Chapter 11

Configuring IRB

This chapter describes how to configure integrated routing and bridging (IRB) for the ML-Series card. For more information about the Cisco IOS commands used in this chapter, refer to the Cisco IOS Command Reference publication.

This chapter includes the following major sections:

- Integrated Routing and Bridging, page 11-1
- Configuring IRB, page 11-2
- Monitoring and Verifying IRB, page 11-4

Caution

Cisco Inter-Switch Link (ISL) and Cisco Dynamic Trunking Protocol (DTP) are not supported by the ML-Series, but the ML-Series broadcast forwards these formats. Using ISL or DTP on connecting devices is not recommended. Some Cisco devices attempt to use ISL or DTP by default.

Integrated Routing and Bridging

Your network might require you to bridge local traffic within several segments and have hosts on the bridged segments reach the hosts or ML-Series card on routed networks. For example, if you are migrating bridged topologies into routed topologies, you might want to start by connecting some of the bridged segments to the routed networks.

Using the integrated routing and bridging (IRB) feature, you can route a given protocol between routed interfaces and bridge groups within a single ML-Series card. Specifically, local or unroutable traffic is bridged among the bridged interfaces in the same bridge group, while routable traffic is routed to other routed interfaces or bridge groups.

Because bridging is in the data link layer and routing is in the network layer, they have different protocol configuration models. With IP, for example, bridge group interfaces belong to the same network and have a collective IP network address. In contrast, each routed interface represents a distinct network and has its own IP network address. Integrated routing and bridging uses the concept of a Bridge Group Virtual Interface (BVI) to enable these interfaces to exchange packets for a given protocol.

A BVI is a virtual interface within the ML-Series card that acts like a normal routed interface. A BVI does not support bridging but actually represents the corresponding bridge group to routed interfaces within the ML-Series card. The interface number is the link between the BVI and the bridge group.

Before configuring IRB, consider the following:

- The default routing/bridging behavior in a bridge group (when IRB is enabled) is to bridge all packets. Make sure that you explicitly configure routing on the BVI for IP traffic.
• Packets of unroutable protocols such as local-area transport (LAT) are always bridged. You cannot disable bridging for the unroutable traffic.

• Protocol attributes should not be configured on the bridged interfaces when you are using IRB to bridge and route a given protocol. You can configure protocol attributes on the BVI, but you cannot configure bridging attributes on the BVI.

• A bridge links several network segments into one large, flat network. To bridge a packet coming from a routed interface among bridged interfaces, the bridge group should be represented by one interface.

• All ports in a BVI group must have matching MTU settings.

## Configuring IRB

The process of configuring integrated routing and bridging consists of the following tasks:

1. Configure bridge groups and routed interfaces.
   a. Enable bridging.
   b. Assign interfaces to the bridge groups.
   c. Configure the routing.
2. Enable IRB.
3. Configure the BVI.
   a. Enable the BVI to accept routed packets.
   b. Enable routing on the BVI.
4. Configure IP addresses on the routed interfaces.
5. Verify the IRB configuration.

When you configure the BVI and enable routing on it, packets that come in on a routed interface destined for a host on a segment that is in a bridge group are routed to the BVI and forwarded to the bridging engine. From the bridging engine, the packet exits through a bridged interface. Similarly, packets that come in on a bridged interface but are destined for a host on a routed interface go first to the BVI. The BVI forwards the packets to the routing engine that sends them out on the routed interface.

To configure a bridge group and an interface in the bridge group, perform the following procedure, beginning in global configuration mode:

<table>
<thead>
<tr>
<th>Step</th>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>Router(config)# bridge bridge-group protocol {ieee</td>
<td>rstp}</td>
</tr>
<tr>
<td>Step 2</td>
<td>Router(config)# interface type number</td>
<td>Enters interface configuration mode.</td>
</tr>
<tr>
<td>Step 3</td>
<td>Router(config-if)# bridge-group bridge-group</td>
<td>Assigns the interface to the specified bridge group.</td>
</tr>
<tr>
<td>Step 4</td>
<td>Router(config-if)# end</td>
<td>Returns to privileged EXEC mode.</td>
</tr>
</tbody>
</table>
To enable and configure IRB and BVI, perform the following procedure, beginning in global configuration mode:

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>Router(config)# bridge irb Enables IRB. Allows bridging of traffic.</td>
</tr>
<tr>
<td>Step 2</td>
<td>Router(config)# interface bvi bridge-group Configures the BVI by assigning the number of the corresponding bridge group to the BVI. Each bridge group can have only one corresponding BVI.</td>
</tr>
<tr>
<td>Step 3</td>
<td>Router(config-if)# ip address ip-address ip-address-subnet-mask Configures IP addresses on routed interfaces.</td>
</tr>
<tr>
<td>Step 4</td>
<td>Router(config-if)# exit Exits the interface configuration mode.</td>
</tr>
<tr>
<td>Step 5</td>
<td>Router(config-if)# bridge bridge-group route protocol Enables a BVI to accept and route routable packets received from its corresponding bridge group. Enter this command for each protocol that you want the BVI to route from its corresponding bridge group to other routed interfaces.</td>
</tr>
<tr>
<td>Step 6</td>
<td>Router(config)# end Returns to the privileged EXEC mode.</td>
</tr>
<tr>
<td>Step 7</td>
<td>Router# copy running-config startup-config (Optional) Saves your configuration changes to NVRAM.</td>
</tr>
</tbody>
</table>

### Configuring IRB Example

Figure 11-1 shows an example of an IRB configuration.

#### Figure 11-1 IRB Example

```
ONS 15454 with ML100T-12
BVI 1 192.168.1.1/24

SONET/SDH

Router_A pos 0
bridge 1

pos 1
bridge 1

192.168.2.1/24
fast ethernet 0

ONS 15454 with ML100T-12
BVI 1 192.168.1.2/24

pos 0
bridge 1

pos 1
bridge 1

192.168.3.1/24
fast ethernet 0

Router_B
```

### Configuring Router A

```
bridge irb
bridge 1 protocol ieee
bridge 1 route ip
! 
!
interface FastEthernet0
ip address 192.168.2.1 255.255.255.0
```

---

To enable and configure IRB and BVI, perform the following procedure, beginning in global configuration mode:

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>Router(config)# bridge irb Enables IRB. Allows bridging of traffic.</td>
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<tr>
<td>Step 2</td>
<td>Router(config)# interface bvi bridge-group Configures the BVI by assigning the number of the corresponding bridge group to the BVI. Each bridge group can have only one corresponding BVI.</td>
</tr>
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<td>Router(config-if)# ip address ip-address ip-address-subnet-mask Configures IP addresses on routed interfaces.</td>
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<td>Step 4</td>
<td>Router(config-if)# exit Exits the interface configuration mode.</td>
</tr>
<tr>
<td>Step 5</td>
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</tr>
<tr>
<td>Step 6</td>
<td>Router(config)# end Returns to the privileged EXEC mode.</td>
</tr>
<tr>
<td>Step 7</td>
<td>Router# copy running-config startup-config (Optional) Saves your configuration changes to NVRAM.</td>
</tr>
</tbody>
</table>

### Configuring IRB Example

Figure 11-1 shows an example of an IRB configuration.

#### Figure 11-1 IRB Example

```
ONS 15454 with ML100T-12
BVI 1 192.168.1.1/24

SONET/SDH

Router_A pos 0
bridge 1

pos 1
bridge 1

192.168.2.1/24
fast ethernet 0

ONS 15454 with ML100T-12
BVI 1 192.168.1.2/24

pos 0
bridge 1

pos 1
bridge 1

192.168.3.1/24
fast ethernet 0

Router_B
```

### Configuring Router A

```
bridge irb
bridge 1 protocol ieee
bridge 1 route ip
! 
!
interface FastEthernet0
ip address 192.168.2.1 255.255.255.0
```
Configuring IRB

interface POS0
  no ip address
  crc 32
  bridge-group 1
  pos flag c2 1

interface POS1
  no ip address
  crc 32
  bridge-group 1
  pos flag c2 1

interface BVI1
  ip address 192.168.1.1 255.255.255.0

router ospf 1
  log-adjacency-changes
  network 192.168.1.0 0.0.0.255 area 0
  network 192.168.2.0 0.0.0.255 area 0

Configuring Router B

  bridge irb
  bridge 1 protocol ieee
    bridge 1 route ip

  interface FastEthernet0
    ip address 192.168.3.1 255.255.255.0

  interface POS0
    no ip address
    crc 32
    bridge-group 1
    pos flag c2 1

  interface POS1
    no ip address
    crc 32
    bridge-group 1
    pos flag c2 1

  interface BVI1
    ip address 192.168.1.2 255.255.255.0

  router ospf 1
    log-adjacency-changes
    network 192.168.1.0 0.0.0.255 area 0
    network 192.168.3.0 0.0.0.255 area 0

Monitoring and Verifying IRB

Table 11-1 shows the privileged EXEC commands for monitoring and verifying IRB.
Chapter 11  Configuring IRB

Monitoring and Verifying IRB

The following is sample output from the `show interfaces bvi` and `show interfaces irb` commands:

### Example 11-1  Monitoring and Verifying IRB

**Router# show interfaces bvi**

BVI1 is up, line protocol is up
Hardware is BVI, address is 0011.2130.b340 (bia 0000.0000.0000)
Internet address is 100.100.100.1/24
MTU 1500 bytes, BW 145152 Kbit, DLY 5000 usec,
reliability 255/255, txload 1/255, rxload 1/255
Encapsulation ARPA, loopback not set
ARP type: ARPA, ARP Timeout 04:00:00
Last input 03:35:28, output never, output hang never
Last clearing of "show interface" counters never
Queueing strategy: fifo
Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
5 minute input rate 0 bits/sec, 0 packets/sec
5 minute output rate 0 bits/sec, 0 packets/sec
0 packets input, 0 bytes, 0 no buffer
Received 0 broadcasts (0 IP multicast)
0 runts, 0 giants, 0 throttles
0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
1353 packets output, 127539 bytes, 0 underruns
0 output errors, 0 collisions, 0 interface resets
0 output buffer failures, 0 output buffers swapped out

**Router# show interfaces irb**

BVI1
Software MAC address filter on BVI1
<table>
<thead>
<tr>
<th>Hash Len</th>
<th>Address</th>
<th>Matches</th>
<th>Act</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x00:</td>
<td>0 ff ff ff ff</td>
<td>0</td>
<td>RCV</td>
<td>Physical broadcast</td>
</tr>
</tbody>
</table>

GigabitEthernet0
Bridged protocols on GigabitEthernet0:
clns  ip
Software MAC address filter on GigabitEthernet0
<table>
<thead>
<tr>
<th>Hash Len</th>
<th>Address</th>
<th>Matches</th>
<th>Act</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x00:</td>
<td>0 ff ff ff ff</td>
<td>0</td>
<td>RCV</td>
<td>Physical broadcast</td>
</tr>
<tr>
<td>0x58:</td>
<td>0 0100.5e00.0006</td>
<td>0</td>
<td>RCV</td>
<td>IP multicast</td>
</tr>
<tr>
<td>0x5b:</td>
<td>0 0100.5e00.0005</td>
<td>0</td>
<td>RCV</td>
<td>IP multicast</td>
</tr>
<tr>
<td>0x65:</td>
<td>0 0011.2130.b344</td>
<td>0</td>
<td>RCV</td>
<td>Interface MAC address</td>
</tr>
<tr>
<td>0xc0:</td>
<td>0 0100.0ccc.cccc</td>
<td>0</td>
<td>RCV</td>
<td>CDP</td>
</tr>
<tr>
<td>0xc2:</td>
<td>0 0180.c200.0000</td>
<td>0</td>
<td>RCV</td>
<td>IEEE spanning tree</td>
</tr>
</tbody>
</table>

POS0
Routed protocols on POS0:
ip

---

### Table 11-1  Commands for Monitoring and Verifying IRB

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>Router# show interfaces bvi bridge-group</code></td>
<td>Shows BVI information, such as the BVI MAC address and processing statistics.</td>
</tr>
<tr>
<td><code>Router# show interfaces [type-number] irb</code></td>
<td>Shows BVI information for the following:</td>
</tr>
<tr>
<td></td>
<td>- Protocols that this bridged interface can route to the other routed interface (if this packet is routable).</td>
</tr>
<tr>
<td></td>
<td>- Protocols that this bridged interface bridges</td>
</tr>
</tbody>
</table>
Bridged protocols on POS0:
  clns       ip

Software MAC address filter on POS0

<table>
<thead>
<tr>
<th>Hash Len</th>
<th>Address</th>
<th>Matches</th>
<th>Act</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x00:</td>
<td>0 ffff.ffff.ffff</td>
<td>9</td>
<td>RCV</td>
<td>Physical broadcast</td>
</tr>
<tr>
<td>0x58:</td>
<td>0 0100.5e00.0006</td>
<td>0</td>
<td>RCV</td>
<td>IP multicast</td>
</tr>
<tr>
<td>0x5B:</td>
<td>0 0100.5e00.0005</td>
<td>1313</td>
<td>RCV</td>
<td>IP multicast</td>
</tr>
<tr>
<td>0x61:</td>
<td>0 0011.2130.b340</td>
<td>38</td>
<td>RCV</td>
<td>Interface MAC address</td>
</tr>
<tr>
<td>0x61:</td>
<td>1 0011.2130.b340</td>
<td>0</td>
<td>RCV</td>
<td>Bridge-group Virtual Interface</td>
</tr>
<tr>
<td>0x65:</td>
<td>0 0011.2130.b344</td>
<td>0</td>
<td>RCV</td>
<td>Interface MAC address</td>
</tr>
<tr>
<td>0xC0:</td>
<td>0 0100.0ccc.cccc</td>
<td>224</td>
<td>RCV</td>
<td>CDP</td>
</tr>
<tr>
<td>0xC2:</td>
<td>0 0180.c200.0000</td>
<td>0</td>
<td>RCV</td>
<td>IEEE spanning tree</td>
</tr>
</tbody>
</table>

POS1
SPR1
Bridged protocols on SPR1:
  clns       ip

Software MAC address filter on SPR1

<table>
<thead>
<tr>
<th>Hash Len</th>
<th>Address</th>
<th>Matches</th>
<th>Act</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x00:</td>
<td>0 ffff.ffff.ffff</td>
<td>0</td>
<td>RCV</td>
<td>Physical broadcast</td>
</tr>
<tr>
<td>0x60:</td>
<td>0 0011.2130.b341</td>
<td>0</td>
<td>RCV</td>
<td>Interface MAC address</td>
</tr>
<tr>
<td>0x65:</td>
<td>0 0011.2130.b344</td>
<td>0</td>
<td>RCV</td>
<td>Interface MAC address</td>
</tr>
<tr>
<td>0xC0:</td>
<td>0 0100.0ccc.cccc</td>
<td>0</td>
<td>RCV</td>
<td>CDP</td>
</tr>
<tr>
<td>0xC2:</td>
<td>0 0180.c200.0000</td>
<td>0</td>
<td>RCV</td>
<td>IEEE spanning tree</td>
</tr>
</tbody>
</table>

Table 11-1 describes significant fields shown in the display.

**Table 11-2**  show interfaces irb Field Descriptions

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routed protocols on...</td>
<td>List of the routed protocols configured for the specified interface.</td>
</tr>
<tr>
<td>Bridged protocols on...</td>
<td>List of the bridged protocols configured for the specified interface.</td>
</tr>
<tr>
<td>Software MAC address filter on...</td>
<td>Table of software MAC address filter information for the specified interface.</td>
</tr>
<tr>
<td>Hash</td>
<td>Hash key/relative position in the keyed list for this MAC-address entry.</td>
</tr>
<tr>
<td>Len</td>
<td>Length of this entry to the beginning element of this hash chain.</td>
</tr>
<tr>
<td>Address</td>
<td>Canonical (Ethernet ordered) MAC address.</td>
</tr>
<tr>
<td>Matches</td>
<td>Number of received packets matched to this MAC address.</td>
</tr>
<tr>
<td>Routed protocols on...</td>
<td>List of the routed protocols configured for the specified interface.</td>
</tr>
<tr>
<td>Bridged protocols on...</td>
<td>List of the bridged protocols configured for the specified interface.</td>
</tr>
</tbody>
</table>