Configuring EtherChannels

This chapter describes how to configure EtherChannels on the Cisco ASR 901 router Layer 2 or Layer 3 LAN ports.

Understanding How EtherChannels Work

This section contains the following topics:

EtherChannel Feature Overview

An EtherChannel bundles individual Ethernet links into a single logical link that provides the aggregate bandwidth of up to eight physical links.

The Cisco ASR 901 router supports a maximum of eight EtherChannels with a maximum eight member links in each EtherChannel.

You can form an EtherChannel with up to eight compatibly configured LAN ports in a Cisco ASR 901 . All LAN ports in each EtherChannel must be of the same speed and must all be configured as Layer 2 LAN ports.

Note The network device to which a Cisco ASR 901 is connected may impose its own limits on the number of ports in an EtherChannel.

If a segment within an EtherChannel fails, traffic previously carried over the failed link switches to the remaining segments within the EtherChannel. When a failure occurs, the EtherChannel feature sends a trap that identifies the router, the EtherChannel, and the failed link. Inbound broadcast packets on one segment in an EtherChannel are blocked from returning on any other segment of the EtherChannel.

Understanding How EtherChannels Are Configured

This section contains the following topics:

EtherChannel Configuration Overview

You can configure EtherChannels manually or use the Link Aggregation Control Protocol (LACP) to form EtherChannels. The EtherChannel protocols allow ports with similar characteristics to form an EtherChannel through dynamic negotiation with connected network devices. LACP is defined in IEEE 802.3ad.

Table 1: EtherChannel Modes , on page 2 lists the user-configurable EtherChannel modes.

Table 1: EtherChannel Modes

Mode	Description
on	This is the mode that forces the LAN port to channel unconditionally. In the **on** mode, a usable EtherChannel exists only when a LAN port group in the **on** mode is connected to another LAN port group in the **on** mode. Because ports configured in the **on** mode do not negotiate, there is no negotiation traffic between the ports. You cannot configure the **on** mode with an EtherChannel protocol.
passive	(Default for LACP) LACP mode that places a port into a passive negotiating state, in which the port responds to LACP packets it receives but does not initiate LACP negotiation.
active	LACP mode that places a port into an active negotiating state, in which the port initiates negotiations with other ports by sending LACP packets.

Understanding Manual EtherChannel Configuration

Manually configured EtherChannel ports do not exchange EtherChannel protocol packets. A manually configured EtherChannel forms only when you enter configure all ports in the EtherChannel compatibly.

Understanding IEEE 802.3ad LACP EtherChannel Configuration

LACP supports the automatic creation of EtherChannels by exchanging LACP packets between LAN ports. LACP packets are exchanged only between ports in **passive** and **active** modes.

The protocol learns the capabilities of LAN port groups dynamically and informs the other LAN ports. Once LACP identifies correctly matched Ethernet links, it facilitates grouping the links into an EtherChannel. The EtherChannel is then added to the spanning tree as a single bridge port.

Both the **passive** and **active** modes allow LACP to negotiate between LAN ports to determine if they can form an EtherChannel, based on criteria such as port speed and trunking state. Layer 2 EtherChannels also use VLAN numbers.

LAN ports can form an EtherChannel when they are in different LACP modes as long as the modes are compatible. For example:

- A LAN port in **active** mode can form an EtherChannel successfully with another LAN port that is in **active** mode.
- A LAN port in **active** mode can form an EtherChannel with another LAN port in **passive** mode.
- A LAN port in **passive** mode cannot form an EtherChannel with another LAN port that is also in **passive** mode, because neither port will initiate negotiation.

Table 2: LACP EtherChannel Modes, on page 3 provides a summary of these combinations.

Table 2: LACP EtherChannel Modes

Router A	Router B	Result
passive mode	**passive** mode	No EtherChannel group is created.
passive mode	**active** mode	EtherChannel group is created.
active mode	**passive** mode	EtherChannel group is created.
active mode	**active** mode	EtherChannel group is created.

LACP uses the following parameters:

Note The LACP system ID is the combination of the LACP system priority value and the MAC address of the router.

Note Port priority is only effective when it is configured on a device with an LACP system priority higher than the peer.

- LACP administrative key—LACP automatically configures an administrative key value equal to the channel group identification number on each port configured to use LACP. The administrative key defines the ability of a port to aggregate with other ports. A port's ability to aggregate with other ports is determined by these factors:
  - Port physical characteristics, such as data rate, duplex capability, and point-to-point or shared medium
  - Configuration restrictions that you establish

On ports configured to use LACP, LACP tries to configure the maximum number of compatible ports in an EtherChannel, up to the maximum allowed by the hardware (eight ports). If LACP cannot aggregate all the ports that are compatible (for example, the remote system might have more restrictive hardware limitations), then all the ports that cannot be actively included in the channel are put in hot standby state and are used only if one of the channeled ports fails. You can configure an additional 8 standby ports (total of 16 ports associated with the EtherChannel).

Understanding Port-Channel Interfaces

Each EtherChannel has a numbered port-channel interface. The configuration that you apply to the port-channel interface affects all LAN ports assigned to the port-channel interface.

After you configure an EtherChannel, the configuration that you apply to the port-channel interface affects the EtherChannel; the configuration that you apply to the LAN ports affects only the LAN port to which you apply the configuration. To change the parameters of all ports in an EtherChannel, apply the configuration

commands to the port-channel interface, for example, Spanning Tree Protocol (STP) commands or commands to configure a Layer 2 EtherChannel as a trunk.

Understanding Load Balancing

An EtherChannel balances the traffic load across the links in an EtherChannel by reducing part of the binary pattern formed from the addresses in the frame to a numerical value that selects one of the links in the channel.

EtherChannel load balancing can use MAC addresses or IP addresses. EtherChannel load balancing can use either source or destination or both source and destination addresses or ports. The selected mode applies to all EtherChannels configured on the router. EtherChannel load balancing can use MPLS Layer 2 information.

Use the option that provides the balance criteria with the greatest variety in your configuration. For example, if the traffic on an EtherChannel is going only to a single MAC address and you use the destination MAC address as the basis of EtherChannel load balancing, the EtherChannel always chooses the same link in the EtherChannel; using source addresses or IP addresses might result in better load balancing.

EtherChannel Configuration Guidelines and Restrictions

Note When EtherChannel interfaces are configured improperly, they are disabled automatically to avoid network loops and other problems.

- The commands in this chapter can be used on all LAN ports in the Cisco ASR 901 .
- Configure all LAN ports in an EtherChannel to use the same EtherChannel protocol; you cannot run two EtherChannel protocols in one EtherChannel.
- Configure all LAN ports in an EtherChannel to operate at the same speed and in the same duplex mode.
- LACP does not support half-duplex. Half-duplex ports in an LACP EtherChannel are put in the suspended state.
- Enable all LAN ports in an EtherChannel. If you shut down a LAN port in an EtherChannel, it is treated as a link failure and its traffic is moved to one of the remaining ports in the EtherChannel.
- An EtherChannel will not form if one of the LAN ports is a Switched Port Analyzer (SPAN) destination port.
- For Layer 2 EtherChannels:
  - Assign all LAN ports in the EtherChannel to the same VLAN or configure them as trunks.
  - If you configure an EtherChannel from trunking LAN ports, verify that the trunking mode is the same on all the trunks. LAN ports in an EtherChannel with different trunk modes can operate unpredictably.
  - An EtherChannel supports the same allowed range of VLANs on all the LAN ports in a trunking Layer 2 EtherChannel. If the allowed range of VLANs is not the same, the LAN ports do not form an EtherChannel.
  - LAN ports with different STP port path costs can form an EtherChannel as long they are compatibly configured with each other. If you set different STP port path costs, the LAN ports are still compatible for the formation of an EtherChannel.
  - An EtherChannel will not form if protocol filtering is set differently on the LAN ports.
- You can configure a maximum of eight port-channel interfaces, numbered from 1 to 8.

- After you configure an EtherChannel, the configuration that you apply to the port-channel interface affects the EtherChannel. The configuration that you apply to the LAN ports affects only those LAN ports to which you apply the configuration.
- Enable Bidirectional Forwarding Detection (BFD) for a port channel on Switch Virtual Interface (SVI) to achieve better convergence during failover.

Configuring Etherchannels

This section contains the following topics:

Note Ensure that the LAN ports are configured correctly (see the EtherChannel Configuration Guidelines and Restrictions, on page 4).

Configuring Channel Groups

Note When configuring Layer 2 EtherChannels, configure the LAN ports with the **channel-group** command as described in this section, which automatically creates the port-channel logical interface. You cannot add Layer 2 LAN ports into a manually created port-channel interface.

- To create port-channel interfaces for Layer 2 EtherChannels, the Layer 2 LAN ports must be connected and functioning.

To configure channel groups, complete the following steps for each LAN port in interface configuration mode:

Procedure

	Command or Action	Purpose
Step 1	Router(config)# **interface** *type slot/port*	Selects a LAN port to configure.
Step 2	Router(config-if)# **no ip address**	Ensures that there is no IP address assigned to the LAN port.
Step 3	Router(config-if)# **channel-protocol lacp**	(Optional) On the selected LAN port, restricts the **channel-group** command to the EtherChannel protocol configured with the **channel-protocol** command.
Step 4	Router(config-if)# **channel-group** *number* **mode** {**active** | **on** | **passive**}	Configures the LAN port in a port-channel and specifies the mode (see table in the EtherChannel Configuration Overview, on page 2 section). LACP supports the active and passive modes.

	Command or Action	Purpose
Step 5	Router(config-if)# **lacp port-priority** *priority_value*	(Optional for LACP) Valid values are 1 through 65535. Higher numbers have lower priority. The default is 32768.
Step 6	Router(config-if)# **end**	Exits configuration mode.
Step 7	Router# **show running-config interface** *type slot/port* **Example:** `Router# show interfaces type slot/port etherchannel`	Verifies the configuration. *type*—**gigabitethernet**.

Configuring the LACP System Priority and System ID

The LACP system ID is the combination of the LACP system priority value and the MAC address of the router. To configure the LACP system priority and system ID, complete the following tasks:

Procedure

	Command or Action	Purpose
Step 1	**lacp system-priority** *priority_value* **Example:** `Router(config)# lacp system-priority 23456`	(Optional for LACP) Valid values are 1 through 65535. Higher numbers have lower priority. The default is 32768.
Step 2	**end** **Example:** `Router(config)# end`	Exits configuration mode.
Step 3	**show lacp sys-id** **Example:** `Router# show lacp sys-id`	Verifies the configuration.

What to do next

Configuration examples for LACP system priority

This example shows how to configure the LACP system priority:

```
Router# configure terminal

Router(config)# lacp system-priority 23456
Router(config)# end
```

This example shows how to verify the configuration:

```
Router# show lacp sys-id

23456,0050.3e8d.6400
```

The system priority is displayed first, followed by the MAC address of the router.

Configuring the LACP Transmit Rate

To configure the rate at which Link Aggregation Control Protocol (LACP) control packets are transmitted to an LACP-supported interface, complete the following tasks:

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 gigabitethernet 0/1`	Specifies an interface type and number, and enters interface configuration mode.
Step 4	**lacp rate {fast | normal}** **Example:** `Router(config-if)# lacp rate fast`	Configures the transmission rate of LACP control packets to an LACP-supported interface. • **fast**—Specifies that LACP control packets are transmitted at the fast rate, once every second. • **normal**—Specifies that LACP control packets are transmitted at the normal rate, every 30 seconds after the link is bundled.
Step 5	**end** **Example:** `Router(config-if)# end`	Exits the interface configuration mode and enters the privileged EXEC mode.

Verifying the LACP Transmit Rate

To verify the LACP control packet transmission rate, use the following show command:

```
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 5
                            LACP port     Admin     Oper    Port        Port
Port      Flags   State     Priority      Key       Key     Number      State
Gi0/1     FA      bndl      32768         0xA       0xA     0x102       0x7D
```

Configuring EtherChannel Load Balancing

To configure EtherChannel load balancing, complete the following steps:

Procedure

	Command or Action	Purpose
Step 1	Router(config)# **port-channel load-balance** {**src-mac** | **dst-mac** | **src-dst-mac** | **src-ip** | **dst-ip** | **src-dst-ip**}	Configures EtherChannel load balancing. The load-balancing keywords indicate the following information: • **dst-ip**—Destination IP addresses • **dst-mac**—Destination MAC addresses • **src-dst-ip**—Source and destination IP addresses • **src-dst-mac**—Source and destination MAC addresses • **src-ip**—Source IP addresses • **src-mac**—Source MAC addresses
Step 2	Router(config)# **end**	Exits configuration mode.
Step 3	Router# **show etherchannel load-balance**	Verifies the configuration.

Configuration Examples

This example shows how to configure EtherChannel to use source and destination IP addresses:

```
Router# configure terminal

Router(config)# port-channel load-balance src-dst-ip

Router(config)# end

Router(config)#
```

This example shows how to verify the configuration:

```
Router# show etherchannel load-balance
```

```
Source XOR Destination IP address
Router#
```

Modifying MTU Size on Port-Channel

Complete the following steps to modify MTU size on the port-channel interface:

Note If the MTU size of a port-channel member link is different from the MTU size of the port-channel interface, the member link is not bundled.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables the privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters the global configuration mode.
Step 3	**interface port-channel** *number* **Example:** `Router(config)# interface port-channel 1`	Selects a port-channel interface and enters interface configuration mode. • *number*—Specifies the port-channel interface number. The range is from 1 to 8.
Step 4	**mtu** *bytes* **Example:** `Router(config-if)# mtu 4000`	Configures the MTU size for port-channel interface. • *bytes*—The range is from 1500 to 9216. The default is 9216. **Note** To set the MTU size to its default value, use the **no mtu** or **default mtu** command.

Verifying the MTU Size on Port-Channel

To verify the MTU size on port-channel interface, use the **show interface port-channel** command.

```
Router# show interface port-channel 1
Port-channel1 is up, line protocol is up (connected)
  Hardware is EtherChannel, address is 4055.3989.4a15 (bia 4055.3989.4a15)
  MTU 4000 bytes
, BW 2000000 Kbit/sec, DLY 1000 usec,
     reliability 255/255, txload 1/255, rxload 0/255
```

```
Encapsulation ARPA, loopback not set
Keepalive set (10 sec)
ARP type: ARPA, ARP Timeout 04:00:00
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
   0 packets input, 0 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
   0 packets output, 0 bytes, 0 underruns
   0 output errors, 0 collisions, 1 interface resets
   0 unknown protocol drops
```

EVC On Port-Channel

An EtherChannel bundles individual Ethernet links into a single logical link that provides the aggregate bandwidth of up to eight physical links.The EVC EtherChannel feature provides support for EtherChannels on Ethernet Virtual Connection Services (EVCS) service instances.

The EVC EtherChannel feature supports MPBE, local connect, and xconnect service types.

Load balancing is accomplished on a Ethernet flow point (EFP) basis where a number of EFPs exclusively pass traffic through member links. In a default load balancing, you have no control over how the EFPs are grouped together, and sometimes the EFP grouping may not be ideal. To avoid this, use manual load balancing to control the EFP grouping.

Restrictions for EVC EtherChannel

The following restrictions apply to EVC EtherChannel:

- Bridge-domains, EVCs, and IP subinterfaces are allowed over the port-channel interface and the main interface.
- If you configure a physical port as part of a channel group, you cannot configure EVCs under that physical port.
- If port-channel is configured on an MPLS core, the encapsulation ID should be the same as the bridge domain.
- A physical port that is part of an EVC port-channel cannot have EVC configuration.
- Statically configuring port-channel membership with LACP is not supported.
- You can apply QoS policies under EVCs on a port-channel.
- You cannot use the police percent commands on EVC port-channels in flat policy-maps or in parent of HQoS policy-maps.

Configuring EVC on Port-Channel

To configure the EVC on port-channel, complete these steps in the interface configuration mode:

Procedure

	Command or Action	Purpose
Step 1	**interface port-channel** *number* **Example:** `Router(config)# interface port-channel 11`	Creates the port-channel interface.
Step 2	**[no] service instance** *id* **ethernet** *service-name* **Example:** `Router(config-if)# service instance 101 ethernet`	Creates a service instance (an instantiation of an EVC) on an interface and sets the device into the config-if-srv submode.
Step 3	**encapsulation {untagged | dot1q** *vlan-id* **[second-dot1q** *vlan-id***]}** **Example:** `Router(config-if-srv)# encapsulation dot1q 13`	Defines the matching criteria to be used in order to map ingress dot1q frames on an interface to the appropriate service instance.
Step 4	**rewrite ingress tag pop 1 symmetric** **Example:** `Router(config-if-srv)# rewrite ingress tag pop 1 symmetric`	Specifies the tag manipulation that is to be performed on the frame ingress to the service instance.
Step 5	**[no] bridge-domain** *bridge-id* **Example:** `Router(config-if-srv)# bridge-domain 12`	The bridge-domain command binds the service instance to a bridge domain instance where bridge-id is the identifier for the bridge domain instance.

Verifying the Configuration

Use the following commands to verify the configuration:

Command	Purpose
Router# show ethernet service evc [id evc-id | interface interface-id] [detail]	Displays information pertaining to a specific EVC if an EVC ID is specified, or pertaining to all EVCs on an interface if an interface is specified. The detailed option provides additional information on the EVC.
Router# show ethernet service instance interface port-channel number [summary]	Displays the summary of all the configured EVCs within the interface.

Command	Purpose
Router# show ethernet service instance [id instance-id interface interface-id | interface interface-id] [detail]	Displays information about one or more service instances. If a service instance ID and interface are specified, only data pertaining to that particular service instance is displayed. If only an interface ID is specified, displays data for all service instances s on the given interface.
Router# show mpls l2 transport vc detail	Displays detailed information related to the virtual connection (VC).
Router# show mpls forwarding	Displays the contents of the Multiprotocol Label Switching (MPLS) Label Forwarding Information Base (LFIB). **Note** Output should have the label entry l2ckt.
Router# show etherchannel summary	Displays view all EtherChannel groups states and ports.
Router# show policy-map interface service instance	Displays the policy-map information for a given service instance.

Troubleshooting Scenarios for EVC on a Port-Channel

Problem	Solution
Port data block issues in port-channel	Use the show ethernet service interface [interface-id] [detail] command to view information on the port data. Share the output with TAC for further investigation.
Issues with platform events or errors	Use the debug platform npc custom-ether client [event, error] command to debug and trace platform issues. Share the output with TAC for further investigation.