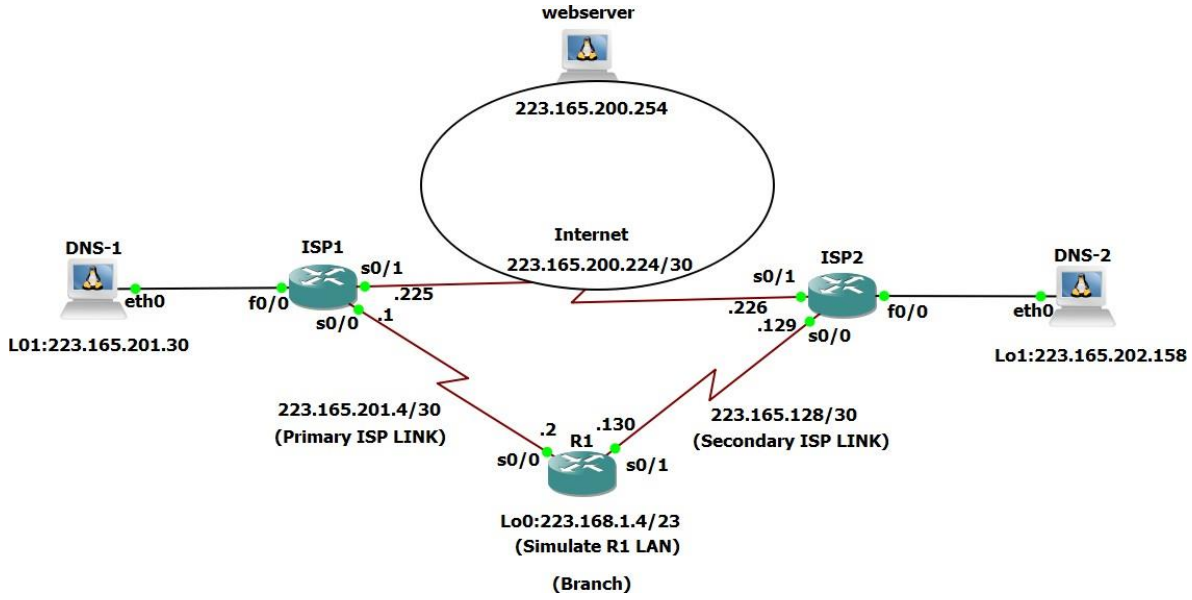
Practical No-1

Aim: Configure IP SLA Tracking and Path Control Topology

Topology:



Objectives:

-Configure and verify the IP SLA feature.

-Test the IP SLA tracking feature.

-Verify the Configuration and Operation using show and debug commands.

Step 1: Prepare the routers and Configure the Router hostname and Interface addresses.

Router R1

Interface Loopback 0

Ip address 223.168.1.4 255.255.255.0

Interface serial 0/0/0

Ip address 223.165.201.2 255.255.255.252

no shutdown

interface serial 0/0/1

ip address 223.165.202.130 255.255.255.252

```
R1#en
R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#host R1
R1(config)#interface Loopback 0
R1(config-if)#
*Mar  1 00:00:47.607: %LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback0,
 changed state to up
R1(config-if)#ip address 223.168.1.4 255.255.255.0
R1(config-if)#
R1(config-if)#int s0/0
R1(config-if)#ip address 223.165.201.2 255.255.255.252
R1(config-if)#no shutdown
R1(config-if)#
R1(config-if)#in
*Mar  1 00:02:54.835: %LINK-3-UPDOWN: Interface Serial0/0, changed state to up
R1(config-if)#int
*Mar  1 00:02:55.839: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0,
 changed state to up
R1(config-if)#int s0/1
R1(config-if)#ip addres
*Mar  1 00:03:24.183: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0,
 changed state to down
R1(config-if)#ip address 223.165.202.130 255.255.255.252
R1(config-if)#no shutdown
```

Router ISP1(R2)

Interface Loopback 0

Ip address 223.165.200.254 255.255.255.255

Interface Loopback 1

Ip address 223.165.201.30 255.255.255.255

Int s0/0

Ip address 223.165.201.1 255.255.255.252

no shutdown

int s0/1

ip address 223.165.200.225 255.255.255.252

no shutdown

```
ISP1#en
ISP1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
ISP1(config)#interface Loopback 0
ISP1(config-if)#ip add
*Mar  1 00:03:11.651: %LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback0,
 changed state to up
ISP1(config-if)#ip address 223.165.200.254 255.255.255.255
ISP1(config-if)#interface Loopback 1
ISP1(config-if)#
*Mar  1 00:05:04.991: %LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback1,
 changed state to up
ISP1(config-if)#ip address 223.165.201.30 255.255.255.255
ISP1(config-if)#int s0/0
ISP1(config-if)#ip address 223.165.201.1 255.255.255.252
ISP1(config-if)#no shutdown
ISP1(config-if)#
*Mar  1 00:07:06.251: %LINK-3-UPDOWN: Interface Serial0/0, changed state to up
ISP1(config-if)#
*Mar  1 00:07:07.255: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0,
 changed state to up
ISP1(config-if)#ints s0/1
                ^
% Invalid input detected at '^' marker.

ISP1(config-if)#int s0/1
ISP1(config-if)#ip address 223.165.200.225 255.255.252
% Incomplete command.

ISP1(config-if)#ip address 223.165.200.225 255.255.255.252
ISP1(config-if)#no shutdown
ISP1(config-if)#
```

ISP2 Router 3:

Interface Loopback 0
#
ip address 223.165.200.254 255.255.255.255
Interface Loopback 1
#
ip address 223.165.202.158 255.255.255.255

Int s0/0
Ip address 223.165.202.129 255.255.255.252
no shutdown
#
int s0/1
ip address 223.165.200.226 255.255.255.255

```
ISP2#en
ISP2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
ISP2(config)#host ISP2
ISP2(config)#interface Loopback0
ISP2(config-if)#
ISP2(config-if)#
ISP2(config-if)#ip address 223.165.200.254 255.255.255.255
ISP2(config-if)#interface Loopback1
ISP2(config-if)#
ISP2(config-if)#ip address 223.165.202.158 255.255.255.255
ISP2(config-if)#int s0/0
ISP2(config-if)#ip address 223.165.202.129 255.255.255.252
ISP2(config-if)#no shutdown
ISP2(config-if)#
ISP2(config-if)#
ISP2(config-if)#
*Mar  1 00:17:21.467: %LINK-3-UPDOWN: Interface Serial0/0, changed state to up
ISP2(config-if)#
*Mar  1 00:17:22.471: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0,
 changed state to up
ISP2(config-if)#int s0/1
ISP2(config-if)#ip address 223.165.200.226 255.255.255.252
ISP2(config-if)#no shutdown
ISP2(config-if)#
*Mar  1 00:18:28.815: %LINK-3-UPDOWN: Interface Serial0/1, changed state to up
*Mar  1 00:18:29.823: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1,
 changed state to up
```

b. Verify the Configuration by using the show interfaces description command. The output from router R1 is shown here as an example.

R1# show interfaces description

```
R1#show interfaces description
Interface                      Status         Protocol Description
Fa0/0                          admin down     down
Se0/0                          up             up
Fa0/1                          admin down     down
Se0/1                          up             up
Se0/2                          admin down     down
Se0/3                          admin down     down
Se0/4                          admin down     down
Se0/5                          admin down     down
Fa1/0                          admin down     down
Lo0                            up             up
R1#
```

c. The Current routing policy in the topology is as follows:
-- Router R1 establishes connectivity to the Internet through ISP1 using a default static route.

-- ISP1 and ISP2 have dynamic routing enabled between them, advertising their respective public address pools.

-- ISP1 and ISP2 both have static routes back to the ISP LAN.

Router R1 ip route 0.0.0.0 0.0.0.0 223.165.201.

```
R1(config)#ip route 0.0.0.0 0.0.0.0 223.165.201.1
R1(config)#
```

Router ISP1 (R2)

Router eigrp 1

network 223.165.200.224 0.0.03

network 223.165.201.4 0.0.0.31

no auto-summary

ip route 223.168.1.0 255.255.255.0 223.165.201.2

```
ISP2(config)#router eigrp 1
ISP2(config-router)#network 223.165.200.224 0.0.0.3
ISP2(config-router)#
*Mar  1 00:28:14.651: %DUAL-5-NBRCHANGE: IP-EIGRP(0) 1: Neighbor 223.165.200.225
 (Serial0/1) is up: new adjacency
ISP2(config-router)#network 223.165.202.128 0.0.0.31
ISP2(config-router)#no auto-summary
ISP2(config-router)#
ISP2(config-router)#
*Mar  1 00:29:25.351: %DUAL-5-NBRCHANGE: IP-EIGRP(0) 1: Neighbor 223.165.200.225
 (Serial0/1) is resync: summary configured
ISP2(config-router)#ip route 223.168.1.0 255.255.255.0 223.165.202.130
ISP2(config)#
```

Router ISP2 (R3)

Router eigrp 1

Network 223.165.200.224 0.0.0.0
#

Network 223.165.202.128 0.0.031

no auto-summary

#

ip route 223.168.1.0 255.255.255.0 223.165.202.130

```
ISP1(config)#router eigrp 1
ISP1(config-router)#network 223.165.200.224 0.0.0.3
ISP1(config-router)#network 223.165.201.4 0.0.0.31
ISP1(config-router)#no auto-summary
ISP1(config-router)#ip route 223.168.1.0 255.255.255.0 223.165.201.2
ISP1(config)#
```

Step 2: Verify server reachability.

a. Before Implementing the Cisco IOS SLA feature, you must verify reachabilty to the Internet servers. From router R1, ping the web server, ISP1 DNS server, and ISP2

DNS server to verify connectivity. You can copy the following TCL script and paste it into R1.

R1(tcl) # foreach address {

+>(tcl) #223.165.200.254

+>(tcl) #223.165.201.30

+>(tcl) #223.165.202.158

+>(tcl) #} {

+>(tcl) #ping $address source 223.168.1.4

+>(tcl) #}

```
R1#tclsh
R1(tcl)#foreach address{
wrong # args: should be "foreach varList list ?varList list ...? command"
R1(tcl)#foreach address {
+>(tcl)#223.165.200.254
+>(tcl)#223.165.201.30
+>(tcl)#223.165.202.158
+>(tcl)#} {
+>(tcl)#ping $address source 223.168.1.4
+>(tcl)#}
```

```
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 223.165.200.254, timeout is 2 seconds:
Packet sent with a source address of 223.168.1.4
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 20/26/44 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 223.165.201.30, timeout is 2 seconds:
Packet sent with a source address of 223.168.1.4
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 12/20/28 ms
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 223.165.202.158, timeout is 2 seconds:
Packet sent with a source address of 223.168.1.4
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 28/39/68 ms
```

b. Trace the path taken to the web server, ISP1 DNS server, and ISP2 DNS server. You can copy the following TCL script and paste it into R1.

R1(tcl) #foreach address {

+>(tcl) #223.165.200.254

+>(tcl) #223.165.201.30

+>(tcl) #223.165.202.158

+>(tcl) #} {

+>(tcl) # trace $address source 223.168.1.4

+>(tcl) #}

```
R1(tcl)#foreach address {
+>(tcl)#223.165.200.254
+>(tcl)#223.165.201.30
+>(tcl)#223.165.202.158
+>(tcl)#} {
+>(tcl)#trace $address source 223.168.1.4
+>(tcl)#}

Type escape sequence to abort.
Tracing the route to 223.165.200.254

  1 223.165.201.1 40 msec 40 msec 28 msec
Type escape sequence to abort.
Tracing the route to 223.165.201.30

  1 223.165.201.1 32 msec 28 msec 28 msec
Type escape sequence to abort.
Tracing the route to 223.165.202.158

  1 223.165.201.1 40 msec 36 msec 20 msec
  2 223.165.200.226 44 msec 40 msec 24 msec
R1(tcl)#
R1(tcl)#tclquit
```

Step 3: Configure IP SLA probes.

a. Create and ICMP echo probe on R1 to the Primary DNS server on ISP1 using the ip sla command. The previous ip sla monitor command. In addition, the ICMP-echo command has replaced the type echo protocol Ip ICMP Echo command.

R1(config)# ip sla 11

R1(config-ip-sla)# icmp-echo 223.165.201.30

R1(config-ip-sla-echo) # frequency 10

R1(config-ip-sla-echo) #exit

```
R1#en
R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#ip sla 11
R1(config-ip-sla)#icmp-echo 223.165.201.30
R1(config-ip-sla-echo)#frequency 10
R1(config-ip-sla-echo)#exit
R1(config)#
```

b. Verify the IP SLAs Configuration of operation 11 using the show ip sla configuration 11 command.

R1# show ip sla configuration 11

```
R1(tcl)#show ip sla configuration 11
IP SLAs, Infrastructure Engine-II.
Entry number: 11
Owner:
Tag:
Type of operation to perform: icmp-echo
Target address/Source address: 223.165.201.30/0.0.0.0
Operation timeout (milliseconds): 5000
Type Of Service parameters: 0x0
Vrf Name:
Request size (ARR data portion): 28
Verify data: No
Schedule:
   Operation frequency (seconds): 10  (not considered if randomly scheduled)
   Next Scheduled Start Time: Start Time already passed
   Group Scheduled : FALSE
   Randomly Scheduled : FALSE
   Life (seconds): Forever
   Entry Ageout (seconds): never
   Recurring (Starting Everyday): FALSE
   Status of entry (SNMP RowStatus): Active
Threshold (milliseconds): 5000
Distribution Statistics:
   Number of statistic hours kept: 2
   Number of statistic distribution buckets kept: 1
   Statistic distribution interval (milliseconds): 4294967295
History Statistics:
   Number of history Lives kept: 0
   Number of history Buckets kept: 15
   History Filter Type: None
Enhanced History:
```

c. Issue the show ip sla statistic command to display the number of successes, failures, and results of the latest operations.
d. Although not actually required because IP SLA session 11 alone could provide the desired fault tolerance, create a second probe,22, to test connectivity to the second DNS server located on router ISP2. You can copy and paste the following commands on R1.

e. Verify the new probe using the show ip sla configuration and show ip sla statistics commands.

R1# show ip sla configuration 22

```
R1#show ip sla configuration 22
IP SLAs, Infrastructure Engine-II.
Entry number: 22
Owner:
Tag:
Type of operation to perform: icmp-echo
Target address/Source address: 223.165.202.158/0.0.0.0
Operation timeout (milliseconds): 5000
Type Of Service parameters: 0x0
Vrf Name:
Request size (ARR data portion): 28
Verify data: No
Schedule:
   Operation frequency (seconds): 10  (not considered if randomly scheduled)
   Next Scheduled Start Time: Start Time already passed
   Group Scheduled : FALSE
   Randomly Scheduled : FALSE
   Life (seconds): Forever
   Entry Ageout (seconds): never
   Recurring (Starting Everyday): FALSE
   Status of entry (SNMP RowStatus): Active
Threshold (milliseconds): 5000
Distribution Statistics:
   Number of statistic hours kept: 2
   Number of statistic distribution buckets kept: 1
   Statistic distribution interval (milliseconds): 4294967295
History Statistics:
   Number of history Lives kept: 0
   Number of history Buckets kept: 15
   History Filter Type: None
Enhanced History:
```

R1# show ip sla statistics 22

```
R1#
R1#show ip sla statistics 22

Round Trip Time (RTT) for       Index 22
        Latest RTT: 40 milliseconds
Latest operation start time: *00:57:12.643 UTC Fri Mar 1 2002
Latest operation return code: OK
Number of successes: 9
Number of failures: 0
Operation time to live: Forever
```

Step 4: Configure tracking options.

a. Remove the current default route on R1, and replace it with a floating static route having an administrative distance of 5.

R1(config) # no ip route 0.0.0.0 0.0.0.0 223.165.201.1

```
R1#en
R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#no ip route 0.0.0.0 0.0.0.0 223.165.201.1
R1(config)#ip route 0.0.0.0 0.0.0.0 223.165.201.1 5
R1(config)#exit
```

R1(config) #ip route 0.0.0.0 0.0.0.0 223.165.201.1 5

b. Verify the Routing table.

```
R1#
R1#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 223.165.201.1 to network 0.0.0.0

C    223.168.1.0/24 is directly connected, Loopback0
     223.165.202.0/30 is subnetted, 1 subnets
C       223.165.202.128 is directly connected, Serial0/1
     223.165.201.0/30 is subnetted, 1 subnets
C       223.165.201.0 is directly connected, Serial0/0
S*   0.0.0.0/0 [5/0] via 223.165.201.1
```

R1# show ip route

c. Use the trace 1 ip sla 11 reachability command to enter the config-track sub-Configuration mode.

R1(config)# track 1 ip sla 11 reachability.

R1(config-track) #

d. Configure the floating static route that will be implemented with when tracking object 1 is active. To view routing table changes as they happen, first enable the debug ip routing command. Next, use the ip route 0.0.0.0 0.0.0.0 223.165.201.1 2 track 1 command to create a floating static default route via 223.165.201.1 (ISP1). Notice that this command references the tracking object number 1, which in turn references IP SLA operation number 11.

R1# debug ip routing:

```
R1#debug ip  routing
IP routing debugging is on
R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#ip route 0.0.0.0 0.0.0.0 223.165.201.1 2 track 1
R1(config)#
```

R1(config)# ip route 0.0.0.0 0.0.0.0 223.165.201.1 2 track 1

```
R1(config)#track 1 rtr 11 reachability
R1(config-track)#
*Mar  1 03:28:01.267: RT: closer admin distance for 0.0.0.0, flushing 1 routes
*Mar  1 03:28:01.271: RT: NET-RED 0.0.0.0/0
*Mar  1 03:28:01.271: RT: add 0.0.0.0/0 via 223.165.201.1, static metric [2/0]
*Mar  1 03:28:01.271: RT: NET-RED 0.0.0.0/0
*Mar  1 03:28:01.271: RT: default path is now 0.0.0.0 via 223.165.201.1
*Mar  1 03:28:01.271: RT: new default network 0.0.0.0
*Mar  1 03:28:01.271: RT: NET-RED 0.0.0.0/0
R1(config-track)#
*Mar  1 03:28:06.271: RT: NET-RED 0.0.0.0/0
R1(config-track)#
*Mar  1 03:28:07.399: RT: NET-RED 0.0.0.0/0
R1(config-track)#
*Mar  1 03:29:07.399: RT: NET-RED 0.0.0.0/0
R1(config-track)#delay down 10 up
*Mar  1 03:30:07.399: RT: NET-RED 0.0.0.0/0
R1(config-track)#delay down 10 up 1
R1(config-track)#exit
```

e. Repeat the steps for operation 22, track number 2, and assign the static route an admin distance higher than track 1 and lower than 5. On R1, copy the following configuration, which sets an admin distance of 3. Track 2 ip sla 22 reachability delay down 10 up 1 exit.

ip route 0.0.0.0 0.0.0.0 223.165.202.129 3 track 2

```
R1(config)#track 1 rtr 22 reachability
*Mar  1 03:40:07.399: RT: NET-RED 0.0.0.0/0
R1(config)#track 1 rtr 22 reachability
R1(config-track)#delay down 10 up 1
R1(config-track)#exit
R1(config)#ip route 0
*Mar  1 03:41:07.399: RT: NET-RED 0.0.0.0/0
R1(config)#ip route 0.0.0.0 0.0.0.0 223.165.201.1 2 track 1
R1(config)#ip route 0.0.0.0 0.0.0.0
*Mar  1 03:42:07.399: RT: NET-RED 0.0.0.0/0
R1(config)#ip route 0.0.0.0 0.0.0.0 223.165.202.129 3 track 2
R1(config)#
```

f. Verify the Routing table again.

R1# show ip route

```
R1#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 223.165.201.1 to network 0.0.0.0

C    223.168.1.0/24 is directly connected, Loopback0
     223.165.202.0/30 is subnetted, 1 subnets
C       223.165.202.128 is directly connected, Serial0/1
     223.165.201.0/30 is subnetted, 1 subnets
C       223.165.201.0 is directly connected, Serial0/0
S*   0.0.0.0/0 [2/0] via 223.165.201.1
R1#
```

Step 5: Verify IP SLA operation.

The following summarizes the process:

- Disable the DNS loopback interface ISP1(R2)
- Observe the output of the debug command on R1.
- Verify the static route entries in the routing table and the IP SLA statistic of R1.
- Re-enable the loopback interface on ISP1 (R2) and again observe the operation of the IP SLA tracking feature.

ISP1(config)# interface loopback 1

ISP1(config-if) #shutdown

```
ISP1(config)#
ISP1(config)#interface loopback 1
ISP1(config-if)#
ISP1(config-if)#shutdown
```

b. Verify the routing table.

R1# show ip route

```
R1#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 223.165.201.1 to network 0.0.0.0

C    223.168.1.0/24 is directly connected, Loopback0
     223.165.202.0/30 is subnetted, 1 subnets
C       223.165.202.128 is directly connected, Serial0/1
     223.165.201.0/30 is subnetted, 1 subnets
C       223.165.201.0 is directly connected, Serial0/0
S*   0.0.0.0/0 [2/0] via 223.165.201.1
R1#
```

c. Verify the SLA statistics.

R1# show ip sla statistics

```
R1#show ip sla statistics

Round Trip Time (RTT) for       Index 11
        Latest RTT: NoConnection/Busy/Timeout
Latest operation start time: *04:08:57.926 UTC Fri Mar 1 2002
Latest operation return code: No connection
Number of successes: 31
Number of failures: 97
Operation time to live: Forever



Round Trip Time (RTT) for       Index 22
        Latest RTT: 20 milliseconds
Latest operation start time: *04:09:02.642 UTC Fri Mar 1 2002
Latest operation return code: OK
Number of successes: 79
Number of failures: 0
Operation time to live: Forever
```

d. Initiate a trace to the web server from the internal LAN IP address.

R1# trace 223.165.200.254 source 223.168.1.4

e. Again Examine the IP SLA statistics.

R1# show ip sla statistics

```
R1#show ip sla statistics

Round Trip Time (RTT) for       Index 11
        Latest RTT: NoConnection/Busy/Timeout
Latest operation start time: *04:08:57.926 UTC Fri Mar 1 2002
Latest operation return code: No connection
Number of successes: 31
Number of failures: 97
Operation time to live: Forever



Round Trip Time (RTT) for       Index 22
        Latest RTT: 20 milliseconds
Latest operation start time: *04:09:02.642 UTC Fri Mar 1 2002
Latest operation return code: OK
Number of successes: 79
Number of failures: 0
Operation time to live: Forever
```

g. Verify the Routing Table.

R1# show ip route

```
R1#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 223.165.201.1 to network 0.0.0.0

C    223.168.1.0/24 is directly connected, Loopback0
     223.165.202.0/30 is subnetted, 1 subnets
C       223.165.202.128 is directly connected, Serial0/1
     223.165.201.0/30 is subnetted, 1 subnets
C       223.165.201.0 is directly connected, Serial0/0
S*   0.0.0.0/0 [2/0] via 223.165.201.1
R1#
```