Advertisement interval is 1.000 sec
Preemption enabled
Priority is 100
Authentication MD5, key-chain "RST"
Master Router is 10.0.0.253 (local), priority is 100
Master Advertisement interval is 1.000 sec
Master Down interval is 3.609 sec
```

Both EDGE_1 and EDGE_2 WAN Interface is down, EDGE_3 becomes Master

```
EDGE_1#conf t
EDGE_1(config)#interface e0/1
EDGE_1(config-if)#no shut
*Jun 16 11:56:12.467: %TRACKING-5-STATE: 1 interface Et0/1 line-protocol Down->Up
*Jun 16 11:56:14.468: %LINK-3-UPDOWN: Interface Ethernet0/1, changed state to up
*Jun 16 11:56:15.103: VRRP: Grp 10 Event - Master down timer expired
*Jun 16 11:56:15.103: %VRRP-6-STATECHANGE: Et0/0 Grp 10 state Backup -> Master
*Jun 16 11:56:15.468: %LINEPROTO-5-UPDOWN: Line protocol on Interface
Ethernet0/1, changed state to up

EDGE_2(config-if)#
*Jun 16 11:56:15.105: %VRRP-6-STATECHANGE: Et0/0 Grp 10 state Master -> Backup
```

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Task 5: Verify VRRP Authentication

Step 1 Configure VRRP Authentication

R1:

```
interface ethernet 0/0
vrrp 10 authentication md5 key-chain RST
key chain RST
key 1
key-string cisco
exit
```

Configure EDGE_2 to match authentication configured previously on EDGE_1

R2:

```
interface ethernet 0/0
vrrp 10 authentication md5 key-chain RST
key chain RST
key 1
key-string cisco
exit
```

Configure EDGE_3 to match authentication configured previously on EDGE_1

R3:

```
interface ethernet 0/0
vrrp 10 authentication md5 key-chain RST
key chain RST
key 1
key-string cisco
exit
```

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Step 2 Verify VRRP Authentication

```
EDGE_1#show vrrp
Ethernet0/0 - Group 10
State is Master
Virtual IP address is 10.0.0.254
Virtual MAC address is 0000.5e00.010a
Advertisement interval is 1.000 sec
Preemption enabled
Priority is 200
Authentication MD5, key-chain "RST"
Master Router is 10.0.0.251 (local), priority is 200
Master Advertisement interval is 1.000 sec
Master Down interval is 3.218 sec

EDGE_2#show vrrp
Ethernet0/0 - Group 10
State is Backup
Virtual IP address is 10.0.0.254
Virtual MAC address is 0000.5e00.010a
Advertisement interval is 1.000 sec
Preemption enabled
Priority is 100
Authentication MD5, key-chain "RST"
Master Router is 10.0.0.251, priority is 200
Master Advertisement interval is 1.000 sec
Master Down interval is 3.609 sec (expires in 3.299 sec)

EDGE_3#show vrrp
Ethernet0/0 - Group 10
State is Backup
Virtual IP address is 10.0.0.254
Virtual MAC address is 0000.5e00.010a
Advertisement interval is 1.000 sec
Preemption enabled
Priority is 100
Authentication MD5, key-chain "RST"
Master Router is 10.0.0.251, priority is 200
Master Advertisement interval is 1.000 sec
Master Down interval is 3.609 sec (expires in 3.462 sec)
```

If there is an Authentication failure, that all routers with failed authentication will transition to Master state

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Task 5: Configure MVRRP (Multigroup Virtual Router Redundancy Protocol)

Configure EDGE_1 and EDGE_2 such that

EDGE_1 --> MASTER FOR VLAN 10 / STANDBY FOR VLAN 20
EDGE_2 --> MASTER FOR VLAN 20 / STANDBY FOR VLAN 10
EDGE_3 --> SHOULD TAKE OVER IF ALL OTHER ROUTERS FAIL OR WAN LINK IS DOWN.

HOST 1 ---> VLAN 10 ---> 10.0.0.1/24 ---> DFG: 10.0.0.254
HOST 2 ---> VLAN 10 ---> 10.0.0.2/24 ---> DFG: 10.0.0.254
HOST 3 ---> VLAN 20 ---> 20.0.0.1/24 ---> DFG: 20.0.0.254
HOST 4 ---> VLAN 20 ---> 20.0.0.2/24 ---> DFG: 20.0.0.254

EDGE_1 --> E0/0.10 --> VLAN 10 --> IP 10.0.0.251/24 --> STNDBY IP 10.0.0.254 -->PRI=200
EDGE_1 --> E0/0.20 --> VLAN 20 --> IP 20.0.0.251/24 --> STNDBY IP 20.0.0.254 -->PRI=150
EDGE_2 --> E0/0.10 --> VLAN 10 --> IP 10.0.0.252/24 --> STNDBY IP 10.0.0.254 -->PRI=200
EDGE_2 --> E0/0.20 --> VLAN 20 --> IP 20.0.0.252/24 --> STNDBY IP 10.0.0.254 -->PRI=150
EDGE_3 --> E0/0.10 --> VLAN 10 --> IP 10.0.0.253/24 --> STNDBY IP 10.0.0.254 -->PRI=100
EDGE_3 --> E0/0.20 --> VLAN 20 --> IP 20.0.0.253/24 --> STNDBY IP 10.0.0.254 -->PRI=100

EDGE_1 ---> TRACK E0/1 --> DECREMENT 101
EDGE_2 ---> TRACK E0/1 --> DECREMENT 51
EDGE_3 ---> NO TRACK

Step 1 Configure Initial Configuration

R1:

```
hostname EDGE_1
ip route 0.0.0.0 0.0.0.0 101.0.0.2
interface ethernet 0/0
no shutdown
interface ethernet 0/0.10
encapsulation dot1q 10
ip address 10.0.0.251 255.255.255.0
ip nat inside
interface ethernet 0/0.20
encapsulation dot1q 20
ip address 20.0.0.251 255.255.255.0
ip nat inside
interface ethernet 0/1
ip address 101.0.0.1 255.255.255.0
no shutdown
ip nat outside
ip nat inside source list 1 interface ethernet 0/0 overload
access-list 1 permit any
exit
```

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R2:

```
hostname EDGE_2
ip route 0.0.0.0 0.0.0.0 102.0.0.2
interface ethernet 0/0
no shutdown
interface ethernet 0/0.10
encapsulation dot1q 10
ip address 10.0.0.252 255.255.255.0
ip nat inside
interface ethernet 0/0.20
encapsulation dot1q 20
ip address 20.0.0.252 255.255.255.0
ip nat inside
interface ethernet 0/1
ip address 102.0.0.1 255.255.255.0
no shutdown
ip nat outside
ip nat inside source list 1 interface ethernet 0/0 overload
exit
```

R3:

```
hostname EDGE_3
ip route 0.0.0.0 0.0.0.0 103.0.0.2
interface ethernet 0/0
no shutdown
interface ethernet 0/0.10
encapsulation dot1q 10
ip address 10.0.0.253 255.255.255.0
ip nat inside
interface ethernet 0/0.20
encapsulation dot1q 20
ip address 20.0.0.253 255.255.255.0
ip nat inside
interface ethernet 0/1
ip address 103.0.0.1 255.255.255.0
no shutdown
ip nat outside
ip nat inside source list 1 interface e0/0 overload
exit
```

R4:

```
hostname OUTSIDE
interface ethernet 0/1
ip address 101.0.0.2 255.255.255.0
no shutdown
interface ethernet 0/2
ip address 102.0.0.2 255.255.255.0
no shutdown
```

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interface ethernet 0/3
ip address 103.0.0.2 255.255.255.0
no shutdown
interface loopback 0
ip address 200.0.0.1 255.255.255.255
exit

R5:
hostname HOST1
no ip domain-lookup
interface ethernet 0/0
ip address 10.0.0.1 255.255.255.0
no shutdown
ip route 0.0.0.0 0.0.0.0 10.0.0.254
exit

R6:
hostname HOST2
no ip domain-lookup
interface ethernet 0/0
ip address 10.0.0.2 255.255.255.0
no shutdown
ip route 0.0.0.0 0.0.0.0 10.0.0.254
exit

R7:
hostname HOST3
no ip domain-lookup
interface ethernet 0/0
ip address 20.0.0.1 255.255.255.0
no shutdown
ip route 0.0.0.0 0.0.0.0 20.0.0.254
exit

R8:
hostname HOST4
no ip domain-lookup
interface ethernet 0/0
ip address 20.0.0.2 255.255.255.0
no shutdown
ip route 0.0.0.0 0.0.0.0 20.0.0.254
exit

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SW9:

```
hostname ACCESS_SWITCH
no ip domain-lookup
interface range ethernet1/0-1
switchport mode access
switchport access vlan 10
interface range ethernet1/2-3
switchport mode access
switchport access vlan 20
interface range e0/0-3
switchport trunk encap dot1q
switchport mode trunk
exit
```

Step 2 Configure Basic MVRRP

R1:

```
interface ethernet 0/0.10
vrrp 10 ip 10.0.0.254
vrrp 10 priority 200
vrrp 10 track 1 decrement 101
interface ethernet 0/0.20
vrrp 20 ip 20.0.0.254
vrrp 20 track 1 decrement 51
track 1 interface ethernet 0/1 line-protocol
exit
```

R2:

```
interface ethernet 0/0.10
vrrp 10 ip 10.0.0.254
vrrp 10 track 1 decrement 51
interface ethernet 0/0.20
vrrp 20 ip 20.0.0.254
vrrp 20 priority 200
vrrp 20 track 1 decrement 101
track 1 interface ethernet 0/1 line-protocol
exit
```

R3:

```
interface ethernet 0/0.10
vrrp 10 ip 10.0.0.254
interface ethernet 0/0.20
vrrp 20 ip 20.0.0.254
exit
```

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Task 2: Verification

Step 1 Verify MVRRP

```
EDGE_1#show vrrp
Ethernet0/0.10 - Group 10
State is Master
Virtual IP address is 10.0.0.254
Virtual MAC address is 0000.5e00.010a
Advertisement interval is 1.000 sec
Preemption enabled
Priority is 200
Track object 1 state Up decrement 101
Master Router is 10.0.0.251 (local), priority is 200
Master Advertisement interval is 1.000 sec
Master Down interval is 3.218 sec
Ethernet0/0.20 - Group 20
State is Backup
Virtual IP address is 20.0.0.254
Virtual MAC address is 0000.5e00.0114
Advertisement interval is 1.000 sec
Preemption enabled
Priority is 100
Track object 1 state Up decrement 51
Master Router is 20.0.0.252, priority is 200
Master Advertisement interval is 1.000 sec
Master Down interval is 3.609 sec (expires in 3.333 sec)

EDGE_2#show vrrp
Ethernet0/0.10 - Group 10
State is Backup
Virtual IP address is 10.0.0.254
Virtual MAC address is 0000.5e00.010a
Advertisement interval is 1.000 sec
Preemption enabled
Priority is 100
Track object 1 state Up decrement 51
Master Router is 10.0.0.251, priority is 200
Master Advertisement interval is 1.000 sec
Master Down interval is 3.609 sec (expires in 2.813 sec)
Ethernet0/0.20 - Group 20
State is Master
Virtual IP address is 20.0.0.254
Virtual MAC address is 0000.5e00.0114
Advertisement interval is 1.000 sec
Preemption enabled
Priority is 200
Track object 1 state Up decrement 101
```

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Master Router is 20.0.0.252 (local), priority is 200
Master Advertisement interval is 1.000 sec
Master Down interval is 3.218 sec

EDGE_3#show vrrp
Ethernet0/0.10 - Group 10
State is Backup
Virtual IP address is 10.0.0.254
Virtual MAC address is 0000.5e00.010a
Advertisement interval is 1.000 sec
Preemption enabled
Priority is 100
Master Router is 10.0.0.251, priority is 200
Master Advertisement interval is 1.000 sec
Master Down interval is 3.609 sec (expires in 3.508 sec)
Ethernet0/0.20 - Group 20
State is Backup
Virtual IP address is 20.0.0.254
Virtual MAC address is 0000.5e00.0114
Advertisement interval is 1.000 sec
Preemption enabled
Priority is 100
Master Router is 20.0.0.252, priority is 200
Master Advertisement interval is 1.000 sec
Master Down interval is 3.609 sec (expires in 3.030 sec)

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