

Configuring vBranch High Availability

The vbranch high availability (HA) solution is a box-to-box HA. It is similar to the traditional branch, which uses physical boxes for routing and other services. This solution uses the Hot Standby Router Protocol (HSRP), a default gateway redundancy (or a first hop redundancy), which allows the network to recover from the failure of the device acting as the default gateway for the LAN side end points (devices). The routing protocols are configured to converge the traffic on the WAN side, when there are failures. So, this solution uses HSRP to provide redundancy for the branch connectivity on the LAN side. The Enhanced Interior Gateway Routing Protocol (EIGRP), Open Shortest Path First (OSPF) routing protocols, and Embedded Event manager (EEM) scripts are configured to converge on the WAN side. The following section explains the redundancy solutions for the branch, with each ENCS having separate active WAN link.

Note You can use this recommended HA design as is, or modify as per the field requirement.

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Prerequisites for vBranch HA

- Cisco ISRv must run HSRP on the LAN facing interface.
- The WAN links are active on both Cisco ENCS1 and Cisco ENCS2. Each of the ENCS WAN link is connected to the WAN network (most cases with two SPs), with two ENCSs in an active-active mode.
- The LAN facing links of both Cisco ENCS devices are connected to an external switch (as an uplink), and all the devices on the LAN segment are also connected to the external switch. There should be no LAN device connecting directly to the Cisco ENCS internal switch.
- A transit link, which is L3 routed, is configured between the Cisco ENCS devices. Since the LAN HSRP makes only one device active, the transit link is used to forward traffic This link is used to forward traffic from the standby ENCS WAN to LAN or LAN to WAN. This link can be back-to-back connected on the ENCS internal switch ports.

- VMs and VNFs on both ENCS devices must be configured identical.

vBranch HA Design and Topology

Physical Devices Connection

Each Cisco ENCS has a WAN traffic connected to the Gigabit Ethernet interface, GE0-0, in this dual-WAN topology.

There are two Cisco ENCS devices namely ENCS1 and ENCS2. There is an external switch connecting one of the LAN ports from each Cisco ENCS. There is a back-to-back connection between ENCS1 and ENCS2 connecting one of the LAN ports from each Cisco ENCS. The WAN port from each Cisco ENCS is connected to the service providers network.

ISRv1 on ENCS1 and ISRv2 on ENCS2 are responsible for handling packets from LAN to WAN and WAN to LAN. If the WAN connection goes down or if the ISRv1 becomes unavailable, fast converging routing protocols, such as EIGRP and OSPF, can respond within seconds so that ISRv2 is prepared to transfer packets.

VM and Service Chain Network Connection

The Cisco ISRv should be created with an additional vNIC mapped to the transit link between two Cisco ENCS devices, apart from the regular WAN and LAN or service net links. The Cisco ISRv on both ENCS should have identical resource configurations (vNICs, vCPU, memory, etc.) and feature configurations.

Each Cisco ENCS is running an instance of service VNFs (for example, Cisco ASAv and Cisco vWAAS), and should have the identical service chain VNFs configured on both Cisco ENCS devices. Service VNFs should also have same features configured on both Cisco ENCS devices. The traffic goes through the service VNFs on the active Cisco ENCS only, even though both Cisco ENCS devices are actively forwarding on the WAN link. On a failover, the traffic will go over the service VNFs on the newly active ENCS (ENCS2).

This HA solution requires a transit link configured between two Cisco ENCS devices. One of the LAN ports from each of the Cisco ENCS can be connected back to back. This transit link port should be extended to the Cisco ISRv.

Enable Virtual NIC Failure Detection with Track Feature

You can enable the Track feature to detect virtual NIC failure in the following two scenarios:

- When the underlying physical link fails, the HSRP or routing protocols cannot detect the failure—This is because the line protocol does not go down when the underlying physical link fails if the Cisco ISRv is using a virtual NIC.
- With EEM scripts unconfigured, when the underlying physical link fails, the virtual NIC line protocol does not go down. In this case the routing protocol does not withdraw the routes.

Configuration Example for the Track Feature with Scenario 1 (HSRP)

In the virtual environment, you can enable higher protocols like HSRP to take action when the link failure happens. One way to achieve this is by configuring the Track feature on some object (ICMP ping) in Cisco IOS XE.

In Cisco ISRv, if the LAN interface where HSRP is running is a virtual NIC, then you can configure the track object to ping some device on the LAN segment, and monitor the connection failures. So, when the track object is down due to some connection failure, you can configure an action as to shut down the HSRP group, so that the peer will take over the active role making the default Gatway IP active. Without this track object, both Cisco ENCS devices will become active getting into a split-brain scenario.

The following example shows how to configure the track object on the active ISRv1, and monitor the connection failures by pinging the device IP in the network.



Note The Cisco ISRv should have AX license to configure the IP SLA.

```
track 1 ip sla 1 reachability
ip sla 1
 icmp-echo 192.0.2.1 source-ip 198.51.100.1
 frequency 5
ip sla schedule 1 life forever start-time now
!
track 5 ip sla 5 reachability
ip sla 5
 icmp-echo 192.0.2.2 source-ip 198.51.100.2
 frequency 5
ip sla schedule 5 life forever start-time now
!
```

The following output shows that the Track 1 reachability is failed, and Track 5 is up.

```
device1# show track
Track 1
  IP SLA 1 reachability
  Reachability is Down
    11 changes, last change 00:01:22
  Latest operation return code: Timeout
  Tracked by:
    HSRP GigabitEthernet3 25
Track 5
  IP SLA 5 reachability
  Reachability is Up
    4 changes, last change 00:02:32
  Latest operation return code: OK
  Latest RTT (millisecs) 1
  Tracked by:
    HSRP GigabitEthernet3 25
ISRv1#
```

The following example shows how to configure the Track object to monitor the line protocol state of the interface:

```
track 2 interface GigabitEthernet2 line-protocol
```

The following output shows that the line protocol state is down:

```
device# show track
Track 2
  Interface GigabitEthernet2 line-protocol
  Line protocol is Down ((hw down))
    8 changes, last change 00:01:25
```

```
  Tracked by:
    HSRP GigabitEthernet3 25
```

Configuration Example for the Track Feature with Scenario 2 (EEM Scripts)

With EEM scripts unconfigured, when an underlying link fails, the virtual NIC line protocol does not go down. This causes the problem as the routing protocol will not withdraw the routes. You can configure a Track object (can use the same object defined for HSRP above) to detect the failure. When the failure happens, the active Cisco ISRv has to withdraw the routes or network, so that the WAN link does not receive any traffic. One way to withdraw the routes is configure the EEM script, and delete the network from EIGRP.

The following example shows how to configure the EEM scripts, and remove the network from EIGRP:

```
track 5 ip sla 5 reachability
!
ip sla 5
 icmp-echo 192.0.2.1 source-ip 192.0.2.18
 frequency 5
ip sla schedule 5 life forever start-time now
!
event manager applet noshut_int
 event track 5 state up
 action 1.1 cli command "enable"
 action 1.2 cli command "config t"
 action 1.3 cli command "router eigrp 10"
 action 1.4 cli command "network 192.0.2.1 0.0.0.255"
 action 1.5 cli command "end"
event manager applet shut_int
 event track 5 state down
 action 1.1 cli command "enable"
 action 1.2 cli command "config t"
 action 1.3 cli command "router eigrp 10"
 action 1.4 cli command "no network 192.0.2.1 0.0.0.255"
 action 1.5 cli command "end"
```

In the virtual environment HSRP, make sure to use standby use-bia.

The following configuration example shows how to use the Track object (Track 5) to shut down HSRP group in ISRv1, when reachability is down for Track 5:

```
interface GigabitEthernet4
 description Service-NET-Virtio
 ip address 192.0.2.1 255.255.255.0
 standby use-bia
 standby 25 ip 192.0.2.22
 standby 25 timers 1 5
 standby 25 priority 105
 standby 25 preempt
 standby 25 track 5 shutdown
```

Isolating LAN and Transit Link Traffic for vBranch HA

LAN traffic and transit link traffic shall be isolated by configuring different VLANs for each traffic since both links are connected to the same ENCS internal switch. If you do not isolate these traffic, both LAN traffic and transit link will flow through the same internal switch on the Cisco ENCS.

The following Cisco ENCS switch configuration example shows how to isolate traffic. In this example, the Cisco ISRv is configured to send HSRP traffic as an untag and transit traffic in VLAN 46. So, to isolate HSRP traffic and transit traffic on the internal switch, the Gigabit Ethernet interface 1/0 is connected to a LAN network and Gigabit Ethernet interface 1/1 is configured as the transit link. The Gigabit Ethernet interface 1/1 allows the VLAN 46 to pass the transit traffic. It should also have non-default (other than 1) native VLAN (for example, VLAN 2), because the Cisco ENCS internal switch uplink (internal) has the native VLAN 1 configured.

Enable MSTP on all switches before isolating traffic.

```
switch
 interface gigabitEthernet1/0
  negotiation auto
  no shutdown
  switchport access vlan 1
  switchport mode access
  switchport trunk native vlan 1
  switchport trunk allowed vlan 1-2349,2450-4093
!
!
!
switch
 interface gigabitEthernet1/1
  negotiation auto
  no shutdown
spanning-tree mst 1 cost 200000000
 spanning-tree mst 2 cost 200000000
  switchport access vlan 46
  switchport mode trunk
  switchport trunk native vlan 2
  switchport trunk allowed vlan 1-2349,2450-4093
!
!
!
 spanning-tree enable
 spanning-tree mode mst
 spanning-tree mst configuration
 name     region1
  revision 1
  instance 1 vlan 1
  instance 2 vlan 46
 !
```

Use the **show switch vlan detailed** command to verify the configuration as shown below:

```
device# show switch vlan detailed

platform-detail hardware_info Manufacturer "Cisco Systems, Inc."
platform-detail hardware_info PID ENCS5412/K9
platform-detail hardware_info SN FGL212681GK
platform-detail hardware_info hardware-version M3
platform-detail hardware_info UUID 7BBEBDE0-CE3C-42E5-B564-CFEE8F18AE97
platform-detail hardware_info Version 3.8.1-FC3
platform-detail hardware_info Compile_Time "Sunday, April 15, 2018 [20:38:10 PDT]"
platform-detail hardware_info CPU_Information "Intel(R) Xeon(R) CPU D-1557 @ 1.50GHz 12
cores"
platform-detail hardware_info Memory_Information "16227148 kB"
platform-detail hardware_info Disk_Size "64.0 GB"
platform-detail hardware_info CIMC_IP NA
platform-detail hardware_info Entity-Name ENCS
platform-detail hardware_info Entity-Desc "Enterprise Network Compute System"
```

```
platform-detail software_packages Kernel_Version 3.10.0-514.21.1.1.el7.x86_64
platform-detail software_packages QEMU_Version 1.5.3
platform-detail software_packages LibVirt_Version 3.2.0
platform-detail software_packages OVS_Version 2.5.2
platform-detail switch_detail UUID NA
platform-detail switch_detail Type NA
platform-detail switch_detail Name NA
platform-detail switch_detail Ports 8
                                                                                PCI
NAME   TYPE      MEDIA         LINK  SPEED  MTU   MAC                 DETAIL
-------------------------------------------------------------------------------
GE0-0  physical  Twisted Pair  up    1000   9216  70:db:98:c3:f3:64   02:00.0
GE0-1  physical  Twisted Pair  up    1000   9216  70:db:98:c3:f3:65   02:00.1
MGMT   physical  Twisted Pair  up    1000   1500  70:db:98:c3:f3:d8   0e:00.0
```

Packet Flow for vBranch HA

This section explains high-level packet flow in failure and non-failure cases.

Non-Failure Case

In the non-failure case, both active and standby Cisco ENCS devices are up and running.

- LAN to WAN through the standby ENCS1 WAN link
  - The device in the LAN segment is configured with the default gateway as the HSRP virtual IP address, and since ENCS1 is an active HSRP, LAN traffic first comes to the active ENCS1.
  - LAN traffic goes through the service chain VM (Cisco ASAv), and then hits the Cisco ISRv. In this case, the destination IP is routable through the ENCS1 WAN interface. The Cisco ISRv sends traffic over the WAN link.
- LAN to WAN through the standby ENCS2 WAN link—In this case, the LAN to WAN traffic uses the transit link between the active and standby devices.
  - Devices in the LAN segment are configured with the default gateway as the HSRP virtual IP address, and since ENCS1 is an active HSRP, the LAN traffic first comes to the active ENCS1.
  - The LAN traffic goes through the service chain VMs (Cisco ASAv), and then hits the active Cisco ISRv. In this case, the destination IP is routable through the ENCS2 WAN interface. The traffic is sent to the Cisco ISRv on ENCS2 over the transit link, and then sent out over the WAN link to the destination.
- WAN to LAN through the active ENCS1
  - The WAN traffic hits the Cisco ISRv on ENCS1, then it goes through the service chain VMs, and sent to the LAN device.
- WAN to LAN through the standby ENCS2 WAN link—In this case, the WAN to LAN traffic uses the transit link between the active and standby devices.
  - The WAN traffic comes to the Cisco ISRv on ENCS2. The PBR/PFR configuration forces the traffic to use the transit link instead of the directly connected LAN port. So, the traffic is sent to the Cisco ISRv on ENCS1 over the transit link.

- Then, the traffic on ENCS1 goes through the service chain VMs, and sent to the LAN device.

Failure Case

In the failure case, the active device goes down, and the standby device becomes active.

The virtual IP (default gateway) address becomes active on ENCS2. The transit link will not be used. The traffic now goes through the service chain VMs on ENCS2, and gets forwarded directly between WAN and LAN interfaces. The PBR/PFR configuration should monitor the HSRP state, and use the LAN port instead of the transit link to forward LAN traffic.

Configuration Examples for vBranch HA

This sample configuration is for Cisco ENCS HA with a dual-WAN scenario. The Cisco ISRv is configured with vNICs connected to the wan-net, service-net, and transit link. HSRP is configured on the service-net interface. Each Cisco ENCS is provisioned with the Cisco ASAv (service-net) and Cisco vWAAS (service-net).



Note You can use this design as is, or modify as per the field requirement.

Example: Active Cisco ENCS Configuration with ISRv1

```
interface GigabitEthernet1
 vrf forwarding Mgmt-intf
 ip address 192.0.2.1 255.255.255.0
 negotiation auto
!
interface GigabitEthernet2
 description WAN-GE0-0-SRIOV-1
 ip address 192.0.2.2 255.255.255.0
 negotiation auto
!
interface GigabitEthernet3
 description LAN-NET
 no ip address
 shutdown
 negotiation auto
!
interface GigabitEthernet4
 description Service-NET-Virtio
 ip address 192.0.2.3 255.255.255.0
 standby use-bia
 standby 25 ip 192.0.2.20
 standby 25 timers 1 5
 standby 25 priority 105
 standby 25 preempt
 standby 25 track 1 decrement 10
 standby 25 track 2 decrement 10
 standby 25 track 3 decrement 10
 standby 25 track 5 shutdown
 standby 25 track 6 shutdown
 standby 25 track 7 shutdown
 negotiation auto
```

```
 bfd interval 9000 min_rx 9000 multiplier 3
!
interface GigabitEthernet5
 ip address 192.0.2.4 255.255.255.0
!
!
router eigrp stub 10
 network 25.25.25.0 0.0.0.255
 network 38.38.38.0 0.0.0.255
 network 46.46.46.0 0.0.0.255
  !
    !
track 1 ip sla 1 reachability
!
track 2 interface GigabitEthernet2 line-protocol
!
track 3 interface GigabitEthernet4 line-protocol
!
track 5 ip sla 5 reachability
!
track 6 ip sla 6 reachability
!
track 7 ip sla 7 reachability
!
ip sla 1
 icmp-echo 9.9.9.29 source-ip 192.0.2.2
 frequency 5
ip sla schedule 1 life forever start-time now
!
ip sla 5
 icmp-echo 25.25.25.11 source-ip 192.0.2.3
 frequency 5
ip sla schedule 5 life forever start-time now
!
ip sla 6
 icmp-echo 25.25.25.51 source-ip 192.0.2.3
 frequency 5
ip sla schedule 6 life forever start-time now
!
ip sla 7
 icmp-echo 25.25.25.75 source-ip 192.0.2.3
 frequency 5
ip sla schedule 7 life forever start-time now
!
event manager applet noshut_int
 event track 5 state up
 action 1.1 cli command "enable"
 action 1.2 cli command "config t"
 action 1.3 cli command "router eigrp 10"
 action 1.4 cli command "network 25.25.25.0 0.0.0.255"
 action 1.5 cli command "end"
event manager applet shut_int
 event track 5 state down
 action 1.1 cli command "enable"
 action 1.2 cli command "config t"
 action 1.3 cli command "router eigrp 10"
 action 1.4 cli command "no network 25.25.25.0 0.0.0.255"
 action 1.5 cli command "end"
event manager applet ASAv_noshut_int
 event track 6 state up
 action 1.1 cli command "enable"
 action 1.2 cli command "config t"
 action 1.3 cli command "router eigrp 10"
 action 1.4 cli command "network 25.25.25.0 0.0.0.255"
```

```
 action 1.5 cli command "end"
event manager applet ASAv_shut_int
event track 6 state down
 action 1.1 cli command "enable"
 action 1.2 cli command "config t"
 action 1.3 cli command "router eigrp 10"
 action 1.4 cli command "no network 25.25.25.0 0.0.0.255"
 action 1.5 cli command "end"
event manager applet vWAAS_noshut_int
 event track 7 state up
 action 1.1 cli command "enable"
 action 1.2 cli command "config t"
 action 1.3 cli command "router eigrp 10"
 action 1.4 cli command "network 25.25.25.0 0.0.0.255"
 action 1.5 cli command "end"
event manager applet vWAAS_shut_int
 event track 7 state down
 action 1.1 cli command "enable"
 action 1.2 cli command "config t"
 action 1.3 cli command "router eigrp 10"
 action 1.4 cli command "no network 25.25.25.0 0.0.0.255"
 action 1.5 cli command "end"
!
end
```

Example: Standby Cisco ENCS Configuration with ISRv2

```
interface GigabitEthernet1
 vrf forwarding Mgmt-intf
 ip address 192.0.2.1 255.255.255.0
 negotiation auto
!
interface GigabitEthernet2
 description WAN-GE0-0-SRIOV-1
 ip address 192.0.2.21 255.255.255.0
 negotiation auto
!
interface GigabitEthernet3
 no ip address
 shutdown
 negotiation auto
!
interface GigabitEthernet4
 description Service-NET-virtio
 ip address 192.0.2.22 255.255.255.0
 standby use-bia
 standby 25 ip 192.0.2.20
 standby 25 timers 1 5
 standby 25 preempt
 negotiation auto
 bfd interval 9000 min_rx 9000 multiplier 3
!
interface GigabitEthernet5
 ip address 192.0.2.23 255.255.255.0
!
!
router eigrp 10
network 8.8.8.0 0.0.0.255
 network 25.25.25.0 0.0.0.255
 network 46.46.46.0 0.0.0.255
```

!

Cisco ENCS Failure Points

Failure Points	Sequence of Events
ENCS chassis hardware failure: • Power down • Power cycle • Reboot Cisco Enterprise NFVIS software failure • Crash Cisco ISRv software failure • Stop (shutdown) • Reboot • Crash • Error	1. HSRP on ENCS2 detects the reachability failure to ENCS1, and triggers the failover. LAN virtual IP becomes active on ENCS2. 2. WAN-IP1 on ENCS1 becomes unreachable, and all the routes converge towards WAN-IP2 on ENCS2. WAN-IP2 is the only IP for branch connectivity. 3. All the WAN to LAN, and LAN to WAN traffic will now flow through ENCS2. 4. The PBR/PFR configuration will now select the LAN port as the preferred path instead of the transit link for the traffic heading to LAN.

ISRv1 (Active) Before the Failure

```
ISRv1# show platform software vnic-if interface-mapping
------------------------------------------------------------
 Interface Name        Driver Name         Mac Addr
------------------------------------------------------------
 GigabitEthernet5       i40evf             5254.003a.1020 (LAN-SRIOV-2)
 GigabitEthernet4       virtio             5254.0053.e392 (service-net)
 GigabitEthernet3       i40evf             5254.00c4.b925 (LAN-SRIOV-1)
 GigabitEthernet2       igbvf              5254.00d2.cc9a (GE0-0-SRIOV-1)
 GigabitEthernet1       virtio             5254.00d2.1b1c (int-mgmt-net)
------------------------------------------------------------

ISRv1# show standby brief
                     P indicates configured to preempt.
                     |
Interface   Grp  Pri P State   Active          Standby         Virtual IP
Gi4         25   105 P Active  local           192.0.2.1     192.0.2.222
#
```

ISRv2 (Standby) Before the Failure

```
ISRv2#show platform software vnic-if interface-mapping
------------------------------------------------------------
 Interface Name        Driver Name         Mac Addr
------------------------------------------------------------
 GigabitEthernet5       i40evf             5254.00cc.ce9f (LAN-SRIOV-2)
 GigabitEthernet4       virtio             5254.00e7.523f (Service-net)
```

```
 GigabitEthernet3       i40evf             5254.0055.ee45 (LAN-SRIOV-1)
 GigabitEthernet2       igbvf              5254.00a3.d443 (GE0-0-SRIOV-1)
 GigabitEthernet1       virtio             5254.0048.e84c (int-mgmt-net)
------------------------------------------------------------
```

```
ISRv2#show standby brief
                     P indicates configured to preempt.
                     |
Interface   Grp  Pri P State   Active          Standby         Virtual IP
Gi4         25   100 P Standby 192.0.2.20     local           192.0.2.222
```

ISRv2 After the Failure

ISRv1 becomes unreachable. ISRv2: The HSRP failover occurs, and the state changes from Standby to Active. The virtual IP (LAN side default gateway) becomes active on ENCS2 ISRv2.

```
ISRv2# show standby brief
                     P indicates configured to preempt.
                     |
Interface   Grp  Pri P State   Active          Standby         Virtual IP
Gi4         25   100 P Active  local           unknown         192.0.2.222
```

```
ISRv2# show logging
*Dec 13 21:22:17.138: %HSRP-5-STATECHANGE: GigabitEthernet4 Grp 25 state Speak -> Standby
*Dec 13 21:22:32.385: %HSRP-5-STATECHANGE: GigabitEthernet4 Grp 25 state Standby -> Active
```

Failure Points	Sequence of Events
WAN Net1 failure (WAN SRIOV VF connected to ISRv1) • Link down WAN Phy link failure • Switch failure • End-to-end connectivity failure	**1.** ISRv1 HSRP on ENCS1 detects the WAN connection failure. It reduces the LAN-HSRP priority. This failure is detected when the interface goes down due to VF going down or track object going down. **2.** WAN-IP1 becomes unreachable, and all the routes converge towards WAN-IP2 on ENCS2. WAN-IP2 is the only IP for branch connectivity. **3.** HSRP on ENCS2 becomes higher priority in the group, and takes over the active role. LAN-virtual IP becomes active on ENCS2. **4.** The PBR/PFR configuration will now select the LAN port as the preferred path instead of the transit link for the traffic destined to LAN. **5.** All the WAN to LAN, and LAN to WAN traffic will now flow through ENCS2.

ISRv1 After the Failure

ISRv1 becomes standby.

```
ISRv1# show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet1       192.0.2.1       YES NVRAM  up                    up
GigabitEthernet2       192.0.2.2     YES NVRAM  down                  down
```

```
GigabitEthernet3       unassigned      YES NVRAM  administratively down down
GigabitEthernet4       192.0.2.3     YES NVRAM  up                    up
GigabitEthernet5       unassigned      YES NVRAM  up                    up

ISRv1# show standby brief
                     P indicates configured to preempt.
                     |
Interface   Grp  Pri P State   Active          Standby         Virtual IP
Gi4         25   85  P Standby 192.0.2.22     local           192.0.2.222
ISRv1#
ISRv1#show logg
*Dec 14 03:41:52.307: %TRACK-6-STATE: 2 interface Gi2 line-protocol Up -> Down
*Dec 14 03:42:37.744: %HSRP-5-STATECHANGE: GigabitEthernet4 Grp 25 state Active -> Speak
*Dec 14 03:42:43.663: %HSRP-5-STATECHANGE: GigabitEthernet4 Grp 25 state Speak -> Standby
ISRv1#
ISRv1#show track
Track 1
  IP SLA 1 reachability
  Reachability is Down
    1405 changes, last change 00:03:08
  Latest operation return code: Timeout
  Tracked by:
    HSRP GigabitEthernet4 25
```

ISRv2 After the Failure

```
ISRv2# show standby brief
                     P indicates configured to preempt.
                     |
Interface   Grp  Pri P State   Active          Standby         Virtual IP
Gi4         25   100 P Active  local           192.0.2.3     192.0.2.222
```

Failure Points	Sequence of Events
LAN Phy link failure • Switch failure • End-to-end connectivity failure LAN connectivity failure • Switch failure • End-to-end connectivity failure SC Net failure (ISRv service-net down) • Link down VNFs (Cisco ASAv, Cisco vWAAS, and Windows/Linux) • Power down • Power cycle • Crash/reboot	**1.** ISRv1 HSRP on ENCS1 detects the LAN connection failure, and shut down the HSRP group. This failure is detected when the interface goes down due to the track object going down. **2.** EEM script on ISRv1 withdraws the routes (for example, delete EIGRP networks). All the branch traffic routes will now converge towards WAN-IP2 on ENCS2. WAN-IP2 is the only IP for branch connectivity. **3.** HSRP on ENCS-2 becomes active in the group. LAN virtual IP becomes active on ENCS2. **4.** On ISRv2, the PBR/PFR configuration will now select the LAN port as the preferred path, instead of the transit link for the traffic destined to LAN. **5.** All the WAN to LAN and LAN to WAN traffic will now flow through ENCS2.

ISRv1 After the Failure

```
ISRv1# show track
Track 7
  IP SLA 7 reachability
  Reachability is Down
    7 changes, last change 00:01:40
  Latest operation return code: Timeout
  Tracked by:
    HSRP GigabitEthernet3 25
    EEM 2450904616
    EEM 2450905656
ISRv1#

ISRv1# show ip eigrp topo
EIGRP-IPv4 Topology Table for AS(10)/ID(53.53.53.51)
Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,
       r - reply Status, s - sia Status

P 19.19.19.0/24, 1 successors, FD is 3328
        via 38.38.38.38 (3328/3072), GigabitEthernet2
P 9.9.9.0/24, 1 successors, FD is 3328
        via 38.38.38.38 (3328/3072), GigabitEthernet2
P 25.25.25.0/24, 0 successors, FD is Infinity
        via 38.38.38.38 (3840/3584), GigabitEthernet2
P 27.27.27.0/24, 1 successors, FD is 3328
        via 38.38.38.38 (3328/3072), GigabitEthernet2
P 38.38.38.0/24, 1 successors, FD is 2816
        via Connected, GigabitEthernet2
P 29.29.29.0/24, 1 successors, FD is 3072
        via 38.38.38.38 (3072/2816), GigabitEthernet2
P 33.33.33.0/24, 1 successors, FD is 3840
        via 38.38.38.38 (3840/3584), GigabitEthernet2
P 8.8.8.0/24, 1 successors, FD is 3584
        via 38.38.38.38 (3584/3328), GigabitEthernet2
P 53.53.53.0/24, 1 successors, FD is 2816
        via Connected, GigabitEthernet4
```

ISRv2 After the Failure

```
ISRv2# show standby brief
                     P indicates configured to preempt.
                     |
Interface   Grp  Pri P State   Active          Standby         Virtual IP
Gi3         25   100 P Active  local           unknown         192.0.2.222
```

Failure Points	Sequence of Events
WAN Net2 failure (WAN SRIOV VF connected to ISRv2 is down) • Link down	1. ISRv2 on ENCS2 detects the WAN connection failure. This failure is detected when the interface goes down due to VF going down or the track object going down. 2. WAN-IP2 becomes unreachable, and all the routes converge towards WAN-IP1 on ENCS1. WAN-IP1 is the only IP for branch connectivity. 3. All the WAN to LAN and LAN to WAN traffic will now flow through ENCS1.

Failure Points	Sequence of Events
Transit link between ENCS1 and ENCS2 fails • Link down	**1.** ISRv2 on ENCS2 detects the link going down due to VF going down or connection failure. The connection failure is detected by the track object. Then, ENCS2 WAN-IP2 link with EEM script is shut down. **2.** WAN-IP2 becomes unreachable, and all the routes converge towards WAN-IP1 on ENCS1. WAN-IP1 is the only IP for branch connectivity. **3.** All the WAN to LAN and LAN to WAN traffic will now flow through ENCS1.