



Integrated Routing and Bridging

This chapter describes the configuration of Integrated Routing and Bridging (IRB). IRB provides the ability to exchange traffic between bridging services and a routed interface using a Bridge-Group Virtual Interface (BVI).

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Understanding IRB

IRB provides Layer 2 bridging service between hosts that are within a Layer 2 domain. Also, it provides routing service for hosts that are in different subnets within a Layer 3 VPN.

Bridge-Group Virtual Interface

The BVI is a virtual interface within the router that acts like a normal routed interface. A BVI is associated with a single bridge domain and represents the link between the bridging and the routing domains on the router. To support receipt of packets from a bridged interface that are destined to a routed interface, the BVI must be configured with the appropriate IP addresses and relevant Layer 3 attributes. The BVI does not support bridging itself, but acts as a gateway for the corresponding bridge-domain to a routed interface within the router.

BVI supports these attributes, and has the following characteristics:

- Uses a MAC address taken from the local chassis MAC address pool, unless overridden at the BVI interface.
- Is configured as an interface type using the **interface bvi** command and uses an IPv4 or IPv6 address that is in the same subnet as the hosts on the segments of the bridged domain.
- The BVI identifier is independent of the bridge-domain identifier.
- BVI interfaces support a number range of 1 to 4294967295.

BVI Interface and Line Protocol States

Like typical interface states on the router, a BVI has both an Interface and Line Protocol state.

The BVI interface state is Up when the following occurs:

- The BVI interface is created.
- The bridge-domain that is configured with the **routed interface bvi** command has at least one available active bridge port (Attachment circuit [AC]).



Note A BVI will be moved to the Down state if all of the bridge ports (Ethernet flow points [EFPs]) associated with the bridge domain for that BVI are down. However, the BVI will remain up if at least one bridgeport is up, even if all EFPs are down.

These characteristics determine when the the BVI line protocol state is up:

- The bridge-domain is in Up state.
- The BVI IP address is not in conflict with any other IP address on another active interface in the router.

Prerequisites for Configuring IRB

Before configuring IRB, ensure that these tasks and conditions are met:

- Know the IP addressing and other Layer 3 information to be configured on the bridge virtual interface (BVI).
- Complete MAC address planning if you decide to override the common global MAC address for all BVIs.

You can replace the preferred MAC address for the BVI interface with the default MAC address allocated from the chassis pool. The MAC address is divided into:

- 32 bits most significant bits called MAC prefix.

The router has a limitation of four different MAC prefixes per system. You must not use more than four different MAC prefixes when choosing the MAC address for BVI and other L3 interfaces.

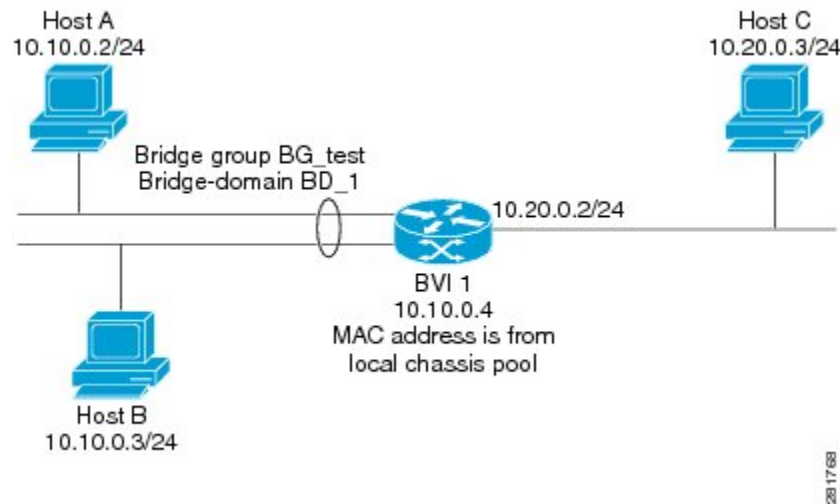
- 16 bits least significant called MAC host. You can choose any value for the MAC host.
- Be sure that the BVI network address is being advertised by running static or dynamic routing on the BVI interface.

Packet Flows Using IRB

This figure shows a simplified functional diagram of an IRB implementation to describe different packet flows between Host A, B, and C. In this example, Host C is on a network with a connection to the same router. In reality, another router could be between Host C and the router shown.

Figure 1:

Figure 2: IRB Packet Flows Between Hosts



When IRB is configured on a router, the following processing happens:

- ARP requests are resolved between the hosts and BVI that are part of the bridge domain.
- All packets from a host on a bridged interface go to the BVI if the destination MAC address matches the BVI MAC address. Otherwise, the packets are bridged.
- For packets destined for a host on a routed network, the BVI forwards the packets to the routing engine before sending them out a routed interface.
- For packets that are destined for a host on a segment in the bridge domain that come in to the router on a routed interface, the BVI forwards the packet to the bridging engine, which forwards it through the appropriate bridged interface.

Packet Flows When Host A Sends to Host B on the Bridge Domain

When Host A sends data to Host B in the bridge domain on the 10.10.0.0 network, no routing occurs. The hosts are on the same subnet and the packets are bridged between their segment interfaces on the router.

Packet Flows When Host A Sends to Host C From the Bridge Domain to a Routed Interface

Using host information from this figure, the following occurs when Host A sends data to Host C from the IRB bridging domain to the routing domain:

- Host A sends the packet to the BVI (as long as any ARP request is resolved between the host and the BVI). The packet has the following information:
 - Source MAC address of host A.
 - Destination MAC address of the BVI.
- Since Host C is on another network and needs to be routed, the BVI forwards the packet to the routed interface with the following information:
 - IP source MAC address of Host A (10.10.0.2) is changed to the MAC address of the BVI (10.10.0.4).

- IP destination address is the IP address of Host C (10.20.0.3).
- Interface 10.20.0.2 sees receipt of a packet from the routed BVI 10.10.0.4. The packet is then routed through interface 10.20.0.2 to Host C.

Packet Flows When Host C Sends to Host B From a Routed Interface to the Bridge Domain

Using host information from this figure, the following occurs when Host C sends data to Host B from the IRB routing domain to the bridging domain:

- The packet comes into the routing domain with the following information:
 - MAC source address—MAC of Host C.
 - MAC destination address—MAC of the 10.20.0.2 ingress interface.
 - IP source address—IP address of Host C (10.20.0.3).
 - IP destination address—IP address of Host B (10.10.0.3).
- When interface 10.20.0.2 receives the packet, it looks in the routing table and determines that the packet needs to be forwarded to the BVI at 10.10.0.4.
- The routing engine captures the packet that is destined for the BVI and forwards it to the BVI's corresponding bridge domain. The packet is then bridged through the appropriate interface if the destination MAC address for Host B appears in the bridging table, or is flooded on all interfaces in the bridge group if the address is not in the bridging table.

Configure IRB

Follow these steps to configure an IRB:

- Configure the Bridge Group Virtual Interface
- (Optional) Configure the static MAC address on the BVI interface
- Configure the Layer 2 AC Interfaces
- Configure a Bridge Group and Assigning Interfaces to a Bridge Domain
- Associate the BVI as the Routed Interface on a Bridge Domain

Configuration Example

```
/* Configure the BVI and its IPv4 address */
Router# configure
Router(config)#interface bvi 1
Router(config-if)#ipv4 address 10.10.0.4 255.255.255.0
Router(config-if)#ipv6 address 2001:100:1:1::1/96

/* optionally, you can configure the static MAC address */
Router(config-if)# mac-address 2001.100.2
Router(config-if)# exit
!
```

```

/* Configure the Layer 2 AC interface */
Router(config)# interface HundredGigE 0/0/0/1 l2transport
Router(config-if-l2)# exit
Router(config-if)# exit
!

/* Configure the L2VPN bridge group and bridge domain and assign interfaces */
Router(config)# l2vpn
Router(config-l2vpn)# bridge group 10
Router(config-l2vpn-bg)# bridge-domain 1
Router(config-l2vpn-bg-bd)# interface HundredGigE 0/0/0/1
Router(config-l2vpn-bg-bd-ac)# exit
!
/* Associate a BVI to the bridge domain */
Router(config-l2vpn-bg-bd)# routed interface bvi 1
Router(config-l2vpn-bg-bd-bvi)# commit

/* IRB configuration for tagged bridge ports (sub-interfaces) in a bridge domain with BVI
*/
Router# configure
Router(config)# interface HundredGigE 0/0/0/2.1 l2transport
Router(config-subif)# encapsulation dot1q 102
Router(config-subif)# rewrite ingress tag pop 1 symmetric
Router(config-subif)# exit
Router(config)# interface bvi 2
Router(config-if)# ipv4 address 56.78.100.1 255.255.255.0
Router(config-if)# ipv6 address 56:78:100::1/64
Router(config-if)# mac-address 2002.100.1
Router(config-if)# exit
Router(config)# l2vpn
Router(config-l2vpn)# bridge group 10
Router(config-l2vpn-bg)# bridge-domain 2
Router(config-l2vpn-bg-bd)# interface HundredGigE 0/0/0/2.1
Router(config-l2vpn-bg-bd-ac)# exit
Router(config-l2vpn-bg-bd)# routed interface bvi 2
Router(config-l2vpn-bg-bd-bvi)# commit

```



Note Double VLAN tagged sub-interface is not supported for IRB service.

Verification

Verify the interface status, line protocol state, and packet counters for the specified BVI:

```

Router# show interfaces bvi 1 brief
BVI1 is up, line protocol is up
Interface state transitions: 701
Hardware is Bridge-Group Virtual Interface, address is 2001.0100.0001
Internet address is 10.10.0.4/24
MTU 1514 bytes, BW 10000000 Kbit (Max: 10000000 Kbit)
reliability 255/255, txload 0/255, rxload 1/255
Encapsulation ARPA, loopback not set,
Last link flapped 2d06h
ARP type ARPA, ARP timeout 04:00:00
Last input 00:00:00, output 00:00:13
Last clearing of "show interface" counters 3d18h
30 second input rate 43721000 bits/sec, 49684 packets/sec
30 second output rate 0 bits/sec, 0 packets/sec
15428019162 packets input, 1697081244790 bytes, 0 total input drops
0 drops for unrecognized upper-level protocol

```

```
Received 0 broadcast packets, 0 multicast packets  
6084259298 packets output, 669870073726 bytes, 0 total output drops  
Output 0 broadcast packets, 0 multicast packets
```