Integrated Routing and Bridging

The BVI is a virtual interface within the router that acts like a normal routed interface. The BVI does not support bridging itself, but acts as a gateway for the corresponding bridge-domain to a routed interface within the router.

Aside from supporting a configurable MAC address, a BVI supports only Layer 3 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 address that is in the same subnet as the hosts on the segments of the bridged domain. The BVI also supports secondary addresses.
- The BVI identifier is independent of the bridge-domain identifier. These identifiers do not need to correlate like they do in Cisco IOS software.
- Is associated to a bridge group using the `routed interface bvi` command.

Bridge-Group Virtual Interface

The BVI is a virtual interface within the router that acts like a normal routed interface. 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 only Layer 3 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 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. These identifiers do not need to correlate like they do in Cisco IOS software.

Is associated to a bridge group using the routed interface bvi command.

BVI interfaces support a number range of 1 to 4294967295.

**Supported Features on a BVI**

These interface commands are supported on a BVI:

- arp purge-delay
- arp timeout
- bandwidth (The default is 10 Gbps and is used as the cost metric for routing protocols for the BVI)
- ipv4
- ipv6
- mac-address
- mtu (The default is 1500 bytes)
- shutdown

The BVI supports IP helper addressing and secondary IP addressing.

**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] or pseudowire [PW]).

*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**

You must be in a user group associated with a task group that includes the proper task IDs. The command reference guides include the task IDs required for each command. If you suspect user group assignment is preventing you from using a command, contact your AAA administrator for assistance.

Before configuring IRB, be sure 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.
• Be sure that the BVI network address is being advertised by running static or dynamic routing on the BVI interface.

**Restrictions for Configuring IRB**

Before configuring IRB, consider these restrictions:

• Only one BVI can be configured in any bridge domain.
• The same BVI can not be configured in multiple bridge domains.
• The following areas are not supported on the Layer2 bridging (with BVI):
  • Access Control Lists (ACLs). However, Layer 2 ACLs can be configured on each Layer 2 port of the bridge domain.
  • Static mac entry configuration in Bridge.
  • Mac ageing configuration at global config mode.
  • MAC Learning Disable.
  • Port-channel sub-interface as bridge member.
  • Physical sub-interface as bridge member.
  • Vlan rewrite.
• QOS configuration on BVI interface is not supported.
• VRF on BVI interface is not supported.
• L2 sub-interfaces are not supported.
How to Configure IRB

This section includes the following configuration tasks:

Configuring the Bridge Group Virtual Interface

To configure a BVI, complete the following steps.

Configuration Guidelines

Consider the following guidelines when configuring the BVI:

• The BVI must be assigned an IPv4 or IPv6 address that is in the same subnet as the hosts in the bridged segments.
• If the bridged network has multiple IP networks, then the BVI must be assigned secondary IP addresses for each network.

SUMMARY STEPS

1. configure
2. interface bvi identifier
3. ipv4 address ipv4-address mask [secondary] ipv6 address ipv6-prefix/prefix-length [eui-64] [route-tag route-tag value]
4. arp purge-delay seconds
5. arp timeout seconds
6. bandwidth rate
7. mtu bytes
8. end or commit

DETAILED STEPS

Step 1  configure
Example:

RP/0/RP0/CPU0:router# configure
Enters the global configuration mode.

Step 2  interface bvi identifier
Example:

RP/0/RP0/CPU0:router(config)# interface bvi 1
Specifies or creates a BVI, where identifier is a number from 1 to 65535.

Step 3  ipv4 address ipv4-address mask [secondary] ipv6 address ipv6-prefix/prefix-length [eui-64] [route-tag route-tag value]
Example:
RP/0/RP0/CPU0:router(config-if)# ipv4 address 10.10.0.4 255.255.255.0
Specifies a primary or secondary IPv4 address or an IPv6 address for an interface.

Step 4  
`arp purge-delay seconds`

Example:

RP/0/RP0/CPU0:router(config-if)# arp purge-delay 120
(Optional) Specifies the amount of time (in seconds) to delay purging of Address Resolution Protocol (ARP) table entries when the interface goes down.
The range is 1 to 65535. By default purge delay is not configured.

Step 5  
`arp timeout seconds`

Example:

RP/0/RP0/CPU0:router(config-if)# arp timeout 12200
(Optional) Specifies how long dynamic entries learned on the interface remain in the ARP cache.
The range is 30 to 2144448000 seconds. The default is 14,400 seconds (4 hours).

Step 6  
`bandwidth rate`

Example:

RP/0/RP0/CPU0:router(config-if)# bandwidth 1000000
(Optional) Specifies the amount of bandwidth (in kilobits per second) to be allocated on the interface. This number is used as the cost metric in routing protocols for the BVI.
The range is 0 to 4294967295. The default is 10000000 (10 Gbps).

Step 7  
`mtu bytes`

Example:

RP/0/RP0/CPU0:router(config-if)# mtu 2000
(Optional) Specifies the maximum transmission unit (MTU) size for packets on the interface. The range is 64 to 65535. The default is 1514.

Step 8  
`end` or `commit`

Example:

RP/0/RP0/CPU0:router(config-if)# end
or

RP/0/RP0/CPU0:router(config-if)# commit
Saves configuration changes.
- When you issue the **end** command, the system prompts you to commit changes:
Uncommitted changes found, commit them before exiting(yes/no/cancel)?
[cancel]:

Entering yes saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode.

Entering no exits the configuration session and returns the router to EXEC mode without committing the configuration changes.

Entering cancel leaves the router in the current configuration session without exiting or committing the configuration changes.

• Use the commit command to save the configuration changes to the running configuration file and remain within the configuration session.

---

**Configuring the Layer 2 AC Interfaces**

To configure the Layer 2 AC interfaces for routing by a BVI, complete the following steps.

**SUMMARY STEPS**

1. configure
2. interface [HundredGigE | TenGigE] l2transport
3. end or commit

**DETAILED STEPS**

**Step 1**
configure
Example:

```
RP/0/RP0/CPU0:router# configure
```

Enters global configuration mode.

**Step 2**
interface [HundredGigE | TenGigE] l2transport
Example:

```
RP/0/RP0/CPU0:router(config)# interface TenGigE 0/1/0/0.1 l2transport
```

Enables Layer 2 transport mode on a Gigabit Ethernet or 10-Gigabit Ethernet interface or subinterface and enters interface or subinterface configuration mode.

**Step 3**
end or commit
Example:

```
RP/0/RP0/CPU0:router(config-if)# end
```

or
RP/0/RP0/CPU0:router(config-if)# commit

Saves configuration changes.

- When you issue the end command, the system prompts you to commit changes:

  Uncommitted changes found, commit them before exiting(yes/no/cancel)?
  
  [cancel]:

- Entering yes saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode.

- Entering no exits the configuration session and returns the router to EXEC mode without committing the configuration changes.

- Entering cancel leaves the router in the current configuration session without exiting or committing the configuration changes.

- Use the commit command to save the configuration changes to the running configuration file and remain within the configuration session.

---

**Configuring a Bridge Group and Assigning Interfaces to a Bridge Domain**

To configure a bridge group and assign interfaces to a bridge domain, complete the following steps.

**SUMMARY STEPS**

1. configure
2. l2vpn
3. bridge group bridge-group-name
4. bridge-domain bridge-domain-name
5. interface [HundredGigE | TenGigE
6. end or commit

**DETAILED STEPS**

---

**Step 1**

configure

*Example:*

RP/0/RP0/CPU0:router# configure

Enters global configuration mode.

**Step 2**

l2vpn

*Example:*

RP/0/RP0/CPU0:router(config)# l2vpn

Enters L2VPN configuration mode.
Step 3  bridge group  bridge-group-name
Example:

RP/0/RP0/CPU0:router(config-l2vpn)# bridge group 10
Creates a bridge group and enters L2VPN bridge group configuration mode.

Step 4  bridge-domain  bridge-domain-name
Example:

RP/0/RP0/CPU0:router(config-l2vpn-bg)# bridge-domain BD_1
Creates a bridge domain and enters L2VPN bridge group bridge domain configuration mode.

Step 5  interface [HundredGigE | TenGigE
Example:

RP/0/RP0/CPU0:router(config-l2vpn-bg-bd)# interface HundredGigE 0/1/0/0.1
Associates the 100-Gigabit Ethernet or 10-Gigabit Ethernet interface with the specified bridge domain and enters L2VPN bridge group bridge domain attachment circuit configuration mode.
Repeat this step for as many interfaces as you want to associate with the bridge domain.

Step 6  end or commit
Example:

RP/0/RP0/CPU0:router(config-l2vpn-bg-bd-ac)# end
or
RP/0/RP0/CPU0:router(config-l2vpn-bg-bd-ac)# commit
Saves configuration changes.

• When you issue the end command, the system prompts you to commit changes:

   Uncommitted changes found, commit them before exiting(yes/no/cancel)?
   [cancel]:

   • Entering yes saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode.

   • Entering no exits the configuration session and returns the router to EXEC mode without committing the configuration changes.

   • Entering cancel leaves the router in the current configuration session without exiting or committing the configuration changes.

   • Use the commit command to save the configuration changes to the running configuration file and remain within the configuration session.
Associating the BVI as the Routed Interface on a Bridge Domain

To associate the BVI as the routed interface on a bridge domain, complete the following steps.

**SUMMARY STEPS**

1. `configure`
2. `l2vpn`
3. `bridge group bridge-group-name`
4. `bridge-domain bridge-domain-name`
5. `routed interface bvi identifier`
6. `end` or `commit`

**DETAILED STEPS**

---

**Step 1**
`configure`

Example:

```
RP/0/RP0/CPU0:router# configure
```

Enters global configuration mode.

**Step 2**
`l2vpn`

Example:

```
RP/0/RP0/CPU0:router(config)# l2vpn
```

Enters L2VPN configuration mode.

**Step 3**
`bridge group bridge-group-name`

Example:

```
RP/0/RP0/CPU0:router(config-l2vpn)# bridge group BG_test
```

Creates a bridge group and enters L2VPN bridge group configuration mode.

**Step 4**
`bridge-domain bridge-domain-name`

Example:

```
RP/0/RP0/CPU0:router(config-l2vpn-bg)# bridge-domain 1
```

Creates a bridge domain and enters L2VPN bridge group bridge domain configuration mode.

**Step 5**
`routed interface bvi identifier`

Example:

```
RP/0/RP0/CPU0:router(config-l2vpn-bg-bd)# routed interface bvi 1
```

Associates the specified BVI as the routed interface for the interfaces assigned to the bridge domain.

**Step 6**
`end` or `commit`
Example:

RP/0/RP0/CPU0:router(config-l2vpn-bg-bd)# end

or

RP/0/RP0/CPU0:router(config-l2vpn-bg-bd)# commit

Saves configuration changes.

- When you issue the **end** command, the system prompts you to commit changes:

  Uncommitted changes found, commit them before exiting(yes/no/cancel)?
  [cancel]:

- Entering **yes** saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode.

- Entering **no** exits the configuration session and returns the router to EXEC mode without committing the configuration changes.

- Entering **cancel** leaves the router in the current configuration session without exiting or committing the configuration changes.

- Use the **commit** command to save the configuration changes to the running configuration file and remain within the configuration session.

---

### Displaying Information About a BVI

To display information about BVI status and packet counters, use the following commands:

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>`show interfaces bvi identifier [accounting</td>
<td>Displays interface status, line protocol state, and packet counters for the</td>
</tr>
<tr>
<td>brief</td>
<td>detail ]</td>
</tr>
<tr>
<td>`show adjacency bvi identifier [detail</td>
<td>Displays packet and byte transmit counters per adjacency to the specified</td>
</tr>
<tr>
<td>remote]</td>
<td>BVI.</td>
</tr>
<tr>
<td><code>show l2vpn bridge-domain detail</code></td>
<td>Displays the reason that a BVI is down.</td>
</tr>
</tbody>
</table>

---

### Additional Information on IRB

### 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.
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.
- All packets either from or destined to a host on a bridged interface go to the BVI first (unless the packet is destined for a host on the bridge domain).
- 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 any ARP request the 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.

Configuration Examples for IRB

This section provides the following configuration examples:

Basic IRB Configuration: Example

The following example shows how to perform the most basic IRB configuration:

```bash
! Configure the BVI and its IPv4 address
RP/0/RP0/CPU0:router# configure
RP/0/RP0/CPU0:router(config)# interface bvi 1
RP/0/RP0/CPU0:router(config-if)# ipv4 address 10.10.0.4 255.255.255.0
RP/0/RP0/CPU0:router(config-if)# exit

! Configure the Layer 2 AC interface
```
IPv4 Addressing on a BVI Supporting Multiple IP Networks: Example

The following example shows how to configure secondary IPv4 addresses on a BVI that supports bridge domains for the 10.10.10.0/24, 10.20.20.0/24, and 10.30.30.0/24 networks. In this example, the BVI must have an address on each of the bridge domain networks:

```
RP/0/RP0/CPU0:router(config)#interface bvi 1
RP/0/RP0/CPU0:router(config-if)#ipv4 address 10.10.10.4 255.255.255.0
RP/0/RP0/CPU0:router(config-if)#ipv4 address 10.20.20.4 255.255.255.0 secondary
RP/0/RP0/CPU0:router(config-if)#ipv4 address 10.30.30.4 255.255.255.0 secondary
RP/0/RP0/CPU0:router(config-if))# commit
```

IRB With BVI and VRRP Configuration: Example

This example shows a partial router configuration for the relevant configuration areas for IRB support of a BVI and VRRP:

```
l2vpn
bridge group IRB
  bridge-domain IRB-EDGE
    interface TenGigE0/0/0/8
      routed interface BVI 100
      interface TenGigE0/0/0/8
        l2transport
      interface BVI 100
      ipv4 address 10.21.1.1 255.255.255.0
    router vrrp
      interface BVI 100
      vrrp 1 ipv4 10.21.1.100
      vrrp 1 priority 100
```

VRRPv6 is also supported.
IRB With BVI and VRRP Configuration: Example