CHAPTER 4

Configuring the Cisco MWR 2941-DC Router Using the CLI

This chapter describes how to use the Cisco IOS software command-line interface (CLI) to configure the the Cisco MWR 2941-DC Mobile Wireless Edge Router in a RAN-O solution and includes the following sections:

- Verifying the Cisco IOS Software Version, page 4-1
- Configuration Sequence, page 4-1
- Monitoring and Managing the Cisco MWR 2941-DC Router, page 4-46

For sample configurations, see Appendix B, "Configuration Examples."

For additional configuration topics, see the Cisco IOS configuration guide and command reference publications. These publications are available on the Documentation DVD that shipped with your router, available online at Cisco.com, or as printed copies that you can order separately.

Note If you skipped Chapter 2, "Cisco IOS Software Basics," and you have never configured a Cisco router, return to Chapter 2 and read it now. The chapter contains important information that you need to successfully configure your router.

Verifying the Cisco IOS Software Version

To implement the Cisco MWR 2941-DC router in a RAN-O solution, Cisco IOS Release 12.4(19)MR2 or later must be installed on the router. To verify the version of Cisco IOS software, use the **show version** command.

The **show version** command displays the configuration of the system hardware, the software version, the names and sources of the configuration files, and the boot images.

Configuration Sequence

The Summary of Steps section provides the recommended primary configuration sequence for the Cisco MWR 2941-DC router in a RAN-O solution. These steps have configuration substeps (or tasks) within the primary steps or tasks.

Note The installation of the Cisco MWR 2941-DC router and the Cisco T1/E1 interface card should be completed before attempting the configuration (see the "Related Documentation" section on page ix for more information).

The configuration sequence of the Cisco MWR 2941-DC router for the RAN-O solution assumes that you will have already had some familiarity with the configuration of Cisco routers. It is also assumed that you are familiar with your own network configurations and that you are familiar with the Command Line Interface (CLI) used in configuring Cisco routers.

Note For correct CLI syntax and format, see the "Cisco MWR 2941-DC Router Command Reference" section on page A-1.

Summary of Steps

To configure the Cisco MWR 2941-DC router in a RAN-O solution, perform the following tasks.

1. Configuring the Hostname and Password
2. Verifying the Hostname and Password, page 4-3
3. Configuring Gigabit Ethernet Interfaces, page 4-4
4. Configuring Network Clocking Support, page 4-6
5. Configuring Pseudowire, page 4-13
6. Configuring MLPPP Backhaul, page 4-22
7. Configuring GSM-Abis Links, page 4-31
8. Configuring SNMP Support, page 4-33
9. Configuring ATM IMA, page 4-37
10. Configuring Satellite Support in a RAN-O Network, page 4-40
11. Configuring Graceful Degradation, page 4-42
12. Saving Configuration Changes, page 4-45

Configuring the Hostname and Password

First configure the hostname and set an encrypted password. Configuring a hostname allows you to distinguish multiple Cisco routers from each other. Setting an encrypted password allows you to prevent unauthorized configuration changes.

Note In the following procedure, press the **Return** key after each step unless otherwise noted. At any time, you can exit the privileged level and return to the user level by entering **disable** at the `Router#` prompt.

To configure a hostname and to set an encrypted password, follow these steps:

Step 1 Enter enable mode.

```
Router> enable
```

The Password prompt appears. Enter your password.

```
Password: password
```

When the prompt changes to `Router`, you have entered enable mode.

Step 2 Enter global configuration mode.

```
Router# configure terminal

Enter configuration commands, one per line. End with CNTL/Z.
```

When the prompt changes to `Router(config)`, you have entered global configuration mode.

```
Router(config)#
```

Step 3 Change the name of the router to a meaningful name. Substitute your hostname for `Router`.

```
Router(config)# hostname Router

Router(config)#
```

Step 4 Enter an enable secret password. This password provides access to privileged EXEC mode. When you type **enable** at the EXEC prompt (`Router>`), you must enter the enable secret password to access configuration mode. Enter your secret password.

```
Router(config)# enable secret secret password
```

Step 5 Exit back to global configuration mode.

```
Router(config)# exit
```

Verifying the Hostname and Password

To verify that you have correctly configured the hostname and password, follow these steps

Step 1 Enter the **show config** command:

```
Router# show config
Using 1888 out of 126968 bytes
!
version XX.X
.
.
.
!
hostname Router
!
enable secret 5 $1$60L4$X2JYOwoDc0.kqa1loO/w8/
.
.
.
```

Step 2 Check the hostname and encrypted password, which appear near the top of the command output.

Step 3 Exit global configuration mode and attempt to re-enter it using the new enable password:

```
Router# exit
.
.
.
Router con0 is now available
```

```
Press RETURN to get started.
Router> enable
Password: password
Router#
```

Configuring Gigabit Ethernet Interfaces

To configure the Gigabit Ethernet (GE) interface on the Cisco MWR 2941-DC, complete the following tasks:

- Configuring the GE Interface Properties, page 4-4
- Setting the Speed and Duplex Mode, page 4-5
- Enabling the GE Interface, page 4-5
- Creating Backup Switch Interfaces, page 4-6

Configuring the GE Interface Properties

Perform a basic Gigabit Ethernet IP Address configuration by specifying the port adapter and aligning an IP address and subnet mask of the interface as follows.

Note In the following procedure, press the **Return** key after each step unless otherwise noted. At any time, you can exit the privileged level and return to the user level by entering **disable** at the `Router#` prompt.

Note The spanning tree-related commands described in this section are optional.

To configure the GE interface, follow these steps while in global configuration mode:

Step 1 Specify the port adapter type and the location of the interface to be configured.

```
Router(config)# interface gigabitethernet slot/port
Router(config-if)#
```

The *slot* is always 0 and the *port* is the number of the port (0 or 1).

Step 2 To set the interface type, use the **switchport mode** command.

```
Router(config-if)# switchport mode {access | trunk}
```

Step 3 To prioritize an interface when two bridges compete for position as the root bridge, use the **spanning tree port-priority** command.

```
Router(config-if)# spanning-tree port-priority port_priority
```

Step 4 To calculate the path cost of STP on an interface, use the **spanning-tree cost** command.

```
Router(config-if)# spanning-tree cost port_cost
```

Step 5 For interfaces that connect to end stations, you can use the **spanning-tree portfast** command to set the interface to move directly to the spanning-tree forwarding state when linkup occurs.

```
Router(config-if)# spanning-tree portfast
```

Step 6 To enable Cisco Discovery Protocol (CDP) on the router, use the **cdp enable** command.

```
Router(config-if)# cdp enable
```

Setting the Speed and Duplex Mode

The Gigabit Ethernet ports of the Cisco MWR 2941-DC router can run in full or half- duplex mode—100 Mbps or 1000 Mbps (1 Gbps). The Cisco MWR 2941-DC router has an autonegotiation feature that allows the router to negotiate the speed and duplex mode with the corresponding interface at the other end of the connection.

Autonegotiation is the default setting for the speed and transmission mode.

When you configure an interface speed and duplex mode, follow these guidelines:

- If both ends of the line support autonegotiation, we highly recommend the use of default autonegotiation settings.
- When autonegotiation is turned on for either speed or duplex mode, it autonegotiates both speed and the duplex mode.
- If one interface supports autonegotiation, and the interface at the other end does not, configure the duplex mode and speed on both interfaces. If you use the autonegotiation setting on the supported side, the duplex mode setting is set at half-duplex.

Note In the following procedure, press the **Return** key after each step unless otherwise noted. At any time, you can exit the privileged level and return to the user level by entering **disable** at the `Router#` prompt.

To configure speed and duplex operation, follow these steps while in interface configuration mode:

Step 1 Specify the duplex operation.

```
Router(config-if)# duplex [auto | half | full]
```

Step 2 Specify the speed.

```
Router(config-if)# speed [auto | 1000 | 100]
```

Enabling the GE Interface

Note In the following procedure, press the **Return** key after each step unless otherwise noted. At any time, you can exit the privileged level and return to the user level by entering **disable** at the `Router#` prompt.

After you configure the GE interface, enable it using the no shutdown command.by following this step

```
Router(config-if)# no shutdown
```

Creating Backup Switch Interfaces

You can use the following command to create a backup switch interface:

```
Rounders(conf-if)# switchport backup interface interface_name preemption [forced |
bandwidth | off] delay [time]
```

For more information about this command, see switchport backup interface, page A-120

Configuring VLANs

The Cisco MWR 2941-DC router supports a full set of VLAN features. For instructions on how to configure VLANs, see the Cisco IOS LAN Switching Configuration Guide, Release 12.4T at

http://www.cisco.com/en/US/docs/ios/lanswitch/configuration/guide/12_4t/lsw_12_4t_book.html.

Configuring Network Clocking Support

This section describes the network clocking support on the Cisco MWR 2941-DC router.

Network Clocking Overview

Network clocking is:

- The means by which a clock signal is generated or derived and distributed through a network and its individual nodes for the purpose of ensuring synchronized network operation.
- An important consideration in the RAN-O networks. Solid network clocking design helps the successful deployment of any RAN-O network.

Figure 4-1 shows an example of network clocking on a RAN-O network using the Cisco MWR 2941-DC.

Figure 4-1 Clocking Example

The base station controller (BSC) provides the clock source:

- Into the network to which the connected devices must synchronize its transmit clocks.
- To the Cisco MWR 2941-DC router, which is distributed to the participating serial and ATM ports.

Network Clocking on the Cisco MWR 2941-DC

The Cisco MWR 2941-DC supports multiple types of network clocking:

- Precision Time Protocol (PTP)—Clocking and clock recovery based on the IEEE 1588-2008 standard; allows the Cisco MWR 2941-DC router to receive clocking from another PTP-enabled device or provide clocking to a PTP-enabled device. To configure PTP clocking, see Configuring PTP Clocking.

- Pseudowire-based clocking—Allows the Cisco MWR 2941-DC router to use clocking using a pseudowire or virtual pseudowire interface. Pseudowire-based clocking supports adaptive clock recovery, which allows the Cisco MWR 2941-DC to recover clocking from the headers of a packet stream. To configure pseudowire-based clocking, see Configuring Pseudowire-based Clocking with Adaptive Clock Recovery
- Synchronous Ethernet—Allows the network to transport frequency and time information over Ethernet. To configure synchronous Ethernet, use the **network-clock-select** command described in the Configure the Global Network Clock section.

Note The Cisco MWR 2941-DC does not support the use of PTP and PWE-based clocking at the same time.

Configuring PTP Clocking

This section describes how to configure PTP-based clocking on the Cisco MWR 2941-DC. For more information about the PTP commands, see, Appendix A, "Cisco MWR 2941-DC Router Command Reference."

Note The settings shown in this section are an example only; you must determine the appropriate PTP settings based upon your network clocking design.

Configuring Global PTP Settings

Step 1 Enter the following commands to configure the global PTP settings:

a. Use the **PTP mode** command to specify the PTP mode.

```
Router(config)# ptp mode ordinary
```

b. Use the **PTP priority1** command to configure the preference level for a clock; slave devices use the priority1 value when selecting a master clock.

```
Router(config)# ptp priority1 128
```

c. Use the **PTP priority2** command to set a secondary preference level for a clock; slave devices use the priority2 value when selecting a master clock.

```
Router(config)# ptp priority2 128
```

d. Use the **PTP domain** command to specify the PTP domain number that the router uses. PTP domains allow you to use multiple independent PTP clocking subdomains on a single network.

```
Router(config)# ptp domain 6
```

Configuring the PTP Mode

Table 4-1 summarizes the PTP mode commands that you can use on the Cisco MWR 2941-DC.

Table 4-1 PTP Mode Commands

Command	Purpose
ptp announce	Sets interval and timeout values for PTP announcement packets.
ptp sync	Specifies the interval that the router uses to send PTP synchronization messages.
ptp delay-req interval	Specifies the delay request interval, the time recommended to member devices to send delay request messages when an interface is in PTP master mode.
ptp clock-source	Specifies the IP address of the clock source. This command only applies when the router is in PTP slave mode.
ptp clock-destination	Specifies the IP address of a clock destination. This command only applies when the router is in PTP master unicast mode.
ptp enable	Enables PTP mode on an interface

The following examples demonstrate how to use these commands to configure each of the six PTP modes. Use the appropriate section based on the PTP mode that you want to configure on the Cisco MWR 2941-DC.

- PTP multicast master mode—Sets the Cisco MWR 2941-DC to act as the master PTP clock. Multicast specifies that the router sends PTP messages to all the slaves listening on the PTP multicast group.

```
Router(config)# interface Vlan10
Router(config-if)# ip address 172.18.52.38 255.255.255.0
Router(config-if)# ip igmp join-group 224.0.1.129
Router(config-if)# ptp announce interval 0
Router(config-if)# ptp sync interval -6
Router(config-if)# ptp delay-req interval -4
Router(config-if)# ptp master multicast
Router(config-if)# ptp enable
```

- PTP multicast slave mode—Sets the Cisco MWR 2941-DC to receive clocking from a PTP master device in multicast mode.

```
Router(config)# interface Vlan10
Router(config-if)# ip address 172.18.52.38 255.255.255.0
Router(config-if)# ip igmp join-group 224.0.1.129
Router(config-if)# ptp announce interval 0
Router(config-if)# ptp sync interval -6
Router(config-if)# ptp delay-req interval -4
Router(config-if)# ptp slave multicast
Router(config-if)# ptp enable
```

- PTP unicast master mode—Sets the Cisco MWR 2941-DC to act as the master PTP clock. Unicast specifies that the router sends PTP messages to a single slave host.

```
Router(config)# interface Vlan2
Router(config-if)# ip address 172.18.52.38 255.255.255.0
Router(config-if)# ptp announce interval 0
Router(config-if)# ptp sync interval -6
Router(config-if)# ptp delay-req interval -4
Router(config-if)# ptp master unicast
```

```
Router(config-if)# ptp clock-destination 172.18.52.201
Router(config-if)# ptp enable
```

- PTP unicast slave mode—Sets the Cisco MWR 2941-DC to receive clocking from a single PTP master device.

```
Router(config)# interface Vlan2
Router(config-if)# ip address 172.18.52.38 255.255.255.0
Router(config-if)# ptp announce interval 3
Router(config-if)# ptp announce timeout 2
Router(config-if)# ptp sync interval -6
Router(config-if)# ptp delay-req interval -4
Router(config-if)# ptp slave unicast
Router(config-if)# ptp clock-source 172.18.52.10
Router(config-if)# ptp enable
```

- PTP unicast master mode (with negotiation enabled)—Sets the Cisco MWR 2941-DC to send clocking to a single PTP slave device; the router allows the slave devices to negotiate their master clock device.

```
Router(config)# interface Vlan2
Router(config-if)# ip address 172.18.52.38 255.255.255.0
Router(config-if)# ptp announce interval 0
Router(config-if)# ptp sync interval -6
Router(config-if)# ptp delay-req interval -4
Router(config-if)# ptp master unicast negotiation
Router(config-if)# ptp clock-destination 172.18.52.201
Router(config-if)# ptp enable
```

- PTP unicast slave mode (with negotiation enabled)—Sets the Cisco MWR 2941-DC to receive clocking from a PTP master devices; the router negotiates between up to 128 PTP master devices.

```
Router(config)# interface Vlan2
Router(config-if)# ip address 172.18.52.38 255.255.255.0
Router(config-if)# ptp announce interval 3
Router(config-if)# ptp announce timeout 2
Router(config-if)# ptp sync interval -6
Router(config-if)# ptp delay-req interval -4
Router(config-if)# ptp slave unicast negotiation
Router(config-if)# ptp clock-source 172.18.52.10
Router(config-if)# ptp enable
```

Note You can only configure one VLAN interface for PTP.

Configure the Global Network Clock

Use the **network-clock-select** command to configure clock selection for the entire network.

- If you configured the router for PTP master mode, set one or more external clock sources using the **network-clock-select** command with the synchronous ethernet (synce), bits, or E1 or T1 interface parameters:

```
Router(config)# network-clock-select 1 BITS
Router(config)# network-clock-select 2 SYNC 0
Router(config)# network-clock-select 3 E1 0/0
```

- If you configured the router for PTP slave mode, enter the following commands:

```
Router(config)# network-clock-select 1 PACKET-TIMING
Router(config)# network-clock-select hold-timeout 900
```

For more information about the **network-clock-select** command, see Appendix A, "Cisco MWR 2941-DC Router Command Reference."

Note The minimum network-clock-select hold-timeout value recommended in the slave mode is 900 seconds or 15 minutes.

Configuring Pseudowire-based Clocking with Adaptive Clock Recovery

Follow these steps to configure pseudowire-based clocking with adaptive clock recovery:

The Cisco MWR 2941-DC supports the following adaptive clock recovery modes:

- In-band master mode—The Cisco MWR 2941-DC provides clocking to slave devices using the headers in a packet stream. To configure this clocking mode, see Configuring In-Band Master Mode.
- In-band slave mode—The Cisco MWR 2941-DC receives clocking from a master clock using the headers from a packet stream. To configure this clocking mode, see Configuring In-Band Slave Mode.
- Out-of-band slave mode—The Cisco MWR 2941-DC receives clocking from a master clock using dedicated packets for timing. To configure this clocking mode, see Configuring Out-of-Band Slave Mode.

Note The Cisco MWR 2941-DC currently does not support out-of-band master mode.

Configuring In-Band Master Mode

Step 1 To configure in-band ACR master mode, you must configure Structure-agnostic TDM over Packet (SAToP) or Circuit Emulation Service (CES).

- The following example shows how to configure SAToP.

```
Router(config)# controller e1 0/0
Router(config-controller)# clock source internal
Router(config-controller)# cem-group 0 unframed
```

- The following example shows how to configure CES.

```
Router(config)# controller e1 0/0
Router(config-controller)# clock source internal
Router(config-controller)# cem-group 3 timeslots 1-31
```

Step 2 Configure the loopback interface.

```
Router(config)# interface Loopback
Router(config-if)# ip address 10.88.88.99 255.255.255.255
```

Step 3 Configure the VLAN interface.

```
Router(config)# interface Vlan1
Router(config-if)# ip address 172.18.52.2 255.255.255.0
Router(config-if)# no ptp enable
Router(config-if)# mpls ip
```

Step 4 Configure MPLS.

```
Router(config)# mpls ldp router-id Loopback0 force
```

Step 5 Configure the CEM interface.

```
Router(config)# interface cem 0/1
Router(config-if)# cem 0
Router(config-if-cem)# xconnect 10.10.10.2 7600 encap mpls
```

Step 6 Set one or more external clock sources using the synce, bits, or E1 interface, or T1 interface parameters:

```
Router(config)# network-clock-select 1 BITS
```

Configuring In-Band Slave Mode

Step 1 To configure in-band ACR slave mode, you must configure Structure-agnostic TDM over Packet (SAToP) or Circuit Emulation Service (CES).

- The following example shows how to configure SAToP.

```
Router(config)# controller e1 0/0
Router(config-controller)# clock source internal
Router(config-controller)# cem-group 0 unframed
```

- The following example shows how to configure CES.

```
Router(config)# controller e1 0/0
Router(config-controller)# clock source internal
Router(config-controller)# cem-group 3 timeslots 1-31
```

Step 2 Enter the following commands to configure the loopback interface.

```
Router(config)# interface Loopback
Router(config-if)# ip address 10.88.88.99 255.255.255.255
```

Step 3 Enter the following commands to configure the VLAN interface.

```
Router(config)# interface Vlan1
Router(config-if)# ip address 172.18.52.10.2 255.255.255.0
Router(config-if)# no ptp enable
Router(config-if)# mpls ip
```

Step 4 Enter the following command to configure MPLS.

```
Router(config)# mpls ldp router-id Loopback0 force
```

Step 5 Enter the following commands to configure the CEM interface.

```
Router(config)# interface cem 0/1
Router(config-if)# cem 0
Router(config-if-cem)# xconnect 10.10.10.2 7600 encap mpls
```

Step 6 Enter the following command to configure adaptive clock recovery using a circuit emulation (CEM) interface:

```
Router(config)# recovered-clock recovered adaptive cem 0 0 1
```

Step 7 Enter the following commands to configure the network clock:

```
Router(config)# network-clock-select 1 PACKET-TIMING
Router(config)# network-clock-select hold-timeout 900
```

Configuring Out-of-Band Slave Mode

Note When configuring out-of-band clocking, verify that the edge router (such as the Cisco 7600 Series Router) has the same out-of-band clocking settings.

Step 1 Enter the following command to configure clock recovery in slave mode:

```
Router(config)# recovered-clock slave
```

Step 2 Enter the following commands to configure the loopback interface.

```
Router(config)# interface Loopback
Router(config-if)# ip address 10.88.88.99 255.255.255.255
```

Step 3 Enter the following commands to configure the VLAN interface.

```
Router(config)# interface Vlan1
Router(config-if)# ip address 172.18.52.10.2 255.255.255.0
Router(config-if)# no ptp enable
Router(config-if)# mpls ip
```

Step 4 Enter the following command to configure MPLS.

Step 5

```
Router(config)# mpls ldp router-id Loopback0 force
```

Step 6 Enter the following commands to configure the CEM interface:

```
Router(config)# interface virtual-cem 0/24
Router(config-if)# payload-size 486
Router(config-if)# cem 0
Router(config-if-cem)# xconnect 10.10.10.2 7600 encap mpls
```

Note The Cisco MWR 2941-DC only supports a payload size of 486 (625 packets per second) or 243 (1250 packets per second). This value affects the payload size only and does not alter the packet size, which is constant regardless of payload value.

Step 7 Enter the following commands to configure the network clock:

```
Router(config)# network-clock-select 1 PACKET-TIMING
Router(config)# network-clock-select hold-timeout 900
```

Verifying Clock-related Settings

Use the following commands to verify the clock settings

- show network-clocks—Displays information about the network clocks
- show controller—Displays the status of the controller, including clocking information.
- show ptp clock—Displays ptp clock information
- show ptp foreign-master-record—Displays PTP foreign master records
- show ptp parent—Displays PTP parent properties
- show ptp port—Displays PTP port properties
- show ptp time-property—Displays PTP clock time properties

- show interface virtual-cem 0/24—Displays the status of the CEM interface
- show cem circuit—Displays information about the CEM circuit
- show platform hardware—Displays the status of hardware devices on the Cisco MWR 2941-DC.

Configuring Pseudowire

This section describes how to configure pseudowire on the Cisco MWR 2941-DC. For an overview of pseudowire, see "Cisco Pseudowire Emulation Edge-to-Edge" section on page 1-2.

The Cisco MWR 2941-DC supports pseudowire connections using SAToP, CESoPSN, and ATM over MPLS. The following sections describe how to configure pseudowire connections on the Cisco MWR 2941-DC.

- Using Pseudowire Classes
- Using CEM Classes
- Configuring Structure-Agnostic TDM over Packet (SAToP)
- Configuring Circuit Emulation Service over Packet-Switched Network (CESoPSN)
- Configuring Transportation of Service Using ATM over MPLS

For full descriptions of each command, see Appendix A, "Cisco MWR 2941-DC Router Command Reference." For pseudowire configuration examples, see Appendix B, "Configuration Examples."

Using Pseudowire Classes

A pseudowire class allows you to create a single configuration template for multiple pseudowire connections. You can apply pseudowire classes to SAToP, CESoPSN, and ATM over MPLS pseudowires. Follow these steps to configure a pseudowire class:

Step 1 Enter the following commands to create the pseudowire class.

a. Enter configuration mode.

```
Router# configure terminal
```

b. Use the **pseudowire-class** command to create a new pseudowire class.

```
Router(config)# pseudowire-class newclass
```

c. Use the **encapsulation** command to set an encapsulation type. This example uses MPLS encapsulation for an ATM over MPLS pseudowire.

```
Router(config-pw-class)# encapsulation mpls
```

d. Use the **mpls experimental** command to specify the 3-bit EXP field in the MPLS label used for pseudowire packets.

```
Router(config-pw-class)# mpls experimental 5
```

Note For more information about the mpls experimental command, see Appendix A, "Cisco MWR 2941-DC Router Command Reference."

Step 2 Follow these steps to create a reference to the pseudowire class in the ATM IMA interface.

a. Configure the pseudowire interface that you want to use the new pseudowire class. This example shows an ATM IMA interface.

```
Router(config)# interface atm0/ima0
Router(config-if)# pvc 0/40 l2transport
Router(cfg-if-atm-l2trans-pvc)# encapsulation aal0
```

b. Use the **xconnect** command to bind an attachment circuit to the ATM IMA interface to create an ATM pseudowire. Use the **pw-class** parameter to specify the pseudowire class that the ATM pseudowire interface uses.

```
Router(cfg-if-atm-l2trans-pvc)# xconnect 1.1.1.1 40 pw-class myclass
```

Note You cannot use the encapsulation **mpls** parameter with the **pw-class** parameter.

Note The use of the **xconnect** command can vary depending on the type of pseudowire you are configuring.

Using CEM Classes

A CEM class allows you to create a single configuration template for multiple CEM pseudowires. Follow these steps to configure a CEM class:

Note You cannot apply a CEM class to other pseudowire types such as ATM over MPLS.

Step 1 Follow these steps to create the CEM class.

a. Enter configuration mode.

```
Router# configure terminal
```

b. Use the class cem command to create a new CEM class

```
Router(config)# class cem mycemclass
```

c. Enter the configuration commands common to the CEM class. This example specifies a sample rate, payload size, dejitter buffer, and idle pattern.

```
Router(config-cem-class)# payload-size 512
Router(config-cem-class)# dejitter-buffer 10
Router(config-cem-class)# idle-pattern 0x55
```

d. Type **exit** to exit the CEM class interface.

```
Router(config-cem-class)# exit
```

Step 2 Follow these steps to create a reference to the CEM class in the CEM interface.

a. Enter the following commands to configure the CEM interface that you want to use the new CEM class.

```
Router(config)# interface cem 0/0
Router(config-if)# no ip address
Router(config-if)# cem 0
Router(config-if-cem)# cem class mycemclass
Router(config-if-cem)# xconnect 10.10.10.10 200 encapsulation mpls
```

Note The use of the xconnect command can vary depending on the type of pseudowire you are configuring.

b. Use the **exit** command to exit the CEM interface.

```
Router(config-if-cem)# exit
Router(config-if)#
```

Configuring Structure-Agnostic TDM over Packet (SAToP)

Follow these steps to configure SAToP on the Cisco MWR 2941-DC.

Step 1 Use the **controller** command to configure the T1 or E1 interface.

```
Router(config)# controller [T1|E1] 0/4
Router(config-controller)#
```

Step 2 Use the **cem-group** command to to assign channels on the T1 or E1 circuit to the circuit emulation (CEM) channel. This example uses the **unframed** parameter to assign all the T1 timeslots to the CEM channel.

```
Router(config-if)# cem-group 4 unframed
```

Step 3 Enter the following commands to define a CEM group.

```
Router(config)# interface CEM0/4
Router(config-if)# no ip address
Router(config-if)# cem 4
```

Step 4 Use the **xconnect** command to bind an attachment circuit to the CEM interface to create a pseudowire. This example creates a pseudowire by binding the CEM circuit 304 to the remote peer 30.30.2.304.

```
Router(config-if)# xconnect 30.30.30.2 304 encapsulation mpls
```

Configuring Circuit Emulation Service over Packet-Switched Network (CESoPSN)

Follow these steps to configure CESoPSN on the Cisco MWR 2941-DC.

Step 1 Use the **controller** command to access the E1 or T1 controller.

```
Router(config)# controller [e1|t1] 0/0
Router(config-controller)#
```

Step 2 Use the **cem-group** command to to assign channels on the T1 or E1 circuit to the circuit emulation (CEM) channel. This example uses the **timeslots** parameter to assign specific timeslots to the CEM channel.

```
Router(config-if)# cem-group 5 timeslots 1-24
```

Step 3 Use the following commands to define a CEM channel:

```
Router(config)# interface CEM0/5
Router(config-if-cem)# cem 5
```

Step 4 Use the **xconnect** command to bind an attachment circuit to the CEM interface to create a pseudowire. This example creates a pseudowire by binding the CEM circuit 305 to the remote peer 30.30.30.2.

```
Router(config-if-cem)# xconnect 30.30.30.2 305 encapsulation mpls
```

Step 5 Use the **exit** command to exit the CEM interface.

```
Router(config-if-cem)# exit
Router(config)#
```

Configuring Transportation of Service Using ATM over MPLS

ATM over MPLS pseudowires allow you to encapsulate and transport ATM traffic across an MPLS network. This service allows you to deliver ATM services over an existing MPLS network.

The following sections describe how to configure transportation of service using ATM over MPLS:

- Configuring the Controller
- Configuring an IMA Interface
- Configuring the ATM over MPLS Pseudowire Interface
- Optional Configurations

Note For sample configurations for ATM over MPLS, see "ATM over MPLS Configuration" section on page B-25.

Configuring the Controller

Follow these steps to configure the controller.

Step 1 Enter the **card type** command to configure IMA on an E1 or T1 interface.

```
Router(config)# card type e1 0 0
```

Step 2 Specify the controller interface on which you want to enable IMA.

```
Router(config)# controller E1 0/4
Router(config-controller)#
```

Step 3 Set the clock source to internal.

```
Router(config-controller)# clock source internal
```

Step 4 If you want to configure an ATM IMA backhaul, use the **ima-group** command to assign the interface to an IMA group. For a T1 connection, use the **no-scrambling-payload** to disable ATM-IMA cell payload scrambling; for an E1 connection, use the **scrambling-payload** parameter to enable ATM-IMA cell payload scrambling.

The follow command assigns the interface to IMA group 0 and enables payload scrambling.

```
Router(config-controller)# ima-group 0 scrambling-payload
```

Note For more information about configuring IMA groups, see Configuring ATM IMA. For more information about how to configure the backhaul connection, see Configuring MLPPP Backhaul.

Configuring an IMA Interface

If you want to use ATM IMA backhaul, follow these steps to configure the IMA interface.

Step 1 Specify the slot location and port of IMA interface group.

```
Router(config-controller)# interface ATMslot/IMAgroup-number
```

- *slot*—Specifies the slot location of the ATM IMA port adapter.
- *group-number*—Specifies the group number of the IMA group.

For example, the following command specifies the slot number as 0 and the group number as 0:

```
Router(config-controller)# interface atm0/ima0
Router(config-if)#
```

Note To explicitly configure the IMA group ID for the IMA interface, you may use the optional **ima group-id** command. You cannot configure the same IMA group ID on two different IMA interfaces; therefore, if you configure an IMA group ID with the system-selected default ID already configured on an IMA interface, the system toggles the IMA interface to make the user-configured IMA group ID the effective IMA group ID. At the same, the system toggles the original IMA interface to select a different IMA group ID.

Step 2 Disable the IP address configuration for the physical layer interface.

```
Router(config-if)# no ip address
```

Step 3 Specify the ATM bandwith as dynamic.

```
Router(config-if)# atm bandwith dynamic
```

Step 4 Disable the Interim Local Management Interface (ILMI) keepalive parameters.

```
Router(config-if)# no atm ilmi-keepalive
```

For more information about configuring IMA groups, see Configuring ATM IMA.

Configuring the ATM over MPLS Pseudowire Interface

You can configure ATM over MPLS is several modes according to the needs of your network. Use the appropriate section according to the needs of your network.

- Configuring N-to-1 VCC Cell Transport Pseudowire—Maps multiple VCCs to a single pseudowire
- Configuring N-to-1 VPC Cell Transport—Maps multiple VPCs to a single pseudowire
- Configuring ATM AAL5 SDU VCC Transport—Maps a single ATM PVC to another ATM PVC
- Configuring 1-to-1 VCC Cell Mode—Maps a single VCC to a single pseudowire
- Configuring a Port Mode Pseudowire—Maps one physical port to a single pseudowire connection

Configuring N-to-1 VCC Cell Transport Pseudowire

An N-to-1 VCC cell transport pseudowire maps one or more ATM virtual channel connections (VCCs) to a single pseudowire. Follow these steps to configure an N-to-1 pseudowire.

You can use the following methods to configure an N-to-1 VCC Cell Transport pseudowire.

- Mapping a Single PVC to a Pseudowire
- Mapping multiple PVCs to a Pseudowire

Mapping a Single PVC to a Pseudowire

To map a single PVC to an ATM over MPLS pseudowire, apply the **xconnect** command at the PVC level. This configuration type only uses AAL0 encapsulation. Follow these steps to map a single PVC to an ATM over MPLS pseudowire.

a. Configure the ATM IMA interface.

```
Router(config)# interface atm0/ima0
```

b. Use the **pvc** command to define a PVC.

```
Router(config-if)# pvc 0/40
Router(cfg-if-atm-l2trans-pvc)#
```

c. Use the **encapsulation** command to define the encapsulation type for the PVC.

```
Router(cfg-if-atm-l2trans-pvc)# encapsulation aal0
```

d. Use the **xconnect** command to bind an attachment circuit to the ATM IMA interface to create a pseudowire. This example creates a pseudowire by binding PVC 40 to the remote peer 1.1.1.1.

```
Router(config-if)# xconnect 1.1.1.1 40 encapsulation mpls
Router(cfg-if-atm-l2trans-pvc-xconn)#
```

e. Use the **end** command to exit configuration mode.

```
Router(cfg-if-atm-l2trans-pvp-xconn)# end
Router#
```

Mapping multiple PVCs to a Pseudowire

To map a multiple PVCs to a single ATM over MPLS pseudowire, apply the **xconnect** command at the subinterface level. This configuration allows you to group pseudowires logically, such as by the BTS to which the pseudowire is connected. Follow these steps to map a multiple PVCs to an ATM over MPLS pseudowire.

Note If you configure multiple PVCs on an N-to-1 subinterface pseudowire, you must use AAL0 encapsulation for all of the PVCs..

Note When you configure a N-to-1 pseudowire, you can also use use the **ignore-vpi-vci** parameter. This parameter sets the Cisco MWR 2941-DC to ignore the VPI/VCI value in the PW packet and rewrite the egress ATM cell header with VPI/VCI value of the locally configured (attachment side) PVC. For more information about the xconnect command and the ignore-vpi-vci parameter, see Appendix A, "Cisco MWR 2941-DC Router Command Reference."

a. Configure the ATM IMA interface.

```
Router(config)# interface atm0/ima0
```

a. Enter the following command to create an ATM IMA multipoint subinterface.

```
Router(config-if)# interface atm 0/ima0.1 multipoint
Router(config-subif)#
```

b. Use the **xconnect** command to bind an attachment circuit to the ATM IMA interface to create a pseudowire. This example creates a pseudowire by binding the ATM circuit 100 to the remote peer 1.1.1.1.

```
Router(config-subif)# xconnect 1.1.1.1 100 encapsulation mpls
Router(config-subif-xconn)#
```

c. Use the **exit** command to exit the xconnect subinterface.

```
Router(config-subif-xconn)# exit
Router(config-subif)#
```

d. Use the **pvc** command to map a PVC to a pseudowire.

```
Router(config-if)# pvc 0/40 l2transport
Router(cfg-if-atm-l2trans-pvc)#
```

e. Use the **encapsulation** command to define the encapsulation type for the PVC.

```
Router(config-if-atm-vc)# encapsulation aal0
```

f. Define additional PVCs as appropriate. We recommend that you include a description for each PVC

```
Router(config-if)# pvc 0/41 l2transport
Router(cfg-if-atm-l2trans-pvc)# encapsulation aal0
Router(cfg-if-atm-l2trans-pvc)# description voice channel
Router(cfg-if-atm-l2trans-pvc)# exit
Router(config-subif)#pvc 0/42 l2transport
Router(cfg-if-atm-l2trans-pvc)#enc aal0
Router(cfg-if-atm-l2trans-pvc)# description data channel
```

Configuring N-to-1 VPC Cell Transport

An N-to-1 VPC cell transport pseudowire maps one or more ATM virtual path connections (VPCs) to a single pseudowire. While the configuration is similar to one-to-one VPC cell mode, this tranport method uses the N-to-1 VPC Pseudowire protocol and format defined in RFCs 4717 and 4446. Follow these steps to configure an N-to-1 VPCpseudowire.

Step 1 Configure the ATM IMA interface.

```
Router(config)# interface atm0/ima0
Router(config-if)#
```

Step 2 Use the **atm pvp** command to map a PVP to a pseudowire

```
Router(config-if)# atm pvp 10 l2transport
Router(cfg-if-atm-l2trans-pvp)#
```

Step 3 Use the **xconnect** command to bind an attachment circuit to the ATM IMA interface to create a pseudowire. This example creates a pseudowire by binding the ATM circuit 305 to the remote peer 30.30.30.2.

```
Router(cfg-if-atm-l2trans-pvp)# xconnect 30.30.30.2 305 encapsulation mpls
Router(cfg-if-atm-l2trans-pvp-xconn)#
```

Step 4 Use the **end** command to exit configuration mode.

```
Router(cfg-if-atm-l2trans-pvp-xconn)# end
Router#
```

Configuring ATM AAL5 SDU VCC Transport

An ATM AAL5 SDU VCC transport pseudowire maps a single ATM PVC to another ATM PVC. Follow these steps to configure an ATM AAL5 SDU VCC transport pseudowire.

Step 1 Configure the ATM IMA interface.

```
Router(config)# interface atm 0/ima0
Router(config-if)#
```

Step 2 Use the **pvc** command to configure a PVC and specify a VCI/VPI.

```
Router(config-if)# pvc 0/12 l2transport
Router(cfg-if-atm-l2trans-pvc)#
```

Step 3 Use the **encapsulation** command to set the PVC encapsulation type to AAL5.

```
Router(cfg-if-atm-l2trans-pvc)# encapsulation aal5
```

Note You must use AAL5 encapsulation for this transport type.

Step 4 Use the **xconnect** command to bind an attachment circuit to the ATM IMA interface to create a pseudowire. This example creates a pseudowire by binding the ATM circuit 125 to the remote peer 25.25.25.25.

```
Router(cfg-if-atm-l2trans-pvc)# xconnect 25.25.25.25 125 encapsulation mpls
```

Configuring 1-to-1 VCC Cell Mode

A VCC 1-to-1 pseudowire allows you to map a single ATM VCC to a single pseudowire. You must use AAL0 encapsulation for this transport type. Follow these steps to configure a 1-to-1 pseudowire.

Step 1 Configure the ATM IMA interface.

```
Router(config)# interface atm 0/ima0
Router(config-if)#
```

Step 2 Use the **pvc** command to configure a PVC and specify a VCI/VPI.

```
Router(config-if)# pvc 0/12 l2transport
Router(cfg-if-atm-l2trans-pvc)#
```

Step 3 Use the **encapsulation** command to set the PVC encapsulation type to AAL0.

```
Router(cfg-if-atm-l2trans-pvc)# encapsulation aal0
```

Note You must use AAL0 encapsulation for this transport type.

Step 4 Use the **xconnect** command to bind an attachment circuit to the ATM IMA interface to create a pseudowire. This example creates a pseudowire by binding the ATM circuit 125 to the remote peer 25.25.25.25.

```
Router(cfg-if-atm-l2trans-pvc)# xconnect 25.25.25.25 125 encapsulation mpls one-to-one
```

Configuring a Port Mode Pseudowire

A port mode pseudowire allows you to map an entire ATM interface to a single pseudowire connection. Follow these steps to configure a port mode pseudowire:

Step 1 Configure the ATM interface.

```
Router(config)# interface atm 0/ima0
```

Step 2 Use the **xconnect** command to bind an attachment circuit to the ATM IMA interface to create a pseudowire. This example creates a pseudowire by binding the ATM circuit 200 to the remote peer 25.25.25.25.

```
Router(cfg-if)# xconnect 25.25.25.25 2000 encapsulation mpls
```

Optional Configurations

You can apply the following optional configurations to a pseudowire link.

- Configuring Cell Packing
- Configuring PVC Mapping

Configuring Cell Packing

Cell packing allows you to improve the effeciency of ATM-to-MPLS conversion by packing multiple ATM cells into a single MPLS packet. Follow these steps to configure cell packing.

Step 1 Use the **atm mcpt-timers** command to define the three Maximum Cell Packing Timeout (MCPT) timers under an ATM interface. The three independent MCPT timers specify a wait time before forwarding a packet.

```
Router(config)# int atm1/0
Router(config-if)# atm mcpt-timers 1000 2000 3000
```

Step 2 Use the **cell-packing** command to specify the maximum number of cells in PW cell pack and the cell packing timer that the Cisco MWR 2941-DC uses. This example specifies 20 cells per pack and the third MCPT timer.

```
Router(config)# pvc 0/11 l2transport
Router(cfg-if-atm-l2trans-pvc)# encapsulation aal0
Router(cfg-if-atm-l2trans-pvc)# cell-packing 20 mcpt-timer 3
```

Configuring PVC Mapping

PVC mapping allows you to map PVCs from multiple cell site routers to equivalent PVCs on a single aggregation node.

Note PVC mapping only applies to N-to-1 cell mode and port mode. You can achieve a similar effect for AAL 5SDU mode and VCC one-to-one mode by configuring a pseudowire between two PVCs with different VPI/VCI values on two PEs.

The following example shows how to use the **pw-pvc** command to map a the local PVCs 0/11 and 0/12 to the remote PVCs 0/11 and 0/12.

```
(config)# int atm1/0
(config-if)# xconnect 25.25.25.25 2000 encapsulation mpls
```

```
(config-if)# pvc 0/11 l2transport
(cfg-if-atm-l2trans-pvc)# encapsulation aal0
(cfg-if-atm-l2trans-pvc)# pw-pvc 1/11
(config-if)# pvc 0/12 l2transport
(cfg-if-atm-l2trans-pvc)# encapsulation aal0
(cfg-if-atm-l2trans-pvc)# pw-pvc 1/12
```

Configuring MLPPP Backhaul

To configure an MLPPP backhaul, complete the following tasks:

- Configuring the Card Type, page 4-22
- Configuring E1 Controllers, page 4-23
- Configuring T1 Controllers, page 4-25
- Configuring Multilink Backhaul Interface, page 4-26
- Configuring the PPP Backhaul Interfaces, page 4-29

Configuring the Card Type

Perform a basic card type configuration by enabling the router, enabling an interface, and specifying the card type as described below. You might also need to enter other configuration commands, depending on the requirements for your system configuration and the protocols you plan to route on the interface.

For information about interface numbering, see Understanding the Cisco MWR 2941-DC Router Interface Numbering, page 3-1.

Note In the following procedure, press the **Return** key after each step unless otherwise noted. At any time, you can exit the privileged level and return to the user level by entering **disable** at the `Router#` prompt.

To select and configure a card type, follow these steps:

Step 1 Enter enable mode.

```
Router> enable
```

Step 2 Enter the password.

```
Password: password
```

When the prompt changes to `Router`, you have entered enable mode.

Step 3 Enter global configuration mode.

```
Router# configure terminal

Enter configuration commands, one per line. End with CNTL/Z.

Router(config)#
```

When the prompt changes to `Router(config)`, you have entered global configuration mode.

Note To view a list of the configuration commands available to you, enter **?** at the prompt or press the **Help** key while in configuration mode.

Step 4 Set the card type.

```
Router(config-if)# card type {e1 | t1} slot subslot
```

- *slot*—Slot number of the interface.
- *subslot*—Specifies the VWIC slot number.

For example, the following command shows how to configure a T1/E HWIC in the first HWIC slot as an E1 card:

```
Router(config)# card type e1 0 1
```

When the command is used for the first time, the configuration takes effect immediately. A subsequent change in the card type does not take effect unless you enter the **reload** command or reboot the router.

Note When you are using the **card type** command to change the configuration of an installed card, you must first enter the **no card type** {**e1** | **t1**} slot subslot command. Then enter the **card type** {**e1** | **t1**} *slot subslot* command for the new configuration information.

Configuring E1 Controllers

Perform a basic E1 controller configuration by specifying the E1 controller, entering the clock source, specifying the channel-group, configuring the serial interface, configuring PPP encapsulation, and enabling keepalive packets. You might also need to enter other configuration commands, depending on the requirements for your system configuration and the protocols you plan to route on the interface.

Note In the following procedure, press the **Return** key after each step unless otherwise noted. At any time, you can exit the privileged level and return to the user level by entering **disable** at the `Router#` prompt.

To configure the E1 controllers, follow these steps while in global configuration mode:

Step 1 Specify the controller that you want to configure. Controller E1 0/0 maps to the T1/E1 HWIC card in HWIC slot 0.

```
Router(config)# controller e1 slot/port
```

For example, the following command shows how to specify the E1 controller as the first port of the T1/E1 HWIC card in slot 0:

```
Router(config)# controller e1 0/0
Router(config-controller)#
```

The prompt changes to `Router(config-controller)`, when you enter controller configuration mode.

Step 2 Specify the framing type.

```
Router(config-controller)# framing {crc4 | no-crc4}
```

Step 3 Specify the line code format.

```
Router(config-controller)# linecode {ami | hdb3}
```

Step 4 Enter the clocking source.

```
Router(config-controller)# clock source {line | internal} [bits]
```

- *line*—Specifies the E1 line from which the clocking is taken.
- *internal*—Specifies internal clocking.
- bits—Enabled Building Integrated Timing Supply (BITS) clocking.

For example, the following command shows how to configure the clock source for the E1 controller:

```
Router(config-controller)# clock source line
```

Note When you are using the **clock source** command to change the configuration of an installed card, you must enter the **no clock source** command first. Then enter the **clock source** command for the new configuration information.

Step 5 Specify the channel-group and time slots to be mapped. After you configure a channel-group, the serial interface is automatically created.

```
Router(config-controller)# channel-group channel-no timeslots timeslot-list speed {64}
```

- *channel-no*—ID number to identify the channel group. The valid range is 0 to 30.
- *timeslot-list*—Timeslots (DS0s) to include in this channel group. The valid timeslots are 1 to 31.
- **speed {64}**—The speed of the DS0: 64 kbps.

For example, the following command configures the channel-group and time slots for the E1 controller:

```
Router(config-controller)# channel-group 0 timeslots 1-31 speed 64
```

Note When you are using the **channel-group** *channel-no* **timeslots** *timeslot-list* **{64}** command to change the configuration of an installed card, you must enter the **no channel-group** *channel-no* **timeslots** *timeslot-list* **speed {64}** command first. Then enter the **channel-group***channel-no* **timeslots** *timeslot-list* **{64}** command for the new configuration information.

Step 6 Exit controller configuration mode.

```
Router(config-controller)# exit
```

Step 7 Configure the serial interface. Specify the E1 slot, port number, and channel-group.

```
Router(config)# interface serial slot/port:channel
```

When the prompt changes to `Router(config-if)`, you have entered interface configuration mode.

Note To see a list of the configuration commands available to you, enter **?** at the prompt or press the **Help** key while in the configuration mode.

Step 8 To configure PPP encapsulation, enter the following command:

```
Router(config-if)# encapsulation ppp
```

Step 9 Enable keepalive packets on the interface and specify the number of times keepalive packets are sent without a response before bringing down the interface:

```
Router(config-if)# keepalive [period [retries]]
```

Step 10 Exit interface configuration mode.

```
Router(config-if)# exit
```

Configuring T1 Controllers

Use the following instructions to perform a basic T1 controller configuration: specifying the T1 controller, specifying the framing type, specifying the line code form, specifying the channel-group and time slots to be mapped, configuring the cable length, configuring the serial interface, configuring PPP encapsulation, and enabling keepalive packets. You might also need to enter other configuration commands, depending on the requirements for your system configuration and the protocols you plan to route on the interface.

Note In the following procedure, press the **Return** key after each step unless otherwise noted. At any time, you can exit the privileged level and return to the user level by entering **disable** at the `Router#` prompt.

To configure the T1 interfaces, follow these steps while in the global configuration mode:

Step 1 Specify the controller that you want to configure. Controller T1 0/0 maps to the T1/E1 HWIC card in HWIC slot 0.

```
Router(config)# controller t1 slot/port
```

Step 2 Specify the framing type.

```
Router(config-controller)# framing esf
```

Step 3 Specify the line code format.

```
Router(config-controller)# linecode b8zs
```

Step 4 Specify the channel-group and time slots to be mapped. After you configure a channel-group, the serial interface is automatically created.

Note The default speed of the channel-group is 56.

```
Router(config-controller)# channel-group 0 timeslots 1-24 speed 56
```

Step 5 Configure the cable length.

```
Router(config-controller)# cablelength {long [-15db | -22.5db | -7.5db | 0db] short [110ft
| 220ft | 330ft| 440ft | 550ft | 600ft]}
```

Step 6 Exit controller configuration mode.

```
Router(config-controller)# exit
```

Step 7 Configure the serial interface. Specify the T1 slot (always 0), port number, and channel-group.

```
Router(config)# interface serial slot/port:channel
```

Step 8 Enter the following command to configure PPP encapsulation.

```
Router(config-if)# encapsulation ppp
```

Step 9 Enable keepalive packets on the interface and specify the number of times that keepalive packets will be sent without a response the interface is brought down:

```
Router(config-if)# keepalive [period [retries]]
```

Step 10 Exit to global configuration mode.

```
Router(config-if)# exit
```

Configuring Multilink Backhaul Interface

A multilink interface is a special virtual interface that represents a multilink PPP bundle. The multilink interface coordinates the configuration of the bundled link, and presents a single object for the aggregate links. However, the individual PPP links that are aggregated must also be configured. Therefore, to enable multilink PPP on multiple serial interfaces, you first need to set up the multilink interface, and then configure each of the serial interfaces and add them to the same multilink interface.

Note In the following procedure, press the **Return** key after each step unless otherwise noted. At any time, you can exit the privileged level and return to the user level by entering **disable** at the `Router#` prompt.

The Cisco MWR 2941-DC router can support up to 10 E1 or T1 interfaces through the multilink interface.

Complete the following configuration tasks for a multilink backhaul interface.

- Creating a Multilink Bundle, this page
- Configuring PFC, page 4-27
- Configuring ACFC, page 4-28
- Enable Multilink and Identify the Multilink Interface, page 4-28
- Enable Real-Time Transport Protocol (RTP) Header-Compression, page 4-29

Creating a Multilink Bundle

To create a multilink bundle, follow these steps, while in the global configuration mode:

Step 1 Create a multilink bundle and enter the interface configuration mode:

```
Router(config)# interface multilink group-number
```

- *group-number*—Number of the multilink bundle.

For example, the following command creates a multilink bundle 5:

```
Router(config)# interface multilink5
Router(config-if)#
```

To remove a multilink bundle, use the **no** form of this command.

Note To see a list of the configuration commands available to you, enter **?** at the prompt or press the **Help** key while in the configuration mode.

Step 2 Assign an IP address to the multilink interface.

```
Router(config-if)# ip address address [subnet mask]
```

- *address*—The IP address.
- *subnet mask*—Network mask of IP address.

For example, the following command creates an IP address and subnet mask:

```
Router(config-if)# ip address 10.10.10.2 255.255.255.0
```

Handling PFC and ACFC

Protocol-Field-Compression (PFC) and Address-and-Control-Field-Compression (AFC) are PPP compression methods defined in RFCs 1661 and 1662. PFC allows for compression of the PPP Protocol field; ACFC allows for compression of the PPP Data Link Layer Address and Control fields.

Use the following instructions to perform PFC and ACFC handling during PPP negotiation to be configured. By default, PFC/ACFC handling is not enabled.

Note The recommended PFC and ACFC handling in the Cisco MWR 2941-DC router is: **acfc local request, acfc remote apply, pfc local request, and pfc remote apply**.

Configuring PFC

To configure PFC handling during PPP negotiation, follow these steps, while in the interface configuration mode:

Step 1 To configure how the router handles PFC in its outbound configuration requests, enter the following command:

```
Router(config-if)# ppp pfc local {request | forbid}
```

Where:

- **request**—The PFC option is included in outbound configuration requests.
- **forbid**—The PFC option is not sent in outbound configuration requests, and requests from a remote peer to add the PFC option are not accepted.

For example, the following command shows how to create a method for the router to manage PFC:

```
Router(config-if)# ppp pfc local request
```

Step 2 To configure a method for the router to use to manage the PFC option in configuration requests received from a remote peer, enter the following command:

```
Router(config-if)# ppp pfc remote {apply | reject | ignore}
```

Where:

- **apply**—PFC options are accepted and ACFC may be performed on frames sent to the remote peer.
- **reject**—PFC options are explicitly ignored.
- **ignore**—PFC options are accepted, but ACFC is not performed on frames sent to the remote peer.

For example, issuing the following command allows PFC options to be accepted:

```
Router(config)# ppp pfc remote apply
```

Configuring ACFC

To configure ACFC handling during PPP negotiation, follow these steps, while in interface configuration mode:

Step 1 To configure how the router handles ACFC in its outbound configuration requests, enter the following command:

```
Router(config-if)# ppp acfc local {request | forbid}
```

Where:

- **request**—The ACFC option is included in outbound configuration requests.
- **forbid**—The ACFC option is not sent in outbound configuration requests, and requests from a remote peer to add the ACFC option are not accepted.

For example, the following command creates how the router handles ACFC:

```
Router(config-if)# ppp acfc local request
```

Step 2 To configure how the router handles the ACFC option in configuration requests received from a remote peer, enter the following command:

```
Router(config-if)# ppp acfc remote {apply | reject | ignore}
```

Where:

- **apply**—ACFC options are accepted and ACFC may be performed on frames sent to the remote peer.
- **reject**—ACFC options are explicitly ignored.
- **ignore**—ACFC options are accepted, but ACFC is not performed on frames sent to the remote peer.

For example, the following command allows ACFC options to be accepted:

```
Router(config-if)# ppp acfc remote apply
```

Enable Multilink and Identify the Multilink Interface

To enable multilink and identify the multilink interface, follow these steps, while in interface configuration mode:

Step 1 Enable multilink PPP operation.

```
Router(config-if)# ppp multilink
```

Step 2 Specify an identification number for the multilink interface.

```
Router(config-if)# ppp multilink group group-number
```

- ***group-number***—Multilink group number.

For example, the following command restricts (identifies) the multilink interface, 5, that can be negotiated:

```
Router(config-if)# ppp multilink group 5
```

Step 3 Enable keepalive packets on the interface and specify the number of times the keepalive packets are sent without a response before bringing down the interface.

```
Router(config-if)# keepalive [period [retries]]
```

- ***period***—(Optional) Integer value in seconds greater than 0. The default is 10.
- ***retries***—(Optional) Specifies the number of times that the device will continue to send keepalive packets without response before bringing the interface down. Integer value greater than 1 and less than 255. If omitted, the value that was previously set is used; if no value was specified previously, the default of 5 is used.

For example, the following command shows how to restrict (identify) the multilink interface, 5, that can be negotiated:

```
Router(config-if)# keepalive 1 5
```

Enable Real-Time Transport Protocol (RTP) Header-Compression

To enable RTP Header Compression, follow these steps while in the interface configuration mode:

Step 1 Enable RTP header-compression.

```
Router(config-if)# ip rtp header-compression [passive | iphc-format | ietf-format]
[periodic-refresh]
```

- **passive**—(Optional) Compresses outgoing RTP packets only if incoming RTP packets on the same interface are compressed. If you do not specify the passive keyword, all RTP packets are compressed. This option is not applicable on PPP links.
- **iphc-format**—(Optional) Indicates that the IP Header Compression (IPHC) format of header compression will be used.
- **ietf-format**—(Optional) Indicates that the Internet Engineering Task Force (IETF) format of header compression will be used.
- **periodic-refresh**—(Optional) Indicates that the compressed IP header will be refreshed periodically.

For example, the following command enables RTP header-compression in the Internet Engineering Task Force (IETF) format by suppressing the IP ID in the RTP/UDP header compression:

```
Router(config-if)# ip rtp header-compression ietf-format ignore-id
```

Configuring the PPP Backhaul Interfaces

Use the following instructions to perform a basic backhaul interface configuration: enabling an interface, configuring PPP encapsulation, enabling multilink PPP operation, and specifying an ID number for the multilink interface. You might also need to enter other configuration commands, depending on the requirements for your system configuration and the protocols you plan to route on the interface.

Note In the following procedure, press the **Return** key after each step unless otherwise noted. At any time, you can exit the privileged level and return to the user level by entering **disable** at the `Router#` prompt.

To continue the configuration of the backhaul links for the E1 controllers, follow these steps while in the global configuration mode:

Step 1 Configure the serial interface. Specify the E1 slot, port number, and channel-group.

```
Router(config)# interface serial slot/port:channel-group
```

Where:

- *slot*—Slot number of the interface.
- *port*—Port number of the interface.
- **channel-group**—ID number to identify the channel group.

For example, the following command identifies the serial interface located in slot 0, port 0, channel-group 0:

```
Router(config)# interface serial0/0:0
Router(config-if)#
```

Note To view a list of available configuration commands, enter **?** at the prompt or press the **Help** key while in configuration mode.

Step 2 Do not assign an IP address and subnet mask to the interface.

```
Router(config-if)# no ip address ip_address subnet_mask
```

Step 3 To configure PPP encapsulation, enter the following command:

```
Router(config-if)# encapsulation ppp
```

Step 4 Enable multilink PPP operation.

```
Router(config-if)# ppp multilink
```

Step 5 Specify an identification number for the multilink interface.

```
Router(config-if)# ppp multilink group group-number
```

- *group-number*—Multilink group number.

For example, the following command shows how to restrict (identify) the multilink interface, 5, that can be negotiated:

```
Router(config-if)# ppp multilink group 5
```

Step 6 Enable keepalive packets on the interface and specify the number of times the keepalive packets is sent without a response before bringing down the interface.

```
Router(config-if)# keepalive [period]
```

- *period*—(Optional) Integer value in seconds greater than 0. The default is 10.

For example, the following command indicates the number of times the keepalive packets will be sent as 1:

```
Router(config-if)# keepalive 1
```

Configuring GSM-Abis Links

Note The following is an example of configuring an E1 on a Cisco T1/E1 HWIC card in a Cisco MWR 2941-DC router.

Use the following instructions to perform a basic GSM-Abis configuration on a Cisco T1/E1 HWIC card located in the Cisco MWR 2941-DC router, by entering the following Cisco IOS commands at the router prompt (see the "Understanding the Cisco MWR 2941-DC Router Interface Numbering" section on page 3-1 for information about slot and port numbering on the Cisco MWR 2941-DC router). You might also need to enter other configuration commands, depending on the requirements for your system configuration and the protocols you plan to route on the interface.

Note In the following procedure, press the **Return** key after each step unless otherwise noted. At any time, you can exit the privileged level and return to the user level by entering **disable** at the `Router#` prompt.

To configure the GSM-Abis attributes, follow these steps while in global configuration mode:

Step 1 Set the card type for the Cisco T1/E1 HWIC card.

```
Router(config)# card type {e1 | t1} slot subslot
```

- **e1**—*Card type E1.*
- **t1**—*Cart type T1.*
- *slot*—Slot number of the interface.
- *subslot*—Specifies the Cisco T1/E1 HWIC interface card (HWIC slot) port number.

The following command configures the Cisco T1/E1 HWIC card located in the HWIC slot 0 as an E1:

```
Router(config)# card type e1 0 1
```

When the command is used for the first time, the configuration takes effect immediately. A subsequent change in the card type does not take effect unless you enter the **reload** command or reboot the router

Step 2 Specify the controller that you want to configure by entering the controller configuration mode. Controller E1 0/0 maps to the Cisco T1/E1 HWIC card located in HWIC slot 0.

Note For more information about interface numbering, see "Understanding the Cisco MWR 2941-DC Router Interface Numbering" section on page 3-1.

```
Router(config)# controller e1 slot/port
```

- *slot*—The HWIC slot where the T1/E1-RAN card is installed.
- *port*—Number of the serial port the T1/E1-RAN card is using.

For example, the following command specifies the E1 controller as the Cisco T1/E1 HWIC card located in HWIC slot 0:

```
Router(config)# controller e1 0/2
Router(config-controller)#
```

Step 3 Enter the clocking source. For more information on clocking, see Configuring Network Clocking Support, page 4-6.

```
Router(config-controller)# clock source {line | internal}
```

- **line**—Specifies the E1 line from which the clocking is taken.
- **internal**—Specifies internal clocking.

For example, the following command configures the clock source for the E1 controller:

```
Router(config-controller)# clock source internal
```

Note When you are using the **clock source** command to change the configuration of an installed card, you must enter the **no clock source** command first. Then enter the **clock source** command for the new configuration information.

Step 4 Specify the channel-group and time slots to be mapped. After you configure a channel-group, the serial interface is automatically created.

Note You can only create one channel group per E1 or T1 interface.

```
Router(config-controller)# channel-group channel-no timeslots timeslot-list speed {64}
```

- *channel-no*—ID number to identify the channel group. The valid range is 0 to 30.
- *timeslot-list*—Timeslots (DS0s) to include in this channel group. The valid timeslots are 1 to 31 and must be contiguous.
- **speed {64}**—The speed of the DS0: 64 kbps.

For example, the following command configures the channel-group and time slots for the E1 controller:

```
Router(config-controller)# channel-group 0 timeslots 1-31 speed 64
```

Note When you are using the **channel-group** *channel-no* **timeslots** *timeslot-list* **{64}** command to change the configuration of an installed card, you must enter the **no channel-group** *channel-no* **timeslots** *timeslot-list* **speed {64}** command first. Then enter the **channel-group** *channel-no* **timeslots** *timeslot-list* **{64}** command for the new configuration information.

Step 5 Exit back to global configuration mode.

```
Router(config-controller)# exit
```

Step 6 To configure the GSM-Abis interface, first specify the serial interface that you want to configure by entering the interface configuration mode.

```
Router(config)# interface serial slot/port:channel-group
```

- *slot*—Number of the slot being configured.
- *port*—Number of the port being configured.
- *channel-group*—Specifies the E1 channel group number defined with the channel-group controller configuration command.

For example, the following command enables the serial interface on HWIC-2, port 0:

```
Router(config)# interface serial 0/2:0
Router(config-if)#
```

Note To view a list of available configuration commands, enter **?** at the prompt or press the **Help** key while in the configuration mode.

Step 7 Enter the following command to configure GSM-Abis interface encapsulation in interface configuration mode.

```
Router(config-if)# encapsulation gsm-abis
```

- **gsm-abis**—Type of interface layer.

For example, the following command enables encapsulation on the GSM-Abis interface layer:

```
Router(config-if)# encapsulation gsm-abis
```

Step 8 To configure the local parameters required to establish an IP/UDP backhaul connection, enter the following command including the IP address and port you want to establish the IP/UDP backhaul connection from in the interface configuration mode.

```
Router(config-if)# gsm-abis local ip-address port
```

- *ip-address*—The IP address for the entry you wish to establish.
- **port**—The port you want to use for the entry you wish to establish.

For example, the following command configures the gsm-abis local parameters to an IP address of 10.10.10.2 located on port 5502:

```
Router(config-if)# gsm-abis local 10.10.10.2 5502
```

Step 9 To configure the remote parameters required to establish an IP/UDP backhaul connection, enter the following command including the IP address and port you want to establish the IP/UDP backhaul connection to in the interface configuration mode.

```
Router(config-if)# gsm-abis remote ip-address port
```

- *ip-address*—The IP address for the entry you wish to establish.
- *port*—The port you want to use for the entry you wish to establish.

For example, the following command configures the **gsm-abis remote** parameters to an IP address of 10.10.10.1 located on port 5502:

```
Router(config-if)# gsm-abis remote 10.10.10.1 5502
```

Step 10 Exit the interface configuration mode.

```
Router(config-if)# exit
```

Configuring SNMP Support

Use the following instructions to configure SNMP support: setting up the community access, establishing a message queue for each trap host, enabling the router to send SNMP traps, enabling SNMP traps for alarms, and enabling SNMP traps for a specific environment. You might also need to enter other configuration commands, depending on the requirements for your system configuration and the protocols you plan to route on the interface.

Note In the following procedure, press the **Return** key after each step unless otherwise noted. At any time, you can exit the privileged level and return to the user level by entering **disable** at the `Router#` prompt.

To configure a Cisco MWR 2941-DC for SNMP, follow these steps while in the global configuration mode:

Step 1 To set up the community access string to permit access to the SNMP, use the **snmp-server community** command. The **no** form of this command removes the specified community string.

```
Router(config)# snmp-server community string [view view-name] [ro | rw] [number]
```

- *string*—Community string that acts like a password and permits access to the SNMP protocol.
- **view** *view-name*—(Optional) Name of a previously defined view. The view defines the objects available to the community.
- **ro**—(Optional) Specifies read-only access. Authorized management stations are only able to retrieve MIB objects.
- **rw**—(Optional) Specifies read-write access. Authorized management stations are able to both retrieve and modify MIB objects.
- *number*—(Optional) Integer from 1 to 99 that specifies an access list of IP addresses that are allowed to use the community string to gain access to the SNMP agent.

For example, the following command sets up the community access string as xxxxx with read-only access:

```
Router(config)# snmp-server community xxxxx RO
```

Step 2 To establish the message queue length for each trap host, use the **snmp-server queue-length** command.

```
Router(config)# snmp-server queue-length length
```

- *length*—Integer that specifies the number of trap events that can be held before the queue must be emptied.

For example, the following command establishes the number of trap events to 100:

```
Router(config)# snmp-server queue-length 100
```

Step 3 To enable the router to send SNMP traps or informs (SNMP notifications), use the **snmp-server enable traps** command. Use the **no** form of this command to disable SNMP notifications.

```
Router(config)# snmp-server enable traps [notification-type] [notification-option]
```

- ***notification-type***—**snmp [authentication]**—Enables RFC 1157 SNMP notifications. Note that use of the **authentication** keyword produces the same effect as not using the **authentication** keyword. Both the **snmp-server enable traps snmp** and **snmp-server enable traps snmp authentication** forms of this command will globally enable (or, if using the **no** form, disable) the following SNMP traps:
  - authentication failure
  - linkup
  - linkdown
  - coldstart
  - warmstart

- ***notification-option***—(Optional) **atm pvc** [**interval** *seconds*] [**fail-interval** *seconds*]—The optional interval seconds keyword/argument combination specifies the minimum period between successive traps, in the range from 1 to 3600. Generation of PVC traps is dampened by the notification interval to prevent trap storms. No traps are sent until the interval lapses. The default interval is 30.

  The optional fail-interval seconds keyword/argument combination specifies the minimum period for storing the failed time stamp, in the range from 0 to 3600. The default fail-interval is 0.

  envmon [**voltage** | **shutdown** | **supply** | **fan** | **temperature**]—When the **envmon** keyword is used, you can enable a specific environmental notification type, or accept all notification types from the environmental monitor system. If no option is specified, all environmental notifications are enabled. The option can be one or more of the following keywords: **voltage**, **shutdown**, **supply**, **fan**, and **temperature**.

  isdn [**call-information** | **isdn u-interface**]—When the **isdn** keyword is used, you can specify the **call-information** keyword to enable an SNMP ISDN call information notification for the ISDN MIB subsystem, or you can specify the **isdnu-interface** keyword to enable an SNMP ISDN U interface notification for the ISDN U interface MIB subsystem.

  repeater [**health** | **reset**]—When the repeater keyword is used, you can specify the repeater option. If no option is specified, all repeater notifications are enabled. The option can be one or more of the following keywords:

  – **health**—Enables IETF Repeater Hub MIB (RFC 1516) health notification.

  – **reset**—Enables IETF Repeater Hub MIB (RFC 1516) reset notification.

For example, the following command enables traps for SNMP link down, link up, coldstart, and warmstart:

```
Router(config)# snmp-server enable traps snmp linkdown linkup coldstart warmstart
```

Step 4 To enable SNMP traps for all IP-RAN notifications, enter:

```
Router(config)# snmp-server enable traps ipran
```

Note Besides enabling SNMP traps for all IP-RAN notifications, you can also enable traps for IP-RAN GSM alarms, UMTS alarms, and general information about the backhaul utilization (see Appendix A, "Cisco MWR 2941-DC Router Command Reference" for descriptions on how to use these SNMP commands.

Step 5 To enable SNMP traps for a specific environment, enter:

```
Router(config)# snmp-server enable traps envmon
```

Step 6 To specify the recipient of an SNMP notification operation, use the **snmp-server host** command. To remove the specified host, use the **no** form of this command.

```
Router(config)# snmp-server host host-addr [traps | informs] [version {1 | 2c | 3 [auth |
noauth | priv]}] community-string [udp-port port] [notification-type]
```

- *host-addr*—Name or Internet address of the host (the targeted recipient).
- **traps**—(Optional) Send SNMP traps to this host. This is the default.
- **informs**—(Optional) Send SNMP informs to this host.
- **version**—(Optional) Version of the Simple Network Management Protocol (SNMP) used to send the traps. Version 3 is the most secure model, as it allows packet encryption with the **priv** keyword. If you use the version keyword, one of the following must be specified:

  – **1**—SNMPv1. This option is not available with informs.

  - **2c**—SNMPv2C.
  - **3**—SNMPv3. The following three optional keywords can follow the version 3 keyword:

    –**auth** (Optional). Enables Message Digest 5 (MD5) and Secure Hash Algorithm (SHA) packet authentication

    –**noauth** (Default). The noAuthNoPriv security level. This is the default if the [auth | noauth | priv] keyword choice is not specified.

    –**priv** (Optional). Enables Data Encryption Standard (DES) packet encryption (also called "privacy").

- *community-string*—Password-like community string sent with the notification operation. Though you can set this string using the **snmp-server host** command by itself, we recommend you define this string using the **snmp-server community** command before using the **snmp-server host** command.
- **udp-port** *port*—UDP port of the host to use. The default is 162.
- *notification-type*—(Optional) Type of notification to be sent to the host. If no type is specified, all notifications are sent. The notification type can be one or more of the following keywords:
  - **aaa_server**—Enable SNMP AAA Server traps.
  - **atm**—Enable SNMP atm Server traps.
  - **ccme**—Enable SNMP ccme traps.
  - **cnpd**—Enable NBAR Protocol Discovery traps.
  - **config**—Enable SNMP config traps.
  - **config-copy**—Enable SNMP config-copy traps.
  - **cpu**—Allow cpu related traps.
  - **dial**—Enable SNMP dial control traps.
  - **dnis**—Enable SNMP DNIS traps.
  - **ds0-busyout**—Enable ds0-busyout traps.
  - **ds1**—Enable SNMP DS1 traps.
  - **ds1-loopback**—Enable ds1-loopback traps.
  - **ds3**—Enable SNMP DS3 traps.
  - **dsp**—Enable SNMP dsp traps.
  - **eigrp**—Enable SNMP EIGRP traps.
  - **entity**—Enable SNMP entity traps.
  - **envmon**—Enable SNMP environmental monitor traps.
  - **flash**—Enable SNMP FLASH notifications.
  - **frame-relay**—Enable SNMP frame-relay traps.
  - **hsrp**—Enable SNMP HSRP traps.
  - **icsudsu**—Enable SNMP ICSUDSU traps.
  - **ipmulticast**—Enable SNMP ipmulticast traps.
  - **ipran**—Enable IP-RAN Backhaul traps.
  - **ipsla**—Enable SNMP IP SLA traps.
  - **isdn**—Enable SNMP isdn traps.

- **12tun**—Enable SNMP L2 tunnel protocol traps.
- **mpls**—Enable SNMP MPLS traps.
- **msdp**—Enable SNMP MSDP traps.
- **mvpn**—Enable Multicast Virtual Private Networks traps.
- **ospf**—Enable OSPF traps.
- **pim**—Enable SNMP PIM traps.
- **pppoe**—Enable SNMP pppoe traps.
- **pw**—Enable SNMP PW traps.
- **rsvp**—Enable RSVP flow change traps.
- **snmp**—Enable SNMP traps.
- **srst**—Enable SNMP srst traps.
- **syslog**—Enable SNMP syslog traps.
- **tty**—Enable TCP connection traps.
- **voice**—Enable SNMP voice traps.
- **vrrp**—Enable SNMP vrrp traps.
- **vtp**—Enable SNMP VTP traps.
- **xgcp**—Enable XGCP protocol traps.

For example, the following command specifies a recipient of the SNMP operation with a host-address of 10.20.30.40 with a version SNMP of SNMPv2C:

```
Router(config)# snmp-server host 10.20.30.40 version 2c
```

Step 7 Exit the global configuration mode.

```
Router(config)# exit
```

Configuring ATM IMA

The Inverse Multiplexing for ATM (IMA) interface feature as a shorthaul is implemented in Cisco IOS Release 12.4(19)MR2. For more information on the commands used in this section, see Appendix A, "Cisco MWR 2941-DC Router Command Reference."

Inverse multiplexing provides the capability to transmit and receive a single high-speed data stream over multiple slower-speed physical links. In inverse multiplexing over ATM (IMA), the originating stream of ATM cells is divided so that complete ATM cells are transmitted in round-robin order across the set of ATM links. IMA is supported on the Cisco T1/E1 HWIC on the Cisco MWR 2941-DC router.

Step 1 Enter the **card type** command to configure IMA on an E1 or T1 interface.

```
Router(config)# card type e1 0 0
```

Step 2 Specify the controller interface on which you want to enable IMA.

```
Router(config)# controller E1 0/4
Router(config-controller)#
```

Step 3 Set the clock source to internal.

```
Router(config-controller)# clock source internal
```

Step 4 Use the ima-group command to assign the interface to an IMA group, and set the scrambling-payload parameter to randomize the ATM cell payload frames. This command assigns the interface to IMA group 0.

```
Router(config-controller)# ima-group 0 scrambling-payload
```

Note This command automatically creates an ATM0/IMAx interface.

Step 5 To add another member link, repeat Step 1 to Step 4.

Step 6 Type **exit** to exit the controller interface.

```
Router(config-controller)# exit
Router(config)#
```

Step 7 Specify the slot location and port of IMA interface group.

```
Router(config-if)# interface ATMslot/IMA<group-number>
```

- *slot*—Specifies the slot location of the ATM IMA port adapter.
- *group-number*—Specifies the group number of the IMA group.

For example, the following command specifies the slot number as 0 and the group number as 0:

```
Router(config-if)# interface atm0/ima0
```

Note To explicitly configure the IMA group ID for the IMA interface, you may use the optional **ima group-id** command. You cannot configure the same IMA group ID on two different IMA interfaces; therefore, if you configure an IMA group ID with the system-selected default ID already configured on an IMA interface, the system toggles the IMA interface to make the user-configured IMA group ID the effective IMA group ID. At the same, the system toggles the original IMA interface to select a different IMA group ID.

Step 8 Disable the IP address configuration for the physical layer interface.

```
Router(config-if)# no ip address
```

Step 9 Specify the ATM bandwith as dynamic.

```
Router(config-if)# atm bandwith dynamic
```

Step 10 Disable the Interim Local Management Interface (ILMI) keepalive parameters.

```
Router(config-if)# no atm ilmi-keepalive
```

Note The above configuration has one IMA shorthaul with two member links (atm0/0 and atm0/1).

Configuring BFD

Bidirectional Forwarding Detection (BFD) provides a low-overhead, short-duration method of detecting failures in the forwarding path between two adjacent routers, including the interfaces, data links, and forwarding planes. BFD is a detection protocol that you enable at the interface and routing protocol levels. Cisco supports the BFD asynchronous mode, in which two routers exchange BFD control packets to activate and maintain BFD neighbor sessions. To create a BFD session, you must configure BFD on both systems (or BFD peers). Once you have enabled BFD on the interface and the router level for the appropriate routing protocols, a BFD session is created, BFD timers are negotiated, and the BFD peers begin to send BFD control packets to each other at the negotiated interval.

Configuring BFD for OSPF

This section describes how to configure BFD on the Cisco MWR 2941-DC.

Configuring BFD for OSPF on a Single Interface

Follow these steps to configure BFD for OSPF on a single interface.

Step 1 Enter enable mode.

```
Router> enable
```

Step 2 Enter the password.

```
Password: password
```

When the prompt changes to `Router`, you have entered enable mode.

Step 3 Enter global configuration mode.

```
Router# configure terminal

Enter configuration commands, one per line. End with CNTL/Z.
```

Step 4 Use the **interface** command to specify the interface you wish to configure.

```
Router(config)# interface vlan1
Router(config-if)#
```

Step 5 Use the **bfd interval** command to specify the BFD interval.

```
Router(config-if)# bfd interval milliseconds min_rx milliseconds multiplier
interval-multiplier
```

- *milliseconds*—Specifies the transmit interval between BFD packets.
- *milliseconds*—Specifies the minimum receive interval capability.
- *interval-multiplier*—Specifies the multiplier used to calculate the holddown time.

Step 6 Use the **ip ospf bfd** command to enable BFD for OSPF.

```
Router(config-if)# ip ospf bfd
```

Note You can also use the show bfd neighbors and show ip ospf commands to display troubleshooting information about BFD and OSPF.

For a sample BFD configuration, see Appendix B, "Configuration Examples."

For more information about BFD, refer to the *Cisco IOS IP Routing Protocols Configuration Guide, Release 12.4T.*

Configuring BFD for OSPF on All Interfaces

Step 1 Enter enable mode.

```
Router> enable
```

Step 2 Enter the password.

```
Password: password
```

When the prompt changes to `Router`, you have entered enable mode.

Step 3 Enter global configuration mode.

```
Router# configure terminal

Enter configuration commands, one per line. End with CNTL/Z.
```

Step 4 Use the **router ospf** ***process-id*** command to create a configuration for an OSPF process.

```
Router(config)# router ospf 100
```

Step 5 Use the **bfd all-interfaces** command to enable BFD globally on all interfaces associated with the OSPF routing process.

```
Router(config)# bfd all-interfaces
```

Note You can disable BFD on a single interface using the ip ospf bfd disable command on the relevant interface.

For a sample BFD configuration, see Appendix B, "Configuration Examples."

For more information about BFD, refer to the *Cisco IOS IP Routing Protocols Configuration Guide, Release 12.4T.*

Configuring Satellite Support in a RAN-O Network

To support the configuration of a RAN-O network when satellites are employed, you must implement a configurable jitter buffer and a tunable retransmission timer of repetitive sub-rates to overcome the network latency and satellite signal fade.

Use the following instructions to perform a GSM-Abis configuration with satellite support on the Cisco T1/E1 HWIC card with the Cisco MWR 2941-DC router. You might also need to enter other configuration commands, depending on the requirements for your system configuration and the protocols you plan to route on the interface.

Note In the following procedure, press the **Return** key after each step unless otherwise noted. At any time, you can exit the privileged level and return to the user level by entering **disable** at the `Router#` prompt.

To configure the GSM-Abis attributes with satellite support, follow these steps while in global configuration mode:

Step 1 Perform Steps 1 through 10 as described in the previous procedure (see the "Configuring GSM-Abis Links" procedure on page 4-31).

Step 2 To configure the jitter buffer, enter the following command including the value of the jitter buffer.

```
Router(config-if)# gsm-abis jitter value
```

- *ms*—The value range in milliseconds of the jitter buffer. The default is 4 ms.

For example, the following command configures the **gsm-abis jitter** buffer to 10 ms:

```
Router(config-if)# gsm-abis jitter 10
```

Step 3 To configure the tunable retransmission timer, enter the following command including the value in milliseconds to retransmit.

```
Router(config-if)# gsm-abis retransmit value
```

- *value*—The sample delay which is a value range of the retransmission of 100 ms to 5100 ms in 20 ms intervals. For example, if the value is 5, then the amount of time in ms would be calculated as 5 times 20 ms or a total of 100 ms as the retransmit time.

For example, the following command configures the **gsm-abis retransmit** timer to a value of 5 or 100 ms:

```
Router(config-if)# gsm-abis retransmit 5
```

Configuring Graceful Degradation

A local Cisco MWR 2941-DC router detects congestion on the backhaul by measuring its transmit jitter buffer level. If the transmit jitter buffer shrinks, it means that the backhaul packets are not arriving fast enough to fill the transmit jitter buffer indicating congestion. You should set the congestion abatement detection level at which a remote router will stop suppressing these timeslots.

Use the following instructions to configure graceful degradation on the Cisco MWR 2941-DC router by entering the following Cisco IOS commands at the router prompt.

You might also need to enter other configuration commands, depending on the requirements for your system configuration and the protocols you plan to route on the interface.

Note In the following procedure, press the **Return** key after each step unless otherwise noted. At any time, you can exit the privileged level and return to the user level by entering **disable** at the `Router#` prompt.

To configure graceful degradation, follow these steps while in the global configuration mode:

Step 1 Perform Steps 1 through 10 as described in the previous procedure (see the "Configuring GSM-Abis Links" procedure on page 4-31).

Step 2 To set the congestion detection algorithm to monitor the transmit jitter buffer so as to send the congestion indicator signals to the remote when the congestion is detected, enter the following command.

```
Router(config-if)# gsm-abis congestion enable
```

Step 3 To set the congestion abate detection level, enter the following command.

```
Router(config-if)# gsm-abis congestion abate ms
```

- *ms*—The value of the congestion abate in milliseconds.

For example, the following command configures the **gsm-abis congestion abate** detection level to a value 250 ms:

```
Router(config-if)# gsm-abis congestion abate 250
```

Note The abate detection level is defined as x milliseconds of continuous congestion abatement (that is, no congestion indications).

Step 4 To set the congestion onset detection level at which the remote router will start suppressing all timeslots that are not defined as critical in an effort to alleviate the congestion, enter the following command.

```
Router(config-if)# gsm-abis congestion onset ms
```

- *ms*—The value of the congestion onset in milliseconds.

For example, the following command configures the **gsm-abis congestion onset** detection level to a value 100 ms:

```
Router(config-if)# gsm-abis congestion onset 100
```

Note The onset detection level is defined as x milliseconds of continuous congestion detected.

Step 5 To define the critical timeslots that are exempt from suppression during congestion onset, enter the following command.

```
Router(config-if)# gsm-abis congestion critical timeslot-range
```

- *timeslot-range*—Specifies a value or range of values for time slots that are exempt from suppression during congestion onset. Use a hyphen to indicate a range.

For example, the following command configures the **gsm-abis congestion critical** timeslot range as 1-10:

```
Router(config-if)# gsm-abis congestion critical 1-10
```

Note These are the timeslots that contain signalling and control information exchanged between the BSC and BTS.

Configuring Link Noise Monitor

Noise on T1 and E1 links that span between the BTS and central office can affect voice quality for mobile users to the point where it becomes unacceptable. To monitor the quality of individual links in a multilink bundle, you can configure the Link Noise Monitor (LNM) on your Cisco MWR 2941-DC router.

The LNM detects, alerts, and removes noisy links from a bundle based on user-defined thresholds and durations. In addition, the LNM notifies the operator once the quality of the line has improved, and restores the link service if the link has been removed.

To detect noise on a link, the LNM monitors the following two types of errors which make up the Bit Error Rate (BER) and compares the number of errors with the user-defined thresholds:

- Line Code Violation (LCV)—A Bi-Polar Violation (BPV) or Excessive Zeroes (EXZ) error has occurred.
- Path Code Violation (PCV)—A Cyclic Redundancy Check (CRC) error, which is generally caused by one or more LCV or logic errors, has occurred in a time slot.

The LNM provides the following types of noise monitors:

- Link Warning—Issues a warning when the noise level of a link exceeds a user-defined threshold and notifies the operator when the noise level improves to the point that it drops below a second user-defined threshold.
- Link Removal—Issues an error and removes a link from service when the noise level of the link exceeds a user-defined threshold and restores the link and provides notification when the noise level improves to the point that it drops below a second user-defined threshold.

Note If the noise level on the last active link in a multilink bundle exceeds the Link Removal threshold, an alert is issued but the link will not be removed from service. If this situation occurs, the standard T1 error rate is used to determine if the last active link must be removed from service.

To configure the LNM feature, issue the **span** command from controller configuration mode of each T1 or E1 link in the bundle that you want to monitor. To disable LNM on a link, issue the **no** version of the command from controller configuration mode of the link.

span { **warn** | **remove** } [{ [**lcv** *value* [**pcv** *value*]] [**duration** *seconds*] } **set** | **clear**]

where:

- **warn**—Enables Link Warning monitoring on the link.
- **remove**—Enables Link Removal monitoring on the link.
- **lcv** *value*—Threshold (in bit errors per second) that when exceeded for the configured duration when the **set** keyword has been specified, creates a condition (warning or link removal), or when fallen below for the configured duration when the **clear** keyword has been specified, clears the condition.

  For T1 links:

  - Valid range is 5 to 1544.
  - For Link Warning monitoring, the default is 15.
  - For Link Removal monitoring, the default is 154.

  For E1 links,

  - Valid range is 7 to 2048.
  - For Link Warning monitoring, the default is 20.
  - For Link Removal monitoring, the default is 205.
- **pcv** *value*—Number of time slots in errors per second. If not specified by the user, this value is calculated from the LCV threshold based on a Gaussian distribution that matches typical noise-induced errors.

  For T1 links:

  - Valid range is 3 to 320.
  - For Link Warning monitoring, the default is 15.
  - For Link Removal monitoring, the default is 145.

  For E1 links,

  - Valid range is 8 to 832.
  - For Link Warning monitoring, the default is 20.

  - For Link Removal monitoring, the default is 205.

- **duration** *seconds*—Number of seconds that a threshold must be exceeded to create a condition or fallen below to clear a condition. Valid range is 1 to 600. The default is 10.

  When specified with th**e lcv** keyword, the duration must be configured after the LCV threshold. For example, **span warn lcv 55 duration 20** is a correct way to issue the command; s**pan warn duration 20 lcv 55** is not.

- **set**—Specifies that the values configured for the **span** command are to be used to set a condition.
- **clear**—Specifies that the values configured for the **span** command are to be used to clear a condition.

Usage Notes

When configuring the LNM, please note the following:

- If the **warn** and **remove** keywords are specified without any other options, the LCV and PCV thresholds and duration defaults will be used to determine (**set**) and clear (**clear**) the condition.
- If the **span** command is issued with the **set** keyword specified (defining the LNM type and parameters to use to determine a condition exists) and the command is not issued again with the **clear** keyword specified (defining the parameters used to clear a condition), or vice versa, the values configured for the threshold and duration will be used for both.
- If the **span** command is issued without either the **set** or **clear** keywords specified, **set** is the default.
- The **set** and **clear** keywords can only be specified if the threshold and/or duration has been specified.
- If the PCV threshold is not configured (using the **pcv** keyword and value), the threshold is calculated using Gaussian probability distribution that is representative of most noise environments.
- The following SYSLOG messages have been added for fault notification:

```
- %LNM-4- WARNEXCEED:Controller <Controller IF>, exceeded noise warning threshold
  <int>, duration <int>
- %LNM-4- WARNIMPROVE:Controller <Controller IF>, noise improved below threshold
  <int>, duration <int>
- %LNM-2-REMOVE:Interface <Serial IF> removed, noise exceeded threshold <int>,
  duration <int>
- %LNM-2- RESTORE:Interface <Serial IF> restored, noise improved below threshold
  <int>, duration <int>
- %LNM-2- REMEXCEED:Interface <Serial IF>, noise exceeded threshold <int>,
  duration <int>
- %LNM-2- REMIMPROVE:Interface <Serial IF>, noise improved below threshold <int>,
  duration <int>
```

Saving Configuration Changes

After you have completed configuring your Cisco MWR 2941-DC router, to prevent the loss of the router configuration, you must store the configuration changes by saving it to NVRAM so that the router boots with the configuration you entered.

Step 1 Exit the global configuration mode.

```
Router(config)# exit
```

Tip To return immediately to enable mode (`Router#`), press **Ctrl-Z** in any mode instead of entering **exit**, which returns you to the mode you were in previously.

Step 2 Save the configuration changes to NVRAM so that they are not lost during resets, power cycles, or power outages.

```
Router# copy running-config startup-config
```

Monitoring and Managing the Cisco MWR 2941-DC Router

The following sections describe how to monitor and manage the Cisco MWR 2941-DC.

- Using Cisco Mobile Wireless Transport Manager (MWTM)
- Enabling the Cisco MWR 2941-DC Router for Remote Network Management
- Show Commands for Monitoring the Cisco MWR 2941-DC Router

Using Cisco Mobile Wireless Transport Manager (MWTM)

You can use Cisco network management applications, such as Cisco Mobile Wireless Transport Manager (MWTM), to monitor and manage the Cisco MWR 2941-DC. This Network Management tool provides monitoring and management capabilities to the RAN-O solution. The Cisco MWTM addresses the element-management requirements of mobile operators and provides fault, configuration, and troubleshooting capability. The Cisco MWTM provides the following key features:

- Event Monitoring
- Web-Based Reporting
- Autodiscovery and Topology
- Inventory
- OSS Integration
- Security
- Client/Server Architecture
- Multiple OS Support

The Cisco MWTM integrates with any SNMP-based monitoring system, such as Cisco Info Center products. In addition, the Cisco MWTM collects a large amount of performance data that can be exported or directly accessed from the database. This data can then be used by performance reporting applications. For more information about MWTM, see http://www.cisco.com/en/US/products/ps6472/tsd_products_support_series_home.html.

Enabling the Cisco MWR 2941-DC Router for Remote Network Management

To enable remote network management of the Cisco MWR 2941-DC, do the following:

Step 1 At the privileged EXEC prompt, enter the following command to access the configuration mode:

```
Router# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#
```

Step 2 At the configuration prompt, enter the following command to assign a host name to each of the network management workstations:

```
Router(config)# ip host hostname ip_address
```

Where *hostname* is the name assigned to the Operations and Maintenance (O&M) workstation and *ip_address* is the address of the network management workstation.

Step 3 Enter the following commands to create a loopback interface for O&M (see the "Configuring Gigabit Ethernet Interfaces" section on page 4-4 for more information):

```
Router(config)# interface loopback number
Router(config-if)# ip address ip_address subnet_mask
```

Step 4 Exit interface configuration mode:

```
Router(config-if)# exit
```

Step 5 At the configuration prompt, enter the following command to specify the recipient of a Simple Network Management Protocol (SNMP) notification operation:

```
Router(config)# snmp-server host hostname [traps | informs] [version {1 | 2c | 3 [auth |
noauth | priv]}] community-string [udp-port port] [notification-type]
```

Where *hostname* is the name assigned to the Cisco Info Center workstation with the **ip host** command in Step 2.

Note See the "Configuring SNMP Support" section on page 4-33 for more information about configuring Steps 5 through 8 in this procedure.

Step 6 Enter the following commands to specify the public and private SNMP community names:

```
Router(config)# snmp-server community public RO
Router(config)# snmp-server community private RW
```

Step 7 Enter the following command to enable the sending of SNMP traps:

```
Router(config)# snmp-server enable traps
```

Step 8 Enter the following command to specify the loopback interface from which SNMP traps should originate:

```
Router(config)# snmp-server trap-source loopback number
```

Where *number* is the number of the loopback interface you configured for the O&M in Step 3.

Step 9 At the configuration prompt, press **Ctrl-Z** to exit configuration mode.

Step 10 Write the new configuration to nonvolatile memory as follows:

```
Router# copy running-config startup-config
```

Show Commands for Monitoring the Cisco MWR 2941-DC Router

To monitor and maintain the Cisco MWR 2941-DC router, use the following commands:

Command	Purpose
show atm cell-packing	Information about Layer 2 transport ATM cell-packing.
show cem circuit	Summary about the CEM circuit state, including controller, interface, and AC. Also displays specific CEM circuit state, circuit parameters, and statistics/counters.
show cem platform	CEM errors and information.
show controllers	All network modules and their interfaces. Also displays the status of the VWIC relays when a VWIC is installed.
show controllers gigabitethernet *slot/port*	Information about initialization block, transmit ring, receive ring, and errors for the Fast Ethernet controller chip.
show controllers e1	Information about controller status specific to the controller hardware. Also displays statistics about the E1 link. If you specify a slot and a port number, statistics for each 15-minute period appears.
show controllers t1	Information about cable length, framing, firmware, and errors associated with the T1. With the Cisco MWR 2941-DC router, this command also shows the status of the relays on the VWIC.
show gsm traffic	Traffic rates in bits per second at 1 second, 5 seconds, 1 minute, 5 minutes, and 1 hour intervals for GSM data transmitted and received over the backhaul.
show gsm-abis efficiency [history]	The history of the GSM efficiency averages for compression/decompression at 1-second, 5-second, 1-minute, 5-minute, and 1-hour intervals.
show gsm-abis errors	Error statistics counters of the GSM for compression/decompression.
show gsm-abis packets	Packet statistics counters of the GSM for compression/decompression.
show gsm-abis peering [details]	Peering status, statistics, and history of the GSM compression/decompression.
show interface *type slot/port*	Configuration and status of the specified interface.
show interface virtual-cem *slot/port*	Displays the status of the CEM interface.
show interface gigabitethernet *slot/port*	Status of the FE interface.

Command	Purpose
show ip rtp header-compression	RTP header compression statistics.
show mpls l2transport vc	Information about Any Transport over MPLS (AToM) virtual circuits (VCs) that are enabled to route Layer 2 packets on a router.
show network-clocks	Network clocking configuration.
show platform hardware	Displays the status of hardware devices on the Cisco MWR 2941-DC router.
show ppp multilink	MLP and multilink bundle information.
show ppp multilink interface *number*	Multilink information for the specified interface.
show protocols	Protocols configured for the router and the individual interfaces.
show ptp clock	Displays ptp clock information.
show ptp foreign-master-record	Displays PTP foreign master records.
show ptp parent	Displays PTP parent properties.
show ptp port	Displays PTP port properties.
show ptp time-property	Displays PTP clock time properties.
show xconnect all	xconnect information.