**Ethernet Link Aggregation**

Student Version



Huawei Technologies Co., Ltd.

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# Ethernet Link Aggregation

## Background

As networks grow in scale, users require Ethernet backbone networks to provide higher bandwidth and availability. In the past, the only way to increase bandwidth was to upgrade the network with high-speed LPUs, which is costly and inflexible.

In contrast, link aggregation increases bandwidth by bundling a group of physical port into a single logical port, without the need to upgrade hardware. In addition, link aggregation provides link backup mechanisms, greatly improving link availability. Link aggregation has the following advantages:

Improving bandwidth: The maximum bandwidth of a link aggregation group (LAG) is the combined bandwidth of all member links.

Improving availability: If a link is faulty, the traffic can be switched to other available member links.

Load balancing: The traffic load can be balanced among the active member links in a LAG.

In this lab activity, you will learn how to configure Ethernet link aggregation in manual and LACP modes.

## Objectives

Upon completion of this task, you will be able to:

Learn how to manually configure link aggregation

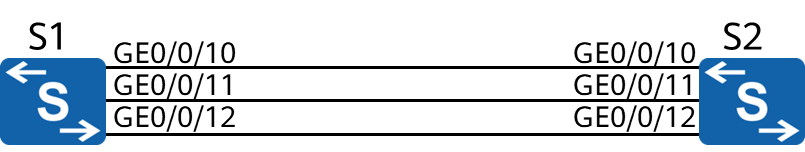
Learn how to configure link aggregation in static LACP mode

Learn how to determine active links in static LACP mode

Learn how to configure some static LACP features

## Topology

Lab Topology



## Implementation

### Roadmap

1. Configure link aggregation manually.
2. Configure link aggregation in LACP mode.
3. Modify parameters to determine active links.
4. Change the load balancing mode.

### Procedure

Configure link aggregation manually.

# Create an Eth-Trunk.

The **interface eth-trunk** command displays the view of an existing Eth-Trunk or creates an Eth-Trunk and displays its view. The number **1** in this example indicates the port number.

# Configure the link aggregation mode of the Eth-Trunk.

[S1-Eth-Trunk1]mode manual load-balance

The **mode** command configures the working mode of the Eth-Trunk, which can be LACP or manual load balancing. By default, the manual load balancing mode is used. Therefore, the preceding operation is unnecessary and is provided for demonstration purpose only.

# Add a port to the Eth-Trunk.

[S1]interface GigabitEthernet 0/0/10

You can enter the interface view of an individual port and add it to an Eth-Trunk. You can also run the **trunkport** command in the Eth-Trunk interface view to add multiple ports to the Eth-Trunk.

[S2]interface Eth-Trunk 1

Note the following points when adding physical ports to an Eth-Trunk:

1. An Eth-Trunk contains a maximum of 8 member ports.
2. An Eth-Trunk cannot be added to another Eth-Trunk.
3. An Ethernet port can be added to only one Eth-Trunk. To add an Ethernet port to another Eth-Trunk, delete it from the original one first.
4. The remote ports directly connected to the local Eth-Trunk member ports must also be added to an Eth-Trunk; otherwise, the two ends cannot communicate.
5. Both endpoints of an Eth-Trunk must use the same number of physical ports, port rate, and duplex mode.

# Display the status of an Eth-Trunk.

[S1]display eth-trunk 1

Eth-Trunk1's state information is:

WorkingMode: **NORMAL** Hash arithmetic: According to SIP-XOR-DIP

Least Active-linknumber: 1 Max Bandwidth-affected-linknumber: 32

Operate status: up Number Of Up Port In Trunk: 3

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PortName Status Weight

GigabitEthernet0/0/10 Up 1

GigabitEthernet0/0/11 Up 1

GigabitEthernet0/0/12 Up 1

Configure link aggregation in LACP mode.

# Delete member ports from an Eth-Trunk.

[S1]interface Eth-Trunk 1

[S2]interface Eth-Trunk 1

Before changing the working mode of an Eth-Trunk, ensure that the Eth-Trunk has no member port.

# Change the aggregation mode.

[S1]interface Eth-Trunk 1

The **mode lacp** command sets the working mode of an Eth-Trunk to LACP.

Note: The command is **mode lacp-static** in some versions.

[S2]interface Eth-Trunk 1

# Add a port to the Eth-Trunk.

[S1]interface Eth-Trunk 1

[S2]interface Eth-Trunk 1

# Display the status of the Eth-Trunk.

[S1]display eth-trunk 1

Eth-Trunk1's state information is:

Local:

LAG ID: 1 WorkingMode: **STATIC**

Preempt Delay: Disabled Hash arithmetic: According to SIP-XOR-DIP

System Priority: 32768 System ID: 4c1f-cc33-7359

Least Active-linknumber: 1 Max Active-linknumber: 8

Operate status: up Number Of Up Port In Trunk: 3

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ActorPortName Status PortType PortPri PortNo PortKey PortState Weight

GigabitEthernet0/0/10 **Selected** 1GE 32768 11 305 10111100 1

GigabitEthernet0/0/11 **Selected** 1GE 32768 12 305 10111100 1

GigabitEthernet0/0/12 **Selected** 1GE 32768 13 305 10111100 1

Partner:

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ActorPortName SysPri SystemID PortPri PortNo PortKey PortState

GigabitEthernet0/0/10 32768 4c1f-ccc1-4a02 32768 11 305 10111100

GigabitEthernet0/0/11 32768 4c1f-ccc1-4a02 32768 12 305 10111100

GigabitEthernet0/0/12 32768 4c1f-ccc1-4a02 32768 13 305 10111100

In normal cases, only GigabitEthernet0/0/11 and GigabitEthernet0/0/12 need to be in the forwarding state, and GigabitEthernet0/0/10 is used as the backup. When the number of active ports falls bellow 2, the Eth-Trunk is shut down.

# Set the LACP priority of S1 to make S1 an active device.

# Configure port priorities so that GigabitEthernet0/0/11 and GigabitEthernet0/0/12 can have a higher priority.

[S1]interface GigabitEthernet 0/0/10

Link Aggregation Control Protocol data units (LACPDUs) are sent and received by both endpoints of a link aggregation group in LACP mode.

First, the actor is elected.

The system priority field is compared. The default priority value is 32768, and a lower value indicates a higher priority. The endpoint with a higher priority is elected as the LACP actor.

If there is a tie in priority, the endpoint with a smaller MAC address becomes the actor.

After the actor is elected, the devices at both ends select active ports according to the port priority settings on the actor.

# Set the upper and lower thresholds of active ports.

[S1]interface Eth-Trunk 1

The bandwidth and status of an Eth-Trunk depend on the number of active ports. The bandwidth of an Eth-Trunk is the total bandwidth of all member ports in Up state. You can set the following thresholds to stabilize an Eth-Trunk's status and bandwidth as well as reduce the impact brought by frequent changes of member link status.

1. Lower threshold: When the number of active ports falls below this threshold, the Eth-Trunk goes Down. This threshold determines the minimum bandwidth of an Eth-Trunk and is configured using the **least active-linknumber** command.
2. Upper threshold: When the number of active ports reaches this threshold, the bandwidth of the Eth-Trunk will not increase even if more member links go Up. The upper threshold ensures network availability and is configured using the **max active-linknumber** command.

# Enable the preemption function.

[S1]interface Eth-Trunk 1

In LACP mode, when an active link fails, the system selects the backup link with the highest priority to replace the faulty one. If the faulty link is recovered and has a higher priority than the backup link, the recovered link can restore the active status if preemption is enabled. The **lacp preempt enable** command enables LACP preemption. By default, this function is disabled.

# Display the status of the current Eth-Trunk.

[S1]display eth-trunk 1

Eth-Trunk1's state information is:

Local:

LAG ID: 1 WorkingMode: STATIC

Preempt Delay Time: 30 Hash arithmetic: According to SIP-XOR-DIP

System Priority: 100 System ID: 4c1f-cc33-7359

Least Active-linknumber: 2 Max Active-linknumber: 2

Operate status: up Number Of Up Port In Trunk: 2

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ActorPortName Status PortType PortPri PortNo PortKey PortState Weight

GigabitEthernet0/0/10 **Unselect** 1GE 40000 11 305 10100000 1

GigabitEthernet0/0/11 **Selected** 1GE 32768 12 305 10111100 1

GigabitEthernet0/0/12 **Selected** 1GE 32768 13 305 10111100 1

Partner:

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ActorPortName SysPri SystemID PortPri PortNo PortKey PortState

GigabitEthernet0/0/10 32768 4c1f-ccc1-4a02 32768 11 305 10110000

GigabitEthernet0/0/11 32768 4c1f-ccc1-4a02 32768 12 305 10111100

GigabitEthernet0/0/12 32768 4c1f-ccc1-4a02 32768 13 305 10111100

GigabitEthernet0/0/11 and GigabitEthernet0/0/12 are in active state.

# Shut down GigabitEthernet0/0/12 to simulate a link fault.

[S1]interface GigabitEthernet 0/0/12

[S1-GigabitEthernet0/0/12]shutdown

[S1]display eth-trunk 1

Eth-Trunk1's state information is:

Local:

LAG ID: 1 WorkingMode: STATIC

Preempt Delay Time: 30 Hash arithmetic: According to SIP-XOR-DIP

System Priority: 100 System ID: 4c1f-cc33-7359

Least Active-linknumber: 2 Max Active-linknumber: 2

Operate status: up Number Of Up Port In Trunk: 2

--------------------------------------------------------------------------------

ActorPortName Status PortType PortPri PortNo PortKey PortState Weight

GigabitEthernet0/0/10 **Selected** 1GE 40000 11 305 10111100 1

GigabitEthernet0/0/11 **Selected** 1GE 32768 12 305 10111100 1

GigabitEthernet0/0/12 **Unselect** 1GE 32768 13 305 10100010 1

Partner:

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ActorPortName SysPri SystemID PortPri PortNo PortKey PortState

GigabitEthernet0/0/10 32768 4c1f-ccc1-4a02 32768 11 305 10111100

GigabitEthernet0/0/11 32768 4c1f-ccc1-4a02 32768 12 305 10111100

GigabitEthernet0/0/12 0 0000-0000-0000 0 0 0 10100011

GigabitEthernet 0/0/10 has become active.

# Shut down GigabitEthernet 0/0/11 to simulate a link fault.

[S1]interface GigabitEthernet 0/0/11

[S1-GigabitEthernet0/0/11]shutdown

[S1]display eth-trunk 1

Eth-Trunk1's state information is:

Local:

LAG ID: 1 WorkingMode: STATIC

Preempt Delay Time: 30 Hash arithmetic: According to SIP-XOR-DIP

System Priority: 100 System ID: 4c1f-cc33-7359

Least Active-linknumber: 2 Max Active-linknumber: 2

Operate status: down Number Of Up Port In Trunk: 0

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ActorPortName Status PortType PortPri PortNo PortKey PortState Weight

GigabitEthernet0/0/10 **Unselect**  1GE 40000 11 305 10100000 1

GigabitEthernet0/0/11 **Unselect**  1GE 32768 12 305 10100010 1

GigabitEthernet0/0/12 **Unselect**  1GE 32768 13 305 10100010 1

Partner:

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ActorPortName SysPri SystemID P ortPri PortNo PortKey PortState

GigabitEthernet0/0/10 32768 4c1f-ccc1-4a02 32768 11 305 10110000

GigabitEthernet0/0/11 0 0000-0000-0000 0 0 0 10100011

GigabitEthernet0/0/12 0 0000-0000-0000 0 0 0 10100011

The lower threshold for the number of active links is set to 2. Therefore, the Eth-Trunk is shut down. Although GigabitEthernet0/0/10 is Up, it is still in Unselect state.

Change the load balancing mode.

# Enable the ports disabled in the previous step.

[S1]inter GigabitEthernet 0/0/11

[S1-GigabitEthernet0/0/11]undo shutdown

[S1-GigabitEthernet0/0/11]quit

[S1]inter GigabitEthernet 0/0/12

[S1-GigabitEthernet0/0/12]undo shutdown

# Wait about 30 seconds and check the status of Eth-Trunk 1.

[S1]display eth-trunk 1

Eth-Trunk1's state information is:

Local:

LAG ID: 1 WorkingMode: STATIC

Preempt Delay Time: 30 Hash arithmetic: According to SIP-XOR-DIP

System Priority: 100 System ID: 4c1f-cc33-7359

Least Active-linknumber: 2 Max Active-linknumber: 2

Operate status: down Number Of Up Port In Trunk: 0

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ActorPortName Status PortType PortPri PortNo PortKey PortState Weight

GigabitEthernet0/0/10 Unselect 1GE 40000 11 305 10100000 1

GigabitEthernet0/0/11 **Selected** 1GE 32768 12 305 10100010 1

GigabitEthernet0/0/12 **Selected** 1GE 32768 13 305 10100010 1

Partner:

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ActorPortName SysPri SystemID PortPri PortNo PortKey PortState

GigabitEthernet0/0/10 32768 4c1f-ccc1-4a02 32768 11 305 10110000

GigabitEthernet0/0/11 0 0000-0000-0000 0 0 0 10100011

GigabitEthernet0/0/12 0 0000-0000-0000 0 0 0 10100011

The preemption function is enabled on the Eth-Trunk. Therefore, when GigabitEthernet0/0/11 and GigabitEthernet0/0/12 enter the Up state, GigabitEthernet0/0/11 and GigabitEthernet0/0/12 have a higher priority than GigabitEthernet0/0/10. As a result, GigabitEthernet0/0/10 enters the Unselect state. In addition, to ensure link stability, the default preemption hold time is 30 seconds. Therefore, preemption occurs 30 seconds after the ports are enabled.

# Change the load balancing mode of the Eth-Trunk to destination IP address-based load balancing.

[S1]interface Eth-Trunk 1

To ensure proper load balancing between physical links of an Eth-Trunk and avoid link congestion, use the **load-balance** command to set the load balancing mode of the Eth-Trunk. Load balancing is valid only for outgoing traffic; therefore, the load balancing modes for the ports at both ends can be different.

**----End**