Configuring Link Aggregation Group and Link Aggregation Control Protocol

This chapter describes Link Aggregation Group, Link Aggregation Control Protocol, and manual load balancing. This chapter also describes the configuration procedures.

This chapter includes the following topics.

Understanding IEEE 802.3ad Link Bundling

The IEEE 802.3ad Link Bundling feature provides a method for aggregating multiple Ethernet links into a single logical channel based on the IEEE 802.3ad standard. This feature helps improve the cost effectiveness of a device by increasing cumulative bandwidth without necessarily requiring hardware upgrades. In addition, the IEEE 802.3ad Link Bundling feature provides a capability to dynamically provision, manage, and monitor various aggregated links and enables interoperability between various Cisco devices and devices of third-party vendors.

Benefits of Link Bundling

The IEEE 802.3ad Link Bundling feature provides the following benefits:

• Increased network capacity without changing physical connections or upgrading hardware.

• Cost savings resulting from use of existing hardware and software for additional functions.

• A standard solution that enables interoperability of network devices.

• Port redundancy without user intervention when an operational port fails.

Link Aggregation Group and Link Aggregation Control Protocol Configuration Procedures

The following procedures can be performed using Cisco IOS commands to configure Link Aggregation Group (LAG) and Link Aggregation Control Protocol (LACP):

The following procedures can be performed using CTC to configure LAG and LACP:

Understanding LACP

The LACP is part of the IEEE802.3ad standard that enables you to bundle several physical ports together to form a single logical channel. LACP enables a network device, such as a switch, to negotiate an automatic bundling of links by sending LACP packets to the peer device. The LACP is a control protocol over LAG to check for any LAG misconfigurations.

LACP enables you to form a single Layer 2 link automatically from two or more Ethernet links. This protocol ensures that both ends of the Ethernet link are functional and agree to be members of the aggregation group. LACP must be enabled at both ends of the link to be operational.

For more information on LACP, see the IEEE802.3ad standard document.

LACP Advantages

LACP provides high reliability and redundancy. If a port fails, traffic continues on the remaining ports.

LACP Functions

LACP performs the following functions in the system:

- Maintains configuration information to control aggregation.
- Exchanges configuration information with other peer devices.
- Attaches or detaches ports from the LAG based on the exchanged configuration information.

LACP Modes

LACP can be configured in the following modes:

- Active—In this mode, the ports send LACP packets at regular intervals to the partner ports.
- Passive—In this mode, the ports do not send LACP packets until the partner port sends LACP packets. After receiving the LACP packets from the partner port, the ports send LACP packets to the partner port.

Note When you enable LACP on the channel group, LACP exchanges Protocol Data Units (PDU) of size 128 bytes. Hence, if the Maximum Transmission Unit (MTU) size of the channel group is set to a value less than 128 bytes, the protocol data units are dropped and the channel group interface goes down.

NTP-J2 Manage LACP

Purpose	This procedure configures LACP and monitors LACP status.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Perform any of the following procedures as needed:

Stop. You have completed this procedure.

DLP-J5 Configure and Retrieve a Port Channel Using Cisco IOS Commands

Purpose	This procedure configures and retrieves a port channel using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Note   You must manually create a port channel logical interface. Configuring the IP address on the port channel interface is not supported.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** Router> enable	Enables privileged EXEC mode. - Enter your password if prompted.
Step 2	**configure terminal** **Example:** Router# configure terminal	Enters global configuration mode.
Step 3	**interface port-channel** *channel-number* **Example:** Router(config)# interface port-channel 10	Identifies the interface port channel and enters interface configuration mode.
Step 4	**end** **Example:**	Returns to privileged EXEC mode.

	Command or Action	Purpose
	Router(config-if)# end	
Step 5	**show running-config interface port-channel** *channel-number* **Example:** Router# show running-config interface port-channel 10	Displays the port channel configuration.
Step 6	**end** **Example:** Router# end	Ends the current configuration session.
Step 7	Return to your originating procedure (NTP).	—

Example: Verify the Port Channel Configuration

The following example shows how to verify the port channel configuration using Cisco IOS commands.

Router# **show running-config interface port-channel 100**

```
Building configuration...

Current configuration : 139 bytes
!
interface Port-channel100
 no ip address
 carrier-delay msec 0
 l2protocol peer cdp lacp
 l2protocol forward stp vtp dtp pagp dot1x
end
```

DLP-J6 Configure LACP over Port Channel Using Cisco IOS Commands

Purpose	This procedure configures LACP using port channel using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** Router> enable	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** Router# configure terminal	Enters global configuration mode.
Step 3	**interface port-channel** *channel-number* **Example:** Router(config)# interface port-channel 10	Identifies the interface port channel and enters interface configuration mode.
Step 4	**exit** **Example:** Router(config-if)# exit	Returns to interface configuration mode.
Step 5	**interface** *type number* **Example:** Router(config)# interface TenGigabitEthernet 4/1	Specifies the interface to configure and enters interface configuration mode.
Step 6	**channel-group** *channel-number* **mode {active | passive}** **Example:** Router(config-if)# channel-group 10 mode active	Configures the interface in a channel group and sets the lacp mode.
Step 7	**exit** **Example:** Router(config-if)# exit	Returns to privileged EXEC mode.
Step 8	Return to your originating procedure (NTP).	—

DLP-J7 Monitor LACP Status Using Cisco IOS Commands

Purpose	This procedure monitors LACP activity in the network using Cisco IOS commands.
Tools/Equipment	None

Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

For examples of **show lacp** commands, see .

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** Router> enable	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**show lacp** {*channel-group-number* | **counters** | **internal [detail]** | **neighbor [detail]** | **sys-id**} **Example:** Router# show lacp internal	Displays LACP information.
Step 3	**end** **Example:** Router# end	Ends the current configuration session.
Step 4	Return to your originating procedure (NTP).	—

Understanding LACP Priority

LACP uses the following parameters to control aggregation:

• LACP system priority—The system priority can be configured automatically or through the CLI. LACP uses the system priority with the device MAC address to form the system ID and also during negotiations with other systems. The range of LACP system priority is from 0 to 65535. The default value is 32768.

• LACP port priority—The port priority can be configured automatically or through the CLI. LACP uses the port priority to decide which ports must be placed first in aggregation. LACP also uses the port priority with the port number to form the port identifier. The range of LACP port priority is from 0 to 65535. The default value is 32768.

• LACP administrative key—LACP automatically configures an administrative key value on each port configured to use LACP. The administrative key defines the ability of a port to aggregate with other ports. The ability of the port to aggregate with the other ports is determined by the following:

◦ Port physical characteristics such as data rate, duplex capability, and point-to-point or shared medium.

◦ Configuration restrictions that you establish.

NTP-J3 Set LACP Priority

Purpose	This procedure sets LACP priority.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Perform any of the following procedures as needed:

Stop. You have completed this procedure.

DLP-J8 Set LACP System Priority Using Cisco IOS Commands

Purpose	This procedure sets the LACP system priority using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** Router> enable	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** Router# configure terminal	Enters global configuration mode.
Step 3	**lacp system–priority** *priority* **Example:** Router(config)# lacp system-priority 200	Sets the system priority. The range of the LACP system priority is from 0 to 65535. The default value is 32768.
Step 4	**end** **Example:** Router(config)# end	Returns to privileged EXEC mode.
Step 5	**show lacp** {*channel-group-number* | **counters** | **internal [detail]** | **neighbor [detail]** | **sys-id**} **Example:** Router# show lacp sys-id	Displays the LACP information.
Step 6	**end** **Example:** Router# end	Ends the current configuration session.
Step 7	Return to your originating procedure (NTP).	—

DLP-J9 Set LACP System Priority Using CTC

Purpose	This procedure sets LACP system priority using CTC.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Step 1	Complete the NTP-J22 Log into CTC procedure at a node where you want to set the LACP system priority.
Step 2	From the View menu, choose **Go to Home View**.
Step 3	Right–click the fabric or line card and choose **Open Packet Transport System View**. The Packet Transport System View dialog box appears.
Step 4	Click the **Provisioning** tab.
Step 5	From the left pane, click **LACP**.
Step 6	Enter the priority in the System Priority field. The range of the LACP system priority is from 0 to 65535. The default value is 32768.
Step 7	Click **Apply** to set the LACP system priority.
Step 8	Return to your originating procedure (NTP).

Understanding LACP 1:1 Redundancy

The LACP 1:1 redundancy feature provides an EtherChannel configuration with one active link and fast switchover to a hot standby link.

To use the LACP 1:1 redundancy feature, configure the LACP EtherChannel with two ports (one active and one standby). If the active link goes down, the EtherChannel stays up and the system performs fast switchover to the hot standby link. When the failed link becomes operational again, the EtherChannel performs another fast switchover to revert to the original active link.

For the LACP 1:1 redundancy feature to work correctly, especially the fast switchover capability, the feature needs to be enabled at both ends of the link.

NTP-J4 Configure LACP 1:1 Redundancy with Fast Switchover Using Cisco IOS Commands

Purpose	This procedure configures LACP 1:1 redundancy with fast switchover using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

For the LACP 1:1 redundancy feature, the channel group must contain two links, of which only one is active. The link with the lower port priority number (and therefore a higher priority) will be the active link, and the other link will be in a hot standby state. The maximum number of active member ports (**lacp max–bundle**) must be set to 1.

Procedure

	Command or Action	**Purpose**
Step 1	**enable** **Example:** Router> enable	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** Router# configure terminal	Enters global configuration mode.
Step 3	**interface port-channel** *channel-number* **Example:** Router(config)# interface port-channel 10	Identifies the interface port channel and enters interface configuration mode.
Step 4	**lacp fast-switchover** **Example:** Router(config-if)# lacp fast-switchover	Enables the fast switchover feature for this channel group.
Step 5	**lacp max-bundle** *number* **Example:** Router(config-if)# lacp max-bundle 1	Sets the maximum number of active member ports in the channel group to 1.
Step 6	**end** **Example:** Router(config-if)# end	Returns to privileged EXEC mode.
Step 7	**show running-config interface port-channel** *channel-number* **Example:** Router# show running-config interface port-channel 10	Displays the port channel configuration.
Step 8	**end** **Example:** Router# end	Ends the current configuration session.

Example: Configure LACP 1:1 Redundancy with Fast Switchover

The following example shows how to configure the LACP channel group with 1:1 redundancy using Cisco IOS commands. Because the Ten Gigabit Ethernet port 4/1 is configured with a higher port priority number (and therefore a lower priority) than the default value of 32768, it will be the standby port.

```
Router> enable
Router# configure terminal
Router(config)# lacp system-priority 33000
Router(config)# interface TenGigabitEthernet4/1
Router(config-if)# channel-group 1 mode active
Router(config)# interface TenGigabitEthernet4/1
Router(config-if)# lacp port-priority 33000
Router(config)# interface port-channel 1
Router(config-if)# lacp fast-switchover
Router(config-if)# lacp max-bundle 1
Router(config-if)# end
Router(config)# show run interface port-channel 1
```

Understanding LAG

The LAG or an EtherChannel, bundles individual Ethernet links into a single logical link that provides the aggregate bandwidth of up to eight physical links. When an Ethernet Flow Point is configured on LAG, the EFP is protected against link failures.

When a link within an EtherChannel fails, the traffic previously carried over the failed link switches to the remaining links within that EtherChannel.

LAG supports manual load balancing and platform default load balancing. LAG supports Ethernet services. LAG can be an attachment circuit for MPLS services.

The LACP is a control protocol that is supported on the LAG.

Restrictions of LAG in CPT

The following restrictions apply to LAG in CPT:

- All the member links of LAG must be connected to the same CPT system and must be of the same interface type (10GE or 1GE). For example, one member link can be present in one CPT 50 and another member link can be present in another CPT 50. These two CPT 50 panels must be connected to the same CPT system.

- All the member links of LAG must operate at the same link speed and in full-duplex mode. LACP does not support the half-duplex mode.

- If you configure a physical port as part of LAG, you cannot configure Ethernet Virtual Circuits (EVCs) under that physical port.

- The number of LAGs supported in the CPT system is 128 with 8 member links per LAG. A member link cannot belong to more than one LAG at the same time.

NTP-J5 Manage a Channel Group

Purpose	This procedure manages a channel group.

Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Perform any of the following procedures as needed:

Stop. You have completed this procedure.

DLP-J11 Configure a Channel Group with LACP Using Cisco IOS Commands

Purpose	This procedure configures a channel group with LACP using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

	Command or Action	Purpose
Step 1	enable Example:	Enables privileged EXEC mode. Enter your password if prompted.

	Command or Action	Purpose
	Router> enable	
Step 2	**configure terminal** **Example:** Router# configure terminal	Enters global configuration mode.
Step 3	**interface port-channel** *channel-number* **Example:** Router(config)# interface port-channel 5	Identifies the interface port channel.
Step 4	**interface** *type number* **Example:** Router(config)# interface TenGigabitEthernet 4/1	Configures a member interface and enters interface configuration mode.
Step 5	**channel-group** *channel-number* **mode** {**active** | **passive**} **Example:** Router(config-if)# channel-group 5 mode active	Configures the channel group with the LACP.
Step 6	**exit** **Example:** Router(config-if)# exit	Returns to privileged EXEC mode.
Step 7	Return to your originating procedure (NTP).	—

Example: Configure a Channel Group with LACP

The following example shows how to configure the channel group number 5 using Cisco IOS commands.

```
Router> enable
Router# configure terminal
Router(config)# interface port-channel5
Router(config)# interface TenGigabitEthernet 7/1
Router(config-if)# channel-group 5 mode active
Router(config-if)# exit
```

DLP-J12 Configure a Channel Group Without LACP Using Cisco IOS Commands

Purpose	This procedure configures a channel group without LACP using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	None

Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** Router> enable	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** Router# configure terminal	Enters global configuration mode.
Step 3	**interface port-channel** *channel-number* **Example:** Router(config)# interface port-channel 5	Identifies the interface port channel.
Step 4	**interface** *type number* **Example:** Router(config)# interface TenGigabitEthernet 4/1	Configures a member interface and enters interface configuration mode.
Step 5	**channel-group** *channel-number* **link** *link-id* **Example:** Router(config-if)# channel-group 5 link 1	Configures the channel group without using LACP.
Step 6	**exit** **Example:** Router(config-if)# exit	Returns to privileged EXEC mode.
Step 7	Return to your originating procedure (NTP).	—

Example: Configure a Channel Group Without Using LACP

The following example shows how to configure the channel group number 5 using Cisco IOS commands.

```
Router> enable
Router# configure terminal
Router(config)# interface port-channel5
Router(config)# interface TenGigabitEthernet 7/1
Router(config-if)# channel-group 5 link 1
Router(config-if)# exit
```

DLP-J13 Add and Remove Interfaces from a Channel Group Using Cisco IOS Commands

Purpose	This procedure adds and removes interfaces from a channel group using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	DLP-J5 Configure and Retrieve a Port Channel Using Cisco IOS Commands, on page 4
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** Router> enable	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** Router# configure terminal	Enters global configuration mode.
Step 3	**interface** *type number* **Example:** Router(config)# interface TenGigabitEthernet 4/1	Configures a member interface and enters the interface configuration mode.
Step 4	**channel-group** *channel-group-number* **mode {active | passive}** **Example:** Router(config-if)# channel-group 5 mode active	Adds a Ten Gigabit Ethernet interface to a channel group.
Step 5	**no channel-group** **Example:** Router(config-if)# no channel-group	Removes the Ten Gigabit Ethernet interface from the channel group.

	Command or Action	Purpose
Step 6	**exit** **Example:** Router(config-if)# exit	Returns to privileged EXEC mode.
Step 7	Return to your originating procedure (NTP).	—

Example: Add and Remove Interface from a Channel Group

The following example shows how to add an interface to a channel group using Cisco IOS commands:

```
Router> enable
Router# configure terminal
Router(config)# interface TenGigabitEthernet 5/0
Router(config-if)# channel-group 5 mode active
Router(config-if)# exit
```

The following example shows how to remove an interface from a channel group using Cisco IOS commands:

```
Router> enable
Router# configure terminal
Router(config)# interface TenGigabitEthernet 5/0
Router(config-if)# no channel-group
Router(config-if)# exit
```

DLP-J14 Set a Minimum and Maximum Threshold of Active Links Using Cisco IOS Commands

Purpose	This procedure sets a minimum and maximum threshold of active links allowed in the LACP bundle using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** Router> enable	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** Router# configure terminal	Enters global configuration mode.
Step 3	**interface** *port-channel channel-number* **Example:** Router(config)# interface port-channel 1	Creates a port channel virtual interface and enters interface configuration mode.
Step 4	**lacp min-bundle** *min-bundle-number* **Example:** Router(config-if)# lacp min-bundle 5	Sets the minimum threshold of active member links allowed in the LACP bundle. The range is 1 to 8.
Step 5	**lacp max-bundle** *max-bundle-number* **Example:** Router(config-if)# lacp max-bundle 7	Sets the maximum threshold of active member links allowed in the LACP bundle. The range is 1 to 8. The maximum threshold value must be greater than or equal to the minimum threshold value.
Step 6	**end** **Example:** Router(config-if)# end	Returns to privileged EXEC mode.
Step 7	Return to your originating procedure (NTP).	—

Set a Minimum Threshold of Active Links

The following example shows how to set a minimum threshold of active member links using Cisco IOS commands:

```
Router> enable
Router# configure terminal
Router(config)# interface port-channel 1
Router(config-if)# lacp min-bundle 5
Router(config-if)# end
```

DLP-J15 Create a Channel Group Using CTC

Purpose	This procedure creates a channel group using CTC.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Step 1 Complete the NTP-J22 Log into CTC procedure at a node where you want to create a channel group.

Step 2 From the View menu, choose **Go to Home View**.

Step 3 Right-click the fabric or line card and choose **Open Packet Transport System View**. The Packet Transport System View dialog box appears.

Step 4 Click the **Provisioning** tab.

Step 5 In the left pane, click **Channel Groups**.

Step 6 Click **Create**. The Channel Group Creation dialog box appears.

Step 7 Enter the name of the channel group in the Name field.

Step 8 From the ID drop-down list, choose an ID for this channel group. The IDs range from 1 to 128.

Step 9 From the Standalone list, choose the ports that will belong to this channel group and click the right arrow button to move the selected ports to the Bundled list.

Step 10 To create a channel group by configuring LACP:

   a) Check the **LACP** check box to configure the channel group using LACP.

   b) Enter the MTU value in the MTU field. The default value is 9600.

   c) Check the **Remote Link Failure Notify** check box to enable the remote link failure notify feature for this channel group.

   d) Enter the minimum number of ports that need to be active for the channel group in the Minimum bundle field. The default value is 1.

   e) Enter the maximum number of ports to be bundled in a channel group in the Maximum bundle field. The default value is 8.

   f) Check the **Fast Switchover** check box to enable the fast switchover feature for this channel group.

   g) Click **Configure/Edit** in the Port LACP area of the port to configure the LACP mode for each port. The LACP Configuration dialog box appears.
The Port column lists all the ports that are added to the channel group.

      • From the LACP Config drop-down list, choose **Active** or **Passive** for each port.

      • Enter the LACP priority in the Priority field for each port. The default value is 32768. The range of LACP port priority is from 0 to 65535.

• Click **Apply**.

h) Click **Configure/Edit** in the Layer 2 action area to configure the actions for each Layer 2 protocol. The L2 Protocol Config dialog box appears.

• From the Action drop-down list, choose **Drop**, **Forward**, or **Peer** for each Layer 2 protocol.

• Click **Apply**.

i) Click **Create**. A new channel group is added in the Channel Group table.

Step 11 To create a channel group without configuring LACP:

a) Enter the MTU value in the MTU field. The default value is 9600.

b) Click **Configure/Edit** in the Layer 2 action area to configure the actions for each Layer 2 protocol. The L2PT Config dialog box appears.

• From the Action drop-down list, choose **Drop**, **Forward**, or **Peer** for each Layer 2 protocol.

• Click **Apply**.

c) Click **Create**. A new channel group is added in the Channel Group table.

Step 12 To delete a channel group, choose a channel group and click **Delete**.

Step 13 Return to your originating procedure (NTP).

DLP-J16 Edit a Channel Group Using CTC

Purpose	This procedure edits a channel group using CTC.
Tools/Equipment	None
Prerequisite Procedures	DLP-J15 Create a Channel Group Using CTC, on page 19
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Step 1 Complete the NTP-J22 Log into CTC procedure at a node where you want to edit a channel group.

Step 2 From the View menu, choose **Go to Home View**.

Step 3 Right-click the fabric or line card and choose **Open Packet Transport System View**. The Packet Transport System View dialog box appears.

Step 4 Click the **Provisioning** tab.

Step 5 In the left pane, click **Channel Groups**.

Step 6 Choose a channel group from the existing channel groups.

Step 7 Click **Edit**. The Edit Channel Group dialog box appears.
You can modify all the parameters of the channel group except the name and ID.

Step 8 To add ports to an existing channel group, choose the required ports from the Standalone list. Click the right arrow button to move the selected ports to the Bundled list.

Step 9 To remove ports from an existing channel group, choose the required ports from the Bundled list. Click the left arrow button to move the selected ports to the Standalone list.

Step 10 Modify the other parameters of the channel group, such as LACP mode of the channel group, soak time, minimum bundle, maximum bundle, LACP mode of ports, and Layer 2 action configuration as required.

Step 11 Click **Apply** to edit the channel group.

Step 12 Return to your originating procedure (NTP).

Understanding Load Balancing

Manual load balancing enables you to manually specify which member link a service instance must use for its egress traffic. This allows you, who has knowledge about the type of traffic traversing an EFP, to equally distribute EFPs.

Note The ingress traffic for any EFP can arrive on any member link of the LAG. All the egress traffic for the EFP must use only one of the member links.

EFPs can be configured on a channel group. The traffic, carried by the EFPs, is load balanced across the member links. Ingress traffic for a single EVC can arrive on any member of the bundle. All egress traffic for an EFP uses only one of the member links. The load balancing is achieved by distributing EFPs between the member links. The EFPs on a channel group are grouped and each group is associated with a member link. The manual load balancing mechanism can be used to control the EFP grouping.

Note CPT supports manual load balancing and platform default load balancing. CPT does not support weighted load balancing in this release. When manual load balancing is not configured and applied to the service instance, the default platform load balancing mechanism is used.

Default Load Balancing

In the default load balancing mechanism, the EFP traffic is distributed based on a hashing algorithm that is determined by the service instance ID and the number of active members in the channel group. The default load balancing algorithm is explained below.

(Service-instance ID) ÷ max_num_links

The maximum number of member links (max_num_links) supported in CPT is 8. Hence, (Service-instance ID) ÷ max_num_links value provides a hash bit value from 0 to 7. This value is then compared with the load share of each member link.

The load share is allocated for each active member link based on the number of active member links in the channel group. The member link whose load share contains the hash bit is selected as the egress link.

The load share derivation is as follows:

The default load share allocation algorithm allocates the load share bits sequentially to the member links.

Let us consider that we have 4 active links as follows. The load share calculation varies based on the link ids defined.

Member-1:4/1- 0 0 0 1 0 0 0 1 = 0x11

Member-2:4/2- 0 0 1 0 0 0 1 0 = 0x22

Member-3:4/3- 0 1 0 0 0 1 0 0 = 0x44

Member-4:4/4- 1 0 0 0 1 0 0 0 = 0x88

1   Create a channel group and add 4 member links (4/1, 4/2, 4/3, and 4/4)

2   The load share is calculated for the active member links.

3   Create a service with id 10 on the channel group. In CTC, the service instance id is automatically generated and can be obtained from the configuration pane (Layer-2 -> Carrier Ethernet).

4   On applying the algorithm: (Service-instance ID) ÷ max_num_links, we get 10 ÷ 8 == 2 (hash bit).

5   In the loadshare derived above, the hash bit = 2 is set for the port 4/3 and hence 4/3 is chosen as the egress port for the service 10.

6   The same procedure is repeated when services are added to obtain the egress port.

NTP-J6 Configure Manual Load Balancing

Purpose	This procedure configures manual load balancing.
Tools/Equipment	None
Prerequisite Procedures	None
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Perform any of the following procedures as needed:

- • DLP-J17 Configure Manual Load Balancing Using Cisco IOS Commands, on page 23
- • DLP-J18 Configure Manual Load Balancing Using CTC, on page 25

Stop. You have completed this procedure.

DLP-J17 Configure Manual Load Balancing Using Cisco IOS Commands

Purpose	This procedure configures manual load balancing on the member links of the LAG using Cisco IOS commands.
Tools/Equipment	None
Prerequisite Procedures	DLP-J11 Configure a Channel Group with LACP Using Cisco IOS Commands, on page 13
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

	Command or Action	Purpose
Step 1	enable **Example:** Router> enable	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	configure terminal **Example:** Router# configure terminal	Enters global configuration mode.
Step 3	interface *type number* **Example:** Router(config)# interface port-channel 10	Creates a port channel virtual interface and enters interface configuration mode.

	Command or Action	**Purpose**
Step 4	**service instance** *id* **ethernet** **Example:** Router(config-if)# service instance 100 ethernet	Configures an Ethernet service instance on an interface and enters service instance configuration mode.
Step 5	**encapsulation untagged, dot1q** {**any** | *vlan-id*} **second-dot1q** {**any** | *vlan-id*} **Example:** Router(config-if-srv)# encapsulation dot1q 100	Defines the matching criteria that maps the ingress dot1q, QinQ, or untagged frames on an interface to the appropriate service instance.
Step 6	**bridge-domain** *bridge-id* **Example:** Router(config-if-srv)# bridge-domain 100	Binds the Ethernet service instance to a bridge domain instance where bridge-id is the identifier for the bridge domain instance.
Step 7	**exit** **Example:** Router(config-if-srv)# exit	Exits the service instance configuration mode.
Step 8	**port-channel load-balance** {**link** *link-id*} **Example:** Router(config-if)# port-channel load-balance link 1	Configures the primary load balanced link.
Step 9	**backup link** *link-id* **Example:** Router(config-if-lb)#backup link 2,3,4	Configures the back up links under the primary link.
Step 10	**service-instance** *id* **Example:** Router(config-if-lb)#service-instance 100	Assigns a service instance to a member link for manual load balancing
Step 11	**exit** **Example:** Router(config-if-lb)#exit	Returns to interface configuration mode.
Step 12	**end** **Example:** Router(config-if)# end	Returns to privileged EXEC mode.
Step 13	Return to your originating procedure (NTP).	—

Example: Configure Manual Load Balancing

The following example shows how the service instances 100 and 101 are manually assigned to link 1 on Ten Gigabit Ethernet interface 5/2. The service instances are also assigned backup links 2, 3, and 4.

```
Router# configure terminal
Router(config)# interface port-channel 10
Router(config-if)# service instance 100 ethernet
Router(config-if-srv)# encapsulation dot1q 100
Router(config-if-srv)# bridge-domain 100
Router(config-if-srv)# exit
Router(config-if)# service instance 101 ethernet
Router(config-if-srv)# encapsulation dot1q 101
Router(config-if-srv)# bridge-domain 101
Router(config-if-srv)# exit
Router(config-if)# port-channel load-balance link 1
Router(config-if-lb)# backup link 2,3,4
Router(config-if-lb)# service-instance 100,101
Router(config-if-lb)# exit

Router(config)# interface TenGigabitEthernet 5/2
Router(config-if)# channel-group 10 mode active link 1
Router(config-if)# exit
```

DLP-J18 Configure Manual Load Balancing Using CTC

Purpose	This procedure configures manual load balancing on the ports of the channel group using CTC.
Tools/Equipment	None
Prerequisite Procedures	DLP-J15 Create a Channel Group Using CTC, on page 19
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Step 1   Complete the NTP-J22 Log into CTC procedure at a node where you want to configure manual load balancing.

Step 2   From the View menu, choose **Go to Home View**.

Step 3   Right-click the fabric or line card and choose **Open Packet Transport System View**. The Packet Transport System View dialog box appears.

Step 4   Click the **Provisioning** tab.

Step 5   From the left pane, click **Channel Groups**.

Step 6   Click the **Load Balancing** tab.

Step 7   From the LAG drop-down list, choose a channel group.

Step 8   Click **Create** to configure manual load balancing on the ports of the channel group. The Manual Load Balancing dialog box appears.

Step 9   From the Primary Loadbalanced Link list, choose a port.

Step 10   From the Available Ports list, choose the required ports and click the right arrow button to move the ports to the Selected Ports list.
The selected ports serve as the backup ports for the primary load balanced port.

Step 11   Click **Apply**.
See DLP-J2 Create an EVC Circuit Using CTC to choose a channel group as the EFP and configure manual load balancing on the channel group.

Step 12   Return to your originating procedure (NTP).

Show Commands

Display Port Channel Statistics

The following example shows how to view port channel statistics.

```
Router# show interfaces stats
```

```
GigabitEthernet0/1
Switching path    Pkts In     Chars In     Pkts Out    Chars Out
Processor         108470      31042570     82259       14255449
Route cache       0           0            0           0
Total             108470      31042570     82259       14255449
GigabitEthernet0/2
Switching path    Pkts In     Chars In     Pkts Out    Chars Out
Processor         15979       19073260     15192       1325713
Route cache       0           0            0           0
Total             15979       19073260     15192       1325713
Port-channel15
Switching path    Pkts In     Chars In     Pkts Out    Chars Out
Processor         0           0            0           0
Route cache       0           0            0           0
Total             0           0            0           0
```

```
Router# show interfaces port-channel 2 stats
```

```
Port-channel2
          Switching path    Pkts In    Chars In    Pkts Out    Chars Out
               Processor  570546645 295127854241   557694541 291427545417
              Route cache          0            0            0            0
                   Total  570546645 295127854241   557694541 291427545417
```

Display Port Channel Interface

The following example shows how to view the information for a port channel interface. `channel-id` is an integer value between 1 to 128.

```
Router# show interfaces port-channel channel-id
```

```
Router# show interfaces port-channel 20
```

```
Port-channel20 is up, line protocol is up
Hardware is GEChannel, address is 0002.0415.0002 (bia 0000.0000.0000)
  MTU 9600 bytes, BW 10000000 Kbit/sec, DLY 10 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  ARP type: ARPA, ARP Timeout 04:00:00
    No. of active members in this channel: 1
        Member 0 : TenGigabitEthernet4/2 , Full-duplex, 10000Mb/s
    No. of passive members in this channel: 0
  Last input never, output never, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     37 packets input, 7820 bytes, 0 no buffer
     Received 0 broadcasts (0 IP multicasts)
     0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
     0 watchdog, 0 multicast, 0 pause input
     39 packets output, 8088 bytes, 0 underruns
     0 output errors, 0 collisions, 0 interface resets
     0 unknown protocol drops
     0 babbles, 0 late collision, 0 deferred
     0 lost carrier, 0 no carrier, 0 pause output
     0 output buffer failures, 0 output buffers swapped out
```

Display EFP Statistics

The following example shows how to view EFP statistics.

```
Router> show ethernet service instance stats
```

```
System maximum number of service instances: 32768
Service Instance 2, Interface TenGigabitEthernet3/1
```

```
Pkts In       Bytes In       Pkts Out       Bytes Out
   0              0              0              0
Service Instance 2, Interface Port-channel15
Pkts In       Bytes In       Pkts Out       Bytes Out
   0              0              0              0
```

Note The **show ethernet service instance stats** command does not display the EFP statistics for a pseudowire. Use the **show mpls l2transport vc [vcid] [detail]** command to view the EFP statistics for a pseudowire.

Display LACP Activity

The following examples show how to view LACP activity in the network.

```
Router# show lacp internal


Flags:  S - Device is requesting Slow LACPDUs
        F - Device is requesting Fast LACPDUs
        A - Device is in Active mode       P - Device is in Passive mode


Channel group 20
                     LACP port   Admin   Oper   Port     Port
Port        Flags State Priority Key     Key    Number   State
Te4/2        SA    bndl  32768   0x5     0x5    0x42     0x3D
```

```
Router# show lacp 20 counters


            LACPDUs        Marker       Marker Response    LACPDUs
Port        Sent   Recv    Sent   Recv   Sent   Recv       Pkts Err

--------------------------------------------------------------------
Channel group 20
Te4/2        21     18      0      0      0      0          0
```

```
Router# show lacp 20 internal


Flags:  S - Device is requesting Slow LACPDUs
        F - Device is requesting Fast LACPDUs
        A - Device is in Active mode       P - Device is in Passive mode

Channel group 20
                     LACP port   Admin   Oper   Port     Port
Port        Flags State Priority Key     Key    Number   State
Te4/2        SA    bndl  32768   0x5     0x5    0x42     0x3D
```

```
Router# show lacp 20 neighbor


Flags:  S - Device is requesting Slow LACPDUs
        F - Device is requesting Fast LACPDUs
        A - Device is in Active mode       P - Device is in Passive mode
```

```
Channel group 20 neighbors

Partner's information:

      Partner Partner LACP Partner  Partner   Partner   Partner      Partner
Port  Flags   State   Port Priority Admin Key Oper Key Port Number Port
State

Te4/2  SA     32768   0011.2026.7300  11s      0x1       0x14        0x3C
```

Router# **show lacp 20 counters**

```
                LACPDUs       Marker    Marker Response    LACPDUs
Port             Sent   Recv  Sent   Recv    Sent   Recv    Pkts   Err
---------------------------------------------------------------------
Channel group: 20
Te4/2            26     31    0      0       0      0        0
```

Router# **show lacp sys-id**

```
32768,0005.9b2e.18e0
```

Display Manual Load Balancing Configuration

Router# **show ethernet service instance load-balance**

```
Manually Assigned Load-Balancing Status for Port-channel1

 Link ID 1: TenGigabitEthernet4/1 (Active)
  Backup: Link ID 2 TenGigabitEthernet3/2
  Service instances: 10

 Link ID 2: TenGigabitEthernet3/2 (Active)
  Backup: Link ID 1 TenGigabitEthernet4/1
  Service instances: 20
```

Router# **show ethernet service instance platform**
Displays the port channel EFPs that are currently using the manual or platform load balancing and the egress link.

```
EFP id: 10 Interface Port-channel1
        Load balancing type: Manual
        Associated Egress Interface: TenGigabitEthernet4/1
EFP id: 20 Interface Port-channel1
        Load balancing type: Manual
        Associated Egress Interface: TenGigabitEthernet3/2
EFP id: 10 Interface Port-channel2
        Load balancing type: Manual
        Associated Egress Interface: TenGigabitEthernet5/1
EFP id: 20 Interface Port-channel2
        Load balancing type: Platform
        Associated Egress Interface: TenGigabitEthernet5/1
```

Interactions of LAG with Other Features

LAG interacts with the following features:

- EVC
- MPLS
- QoS
- IGMP Snooping
- REP

LAG with EVC

EFPs can be configured on a channel group. The traffic, carried by the EFPs, is load balanced across the member links. Ingress traffic for a single EVC can arrive on any member of the bundle. All egress traffic for an EFP uses only one of the member links. The load balancing is achieved by distributing EFPs between the member links. The EFPs on a channel group are grouped and each group is associated with a member link. In the default load balancing mechanism, there is no control over how the EFPs are distributed together, and sometimes the EFP distribution is not ideal. The manual load balancing mechanism can be alternatively used to control the EFP grouping.

When you configure a physical port as part of a channel group, you cannot configure EVCs under that physical port.

LAG can be configured for both point–to–point and point–to–multipoint bridge domains.

LAG with MPLS

LAG can be an attachment circuit for MPLS services.

The following example shows how the Ethernet LAG can connect to MPLS.

```
Router# enable
Router# configure terminal
Router(config)# interface port-channel 10
Router(config-if)# service instance 10 ethernet
Router(config-if-srv)# xconnect 10.0.0.2 999 encapsulation MPLS
Router(config-if-srv)# exit
```

LAG with QoS

See QoS Support on Port-Channel.

LAG with IGMP Snooping

See IGMP Snooping Interaction with LAG.

LAG with REP

REP is not supported on member links that are part of a channel group.