Link Aggregation Configuration

Contents

Chapter 1 Link Aggregation Configuration

1.1 Overview

1.1.1 Introduction to Link Aggregation

Link aggregation means aggregating several ports together to form an aggregation group, so as to implement outgoing/incoming load sharing among the member ports in the group and to enhance the connection reliability.

Depending on different aggregation modes, aggregation groups fall into two types: static LACP and dynamic LACP. Depending on whether or not load sharing is implemented, aggregation groups can be load-sharing or non-load-sharing aggregation groups.
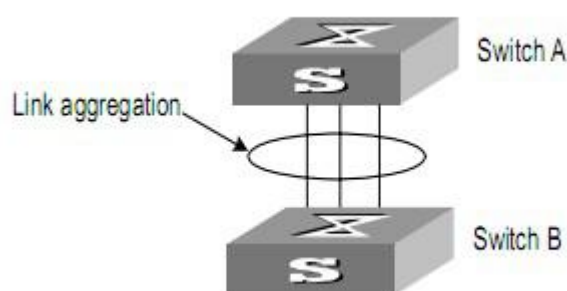

Figure 1-1 Network diagram for link aggregation configuration

For the member ports in an aggregation group, their basic configuration must be the same. The basic configuration includes STP, QoS, VLAN, port attributes, and other associated settings.

➢ STP configuration, including STP status (enabled or disabled), link attribute (point-to-point or not), STP priority, maximum transmission speed, loop prevention status.

➢ QoS configuration, including traffic limiting, priority marking, default 802.1p priority, traffic monitor, traffic redirection, traffic statistics, and so on.

➢ VLAN configuration, including permitted VLANs, and default VLAN ID, tag vlan list for hybrid port and allowed vlan list for trunk port.

➢ Port attribute configuration, including port rate, duplex mode, and link type (Trunk, Hybrid or Access). The ports for a static aggregation group must have the same rate and link type, and the ports for a dynamic aggregation group must have the same rate, duplex mode (full duplex) and link type.

1.1.2   Introduction to LACP

The purpose of link aggregation control protocol (LACP) is to implement dynamic link aggregation and disaggregation. This protocol is based on IEEE802.3ad and uses LACPDUs (link aggregation control protocol data units) to interact with its peer.

After LACP is enabled on a port, LACP notifies the following information of the port to its peer by sending LACPDUs: priority and MAC address of this system, priority, number and operation key (it is so called O-Key) of the port. Upon receiving the information, the peer compares the information with the information of other ports on the peer device to determine the ports that can be aggregated with the receiving port. In this way, the two parties can reach an agreement in adding/removing the port to/from a dynamic aggregation group.

1.1.3   Operation Key (O-Key)

An operation key of an aggregation port is a configuration combination generated by system depending on the configurations of the port (rate, duplex mode, other basic configuration, and administrative key) when the port is aggregated.

1)   The ports in the same aggregation group must have the same operation key (O-Key) and administrative key (A-Key).

2)   The administrative key (A-Key) and operation key (O-Key) of an LACP-enable aggregation port is equal to its aggregation group ID+1.

3)   The administrative key (A-Key) and operation key (O-Key) of an LACP-enable aggregation port cannot be modified.

4)   The operation key (O-Key) which is contained in LACPDU of an LACP-enable aggregation port is the same as its peer.

1.1.4   Static Aggregation Group

1.1.1.1 Introduction to Static Aggregation

A static aggregation group is manually created. All its member ports are manually added and can be manually removed. Each static aggregation group must contain at least one port. When a static aggregation group contains only one port, you cannot remove the whole aggregation group unless you remove the port.

LACP is disabled on the member ports of static aggregation groups, and enabling LACP on such a port will not take effect.

1.1.1.2 Port status of Static Aggregation Group

A port in a static aggregation group is only in one state: on, which means the port in a static aggregation group must transceive packets. There can be at most 8 ports in a static aggregation group.

1.1.5 Dynamic LACP Aggregation Group

1.1.1.3 Introduction to Dynamic LACP Aggregation Group

A dynamic LACP aggregation group is also manually created. All its member ports are manually added and can be manually removed. Each dynamic aggregation group must contain at least one port. When a dynamic aggregation group contains only one port, you cannot remove the whole aggregation group unless you remove the port.

LACP is enabled on the member ports of dynamic aggregation groups, and disabling LACP on such a port will not take effect.

1.1.1.4 Mode of Dynamic Aggregation Group

The mode of dynamic aggregation group can be active or passive. It is manually set by users.   The dynamic aggregation group in active mode will actively send LACPDUs; group in passive mode will only response LACPDUs passively. When interconnecting with another device, static mode can only interconnect with static mode; active mode can interconnect with both active and passive mode, but passive mode can only interconnect with active mode. The default mode is ACTIVE.

1.1.1.5 Port Status of Dynamic Aggregation Group

A port in a dynamic aggregation group can be in one of the three states: bundle (bndl), standby, and no-bundle (no-bndl). In dynamic aggregation group, only bundled ports can transceive LACP protocol packets; others cannot.

Note:

In an aggregation group, the bundled port with the minimum port number serves as the master port of the group, and other bundled ports serve as member ports of the group.

No-bundled ports are the ports which fail to form link aggregation with other ports in the dynamic aggregation.

There is a limit on the number of bundled ports in an aggregation group. Therefore, if the number of the member ports that can be set as bundled ports in an aggregation group exceeds the maximum number supported by the device, the system will negotiate with its peer end, to determine the states of the member ports according to the port IDs of the preferred device (that is, the device with smaller system ID). The following is the negotiation procedure:

1) Compare device IDs (system priority + system MAC address) between the two parties. First compare the two system priorities, then the two system MAC addresses if the system priorities are equal. The device with smaller device ID will be considered as the preferred one.

2)   Compare port IDs (port priority + port number) on the preferred device. The comparison between two port IDs is as follows: First compare the two port priorities, then

the two port numbers if the two port priorities are equal; the port with the smallest port ID is the bundled port and the left ports are standby ports.

1.1.1.6 Configuring System Priority

LACP determines the bundled and standby states of the dynamic aggregation group members according to the priority of the port ID on the end with the preferred device ID.

The device ID consists of system priority and system MAC address, that is, device ID = system priority + system MAC address.

When two device IDs are compared, the system priorities are compared first, and the system MAC addresses are compared when the system priorities are the same. The device with smaller device ID will be considered as the preferred one.

Note:

Changing the system priority of a device may change the preferred device between the two parties, and may further change the states (bundled or standby) of the member ports of dynamic aggregation groups.

1.1.1.7 Configuring Port Priority

LACP determines the bundled and standby states of the dynamic aggregation group members according to the port IDs on the device with the preferred device ID. When the number of members in an aggregation group exceeds the number of bundled ports supported by the device in each group, LACP determines the bundled and standby states of the ports according to the port IDs. The ports with superior port IDs will be set to bundled state and the ports with inferior port IDs will be set to standby state.

The port ID consists of port priority and port number, that is, port ID = port priority + port number. When two port IDs are compared, the port priorities are compared first, and the port numbers are compared if the port priorities are the same. The port with smaller port ID is considered as the preferred one.

1. 2　Redundancy of Interconnected Device

LACP provides link redundancy mechanism to guarantee the redundancy conformity of the two interconnected devices and user can configure the redundant link which is realized by system and port priority. The steps are as following:

Step 1 Selection reference.　The two devices know the LACP sys-id and system MAC address of each other through LACPDUs exchanges. The system priorities are compared first, and the system MAC addresses are compared when the system priorities are the same. The device with smaller device ID will be considered as the preferred one.

Step 2 Redundant link. The port priorities are compared first, and the port numbers are compared if the port priorities are the same. The port with smaller port ID is considered as the preferred one.

1.3   Load-balancing Policy

Load-balancing policy is specific physical link selection strategy when sending packets, which can be source MAC, destination MAC, source and destination MAC, source IP, destination IP, and source and destination IP. The default strategy is source MAC.

1.4   Link Aggregation Configuration

Link aggregation configuration includes:

➢   Configuring a Static Aggregation Group

➢   Configuring a Dynamic LACP Aggregation Group

➢   Displaying and Maintaining Link Aggregation Configuration

1.4.1   Configuring a Static Aggregation Group

You can create a static aggregation group, or remove an existing static aggregation group (before that, all the member ports in the group are removed).

You can manually add/remove a port to/from a static aggregation group, and a port can only be manually added/removed to/from a static aggregation group.

Perform the configuration in global configuration mode.

Table 1-1 Configure a manual aggregation group

Operation	Command	Description
Create a static aggregation group	**channel-group** *channel-group-number*	*channel-group-number* ranges from 0 to 12 If the group has already existed, turn to step 2.
Configure load-balancing policy	**channel-group load-balance {dst-ip|dst-mac|src-dst-ip|src-dst-mac|src-ip|src-mac}**	
Enter interface configuration mode	**interface ethernet** *interface_num*	Enter the port mode which you want to add to the aggregation group.
Enter interface range configuration mode	**interface range ethernet** *interface_list*	If there are multiple ports to be added, enter interface range mode.
Add a port to the aggregation group	**channel-group** *channel-group-number* **mode on**	*channel-group-number* should be existed .

Delete a port from an aggregation group	**no channel-group** *channel-group-number*	This command used in global configuration mode is for deleting a static aggregation group.
Back to global configuration mode	**exit**	
Delete a static aggregation group	**no channel-group** *channel-group-number*	This command used in interface configuration mode is for deleting a port from an aggregation group. Delete all ports from the group first before deleting the group.

1.4.2 Configuring a Dynamic LACP Aggregation Group

You can manually add/remove a port to/from a dynamic aggregation group, and a port can only be manually added/removed to/from a dynamic aggregation group.

Perform the configuration in global configuration mode.

Table 1-1 Configure a dynamic LACP aggregation groups

Step	Operation	Command	Description
1	Create a dynamic aggregation group	**channel-group** *channel-group-number*	*channel-group-number* ranges from 0 to 12 If the group has already existed, turn to step 2.
2	Configure load-balancing policy	**channel-group load-balance {dst-ip|dst-mac|src-dst-ip|src-dst-mac|src-ip|src-mac}**	The default policy is source mac.
3	Configure system priority	**lacp system-priority** *priority*	*priority* ranges from 1 to 65535. The default priority is 32768.
4(1)	Enter interface configuration	**interface ethernet** *interface_num*	Enter the port mode which you want to add to the aggregation group.

	mode		
4(2)	Enter interface range configuration mode	**interface range ethernet** *interface_list*	If there are multiple ports to be added, enter interface range mode.
5	Add a port to the aggregation group	**channel-group** *channel-group-number* **mode {active | passive}**	*channel-group-number* should be existed .
6	Configure port priority	**lacp port-priority** *priority*	*priority* ranges from 1 to 65535. The default priority is 128.
7	Delete a port from an aggregation group	**no channel-group** *channel-group-number*	This command used in global configuration mode is for deleting a static aggregation group.
8	Back to global configuration mode	**exit**	
9	Delete a dynamic aggregation group	**no channel-group** *channel-group-number*	This command used in interface configuration mode is for deleting a port from an aggregation group. Delete all ports from the group first before deleting the group.

1.4.3 Displaying and Maintaining Link Aggregation

Configuration

After the above configuration, execute the show command in any mode to display the running status after the link aggregation configuration and verify your configuration.

Table 1-1 Display and maintain link aggregation configuration

Operation	Command	Description
Show system LACP ID	**show lacp sys-id**	System LACP-ID consists of 16-bit system priority and 48-bit system

		MAC.
Show port member info of the aggregation group	**show lacp internal** [*channel-group-number*]	
Show neighbor port info of the aggregation group	**show lacp neighbor** [*channel-group-number*]	

1.5 LACP Configuration Example

I. Network requirements

As shown in Figure 1-1, the link between switch-A and switch-B should be more reliable. switch-A and switch-B should realize load-balance.
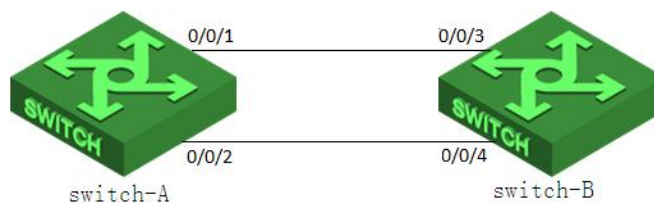
II. Network diagram

Figure 1-2 LACP network diagram

III. Configuration procedure

1.   Create channel-group

#Configure switch-A

switch-A#configure terminal

switch-A(config)#channel-group 1

#Configure switch-B

switch-B#configure terminal

switch-B(config)#channel-group 1

2.   Configure channel-group load-balance

#Configure switch-A

switch-A(config)#channel-group load-balance src-dst-mac

#Configure switch-B

switch-B(config)#channel-group load-balance src-dst-mac

3.   Configure LACP system and port priority

#Configure switch-A

switch-A(config)#lacp system-priority 1024

switch-A(config)#interface range ethernet 0/0/1 to ethernet 0/0/2

switch-A(config-if-range)#lacp port-priority 64

switch-A(config-if-range)#exit

#Configure switch-B
switch-B(config)#lacp system-priority 2048
switch-B(config)#interface range ethernet 0/0/3 to ethernet 0/0/4
switch-B(config-if-range)#lacp port-priority 256
switch-B(config-if-range)#exit

4. Add port member for channel-group
  (1) Static
#Configure switch-A
switch-A(config)#interface range ethernet 0/0/1 to ethernet 0/0/2
switch-A(config-if-range)#channel-group 1 mode on
Remember to re-config mac-addresses associated with port e0/0/1
Remember to re-config mac-addresses associated with port e0/0/2
#Configure switch-B
switch-B(config)#interface range ethernet 0/0/3 to ethernet 0/0/4
switch-B(config-if-range)#channel-group 1 mode on
Remember to re-config mac-addresses associated with port e0/0/3
Remember to re-config mac-addresses associated with port e0/0/4

  (2) Dynamic
#Configure switch-A
switch-A(config)#interface range ethernet 0/0/1 to ethernet 0/0/2
switch-A(config-if-range)#channel-group 1 mode active
Remember to re-config mac-addresses associated with port e0/0/1
Remember to re-config mac-addresses associated with port e0/0/2
#Configure switch-B
switch-B(config)#interface range ethernet 0/0/3 to ethernet 0/0/4
switch-B(config-if-range)#channel-group 1 mode passive
Remember to re-config mac-addresses associated with port e0/0/3
Remember to re-config mac-addresses associated with port e0/0/4

5. Check the configuration
  (1) show lacp internal
#show lacp internal of switch-A
switch-A(config-if-range)#show lacp internal
Load balance: src-dst-mac

Channel: 1, static channel

Port	State	A-Key	O-Key	Priority	Logic-port	Actor-state
e0/0/1	bndl	-	-	-	1	-
e0/0/2	bndl	-	-	-	1	-

actor-state: activity/timeout/aggregation/synchronization

collecting/distributing/defaulted/expired

#show lacp internal of switch-A
switch-A(config-if-range)#show lacp internal
Load balance: src-dst-mac

Channel: 1, dynamic channel

Port	State	A-Key	O-Key	Priority	Logic-port	Actor-state
e0/0/1	bndl	2	2	64	1	10111100
e0/0/2	bndl	2	2	64	1	10111100

actor-state: activity/timeout/aggregation/synchronization
                collecting/distributing/defaulted/expired

#show lacp internal of switch-B
switch-B(config-if-range)#show lacp internal
Load balance: src-dst-mac

Channel: 1, dynamic channel

Port	State	A-Key	O-Key	Priority	Logic-port	Actor-state
e0/0/3	bndl	2	2	256	3	00111100
e0/0/4	bndl	2	2	256	3	00111100

actor-state: activity/timeout/aggregation/synchronization
                collecting/distributing/defaulted/expired

(2) Show LACP neighbor
#Show LACP neighbor of switch-A
switch-A(config-if-range)#show lacp neighbor
Channel: 1

Local	Port	Key	Pri	ID	Timeout	Nei-state
e0/0/1	3	2	256	000000020305	82(90)	00111100
e0/0/2	4	2	256	000000020305	80(90)	00111100

nei-state: activity/timeout/aggregation/synchronization
                collecting/distributing/defaulted/expired

#Show LACP neighbor of switch-B
switch-B(config-if-range)#show lacp neighbor
Channel: 1

Local	Port	Key	Pri	ID	Timeout	Nei-state
e0/0/3	1	2	64	000000010203	71(90)	10111100
e0/0/4	2	2	64	000000010203	69(90)	10111100

nei-state: activity/timeout/aggregation/synchronization
collecting/distributing/defaulted/expired

(3) Show system ID
#Show switch-A system ID
switch-A(config-if-range)#show lacp sys-id
1024,000000010203
#Show switch-B system ID
switch-B(config-if-range)#show lacp sys-id
2048,000000020305

6.   Delete port member from channel-group
#Configure switch-A
switch-A(config-if-range)#no channel-group 1
Remember to re-config mac-addresses associated with port e0/0/1
Remember to re-config mac-addresses associated with port e0/0/2
switch-A(config-if-range)#exit
#Configure switch-B
switch-B(config-if-range)#no channel-group 1
Remember to re-config mac-addresses associated with port e0/0/3
Remember to re-config mac-addresses associated with port e0/0/4
switch-B(config-if-range)#exit
7.   Delete channel-group
#Configure switch-A
switch-A(config)#no channel-group 1
#Configure switch-B
switch-B(config)#no channel-group 1