LAB: VRRP

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VRRP Topology
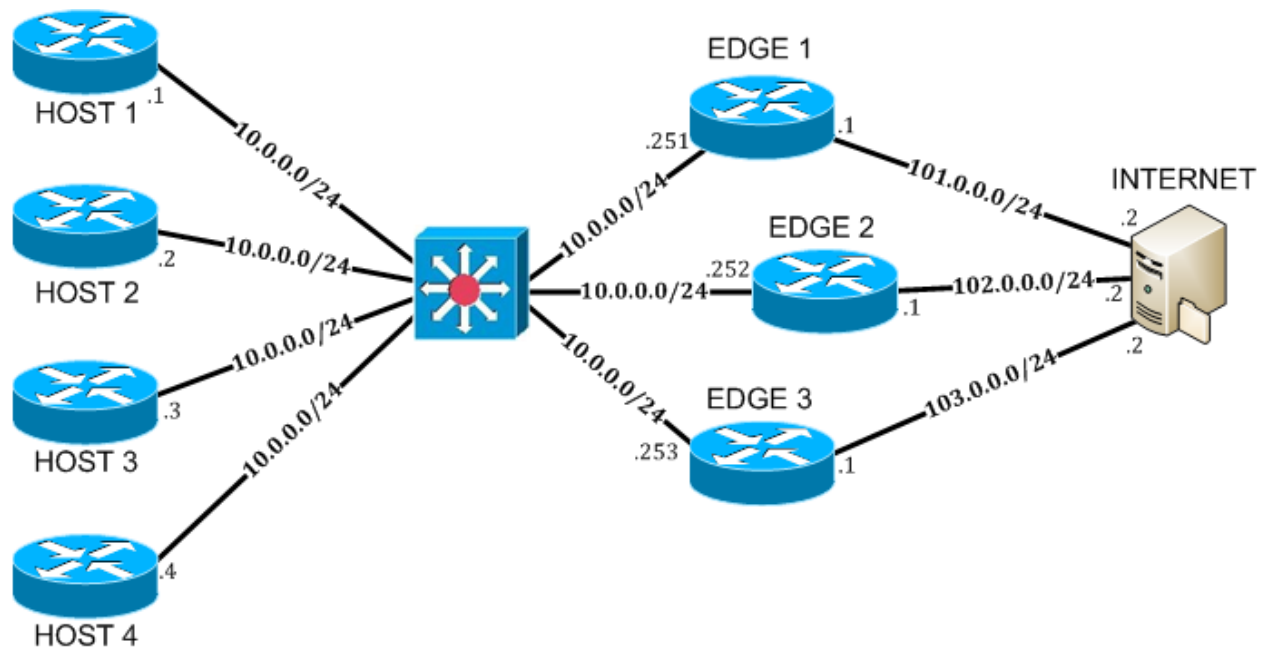
Task 1: Configure VRRP

Step 1 in the configuration mode configure the router with following initial configuration

R1:
hostname EDGE_1
ip route 0.0.0.0 0.0.0.0 101.0.0.2
interface e0/0
ip add 10.0.0.251 255.255.255.0
no shutdown
ip nat inside
interface e0/1
ip add 101.0.0.1 255.255.255.0
no shutdown
ip nat outside
ip nat inside source list 1 interface e0/1 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 e0/0
ip add 10.0.0.252 255.255.255.0
ip nat inside
no shutdown
interface e0/1
ip add 102.0.0.1 255.255.255.0
ip nat outside
no shutdown
ip nat inside source list 1 interface e0/1 overload
access-list 1 permit any
exit
```

R4:
```
hostname INTERNET
interface e0/1
ip add 101.0.0.2 255.255.255.0
no shutdown
interface e0/2
ip add 102.0.0.2 255.255.255.0
no shutdown
interface loopback 0
ip add 200.0.0.1 255.255.255.255
exit
```

R5:
```
hostname HOST1
interface ethernet 0/0
ip add 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   Use following command to configure Basic VRRP on R1, R2, R3

R1:
interface Ethernet0/0
vrrp 10 ip 10.0.0.254
vrrp 10 priority 200
exit
priority 200 is used to make R1 become VRRP Master

R2:
interface Ethernet0/0
vrrp 10 ip 10.0.0.254
exit

R3:
interface Ethernet0/0
vrrp 10 ip 10.0.0.254
exit

Task 2: Verification

Step 1 Verify Master and Backup State in VRRP using show VRRP command

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
<mark>State is Backup</mark>
<mark>Virtual IP address is 10.0.0.254</mark>
<mark>Virtual MAC address is 0000.5e00.010a</mark>
Advertisement interval is 1.000 sec
<mark>Preemption enabled</mark>
<mark>Priority is 100</mark>
<mark>Master Router is 10.0.0.251, priority is 200</mark>
Master Advertisement interval is 1.000 sec
Master Down interval is 3.609 sec (expires in 3.107 sec)

Note: Preemption is enabled in VRRP by Default

Step 2   Verify VRRP Status using show VRRP brief command

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

Step 3   Use debug VRRP command to monitor group messages for troubleshooting purposes.

R1:
EDGE_1#debug vrrp
<mark>VRRP debugging is on</mark>
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

Task 3: Understanding VRRP Failover

Step 1   Shutdown the Master router to initiate failover

R1:
interface e0/0
shutdown
Following messages will be seen on master and backup routers.

*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

Step 2   Verify VRRP Failover and check if EDGE_3 router has become 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

Step 3   Reinstate R1 routers state as Master. Use no shutdown on R1 router

R1:
interface e0/0
no shutdown

Following messages will be seen on master and backup routers

EDGE_1#
*Jun 16 11:01:53.973: %VRRP-6-STATECHANGE: Et0/0 Grp 10 state Backup -> Master

Step 4   Verify and check if EDGE_1 router has re-instated its state and has become master

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

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

Step 3   Verify that by shutting down EDGE_1 WAN Interface the priority is decremented and Edge_2 has become master

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 4   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#sh 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)

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

Task 5: Verify VRRP Authentication

Step 1   Configure VRRP Authentication

R1:
interface e0/0
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 e0/0
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 e0/0
vrrp 10 authentication md5 key-chain RST
key chain RST
key 1
key-string cisco
exit

Step 2   Verify VRRP Authentication

EDGE_1#sh 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#sh 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#sh vrrp

Ethernet0/0 - Group 10
<mark>State is Backup</mark>
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
<mark>Authentication MD5, key-chain "RST"</mark>
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

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 e0/0
no shutdown

```
interface ethernet 0/0.10
encapsulation dot1q 10
ip add 10.0.0.251 255.255.255.0
ip nat inside
interface ethernet 0/0.20
encapsulation dot1q 20
ip add 20.0.0.251 255.255.255.0
ip nat inside
interface ethernet 0/1
ip add 101.0.0.1 255.255.255.0
no shutdown
ip nat outside
ip nat inside source list 1 interface e0/0 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 e0/0
no shutdown
interface e0/0.10
encapsulation dot1q 10
ip add 10.0.0.252 255.255.255.0
ip nat inside
interface e0/0.20
encapsulation dot1q 20
ip add 20.0.0.252 255.255.255.0
ip nat inside
interface e0/1
ip add 102.0.0.1 255.255.255.0
no shutdown
ip nat outside
ip nat inside source list 1 interface e0/0 overload
exit
```

R3:
```
hostname EDGE_3
ip route 0.0.0.0 0.0.0.0 103.0.0.2
interface e0/0
no shutdown
interface e0/0.10
encapsulation dot1q 10
ip add 10.0.0.253 255.255.255.0
ip nat inside
interface e0/0.20
encapsulation dot1q 20
ip add 20.0.0.253 255.255.255.0
```

```
ip nat inside
interface e0/1
ip add 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 e0/1
ip add 101.0.0.2 255.255.255.0
no shutdown
interface e0/2
ip add 102.0.0.2 255.255.255.0
no shutdown
interface e0/3
ip add 103.0.0.2 255.255.255.0
no shutdown
interface loopback 0
ip add 200.0.0.1 255.255.255.255
exit
```

R5:
```
hostname HOST1
no ip domain-lookup
interface ethernet 0/0
ip add 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 add 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 add 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

hostname HOST4
no ip domain-lookup
interface ethernet 0/0
ip add 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

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 e0/0.10
vrrp 10 ip 10.0.0.254
vrrp 10 priority 200
vrrp 10 track 1 decrement 101
interface e0/0.20
vrrp 20 ip 20.0.0.254
vrrp 20 track 1 decrement 51
track 1 interface ethernet 0/1 line-protocol
exit

R2:
interface e0/0.10
vrrp 10 ip 10.0.0.254
vrrp 10 track 1 decrement 51
interface e0/0.20
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 e0/0.10
vrrp 10 ip 10.0.0.254
interface e0/0.20
vrrp 20 ip 20.0.0.254
exit

Task 2: Verification

Step 1   Verify MVRRP

EDGE_1#sh 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#sh 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
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)