Chapter5: Link Aggregation

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5.1 Link Aggregation Overview

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 LACPand dynamic LACP. Depending on whether or not load sharing is implemented, aggregation groups can be load-sharing or non-load-sharing aggregation groups.
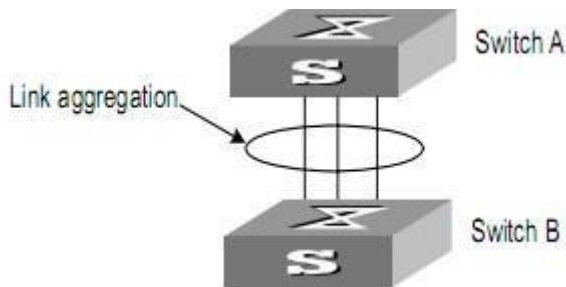
For the member ports in an aggregation group, their basic configuration must be the same. The basic configuration includes STP, QoS, VLAN, port attributes, and other associated settings.

☐   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.

5.1.1 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 operationkey (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 agreementin adding/removing the port to/from a dynamic aggregation group.

5.1.2 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.

5.1.3 Static Aggregation Group

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. Whena 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.

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.

5.1.4 Dynamic LACP Aggregation Group

1) 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 mustcontain 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 onsuch a port will not take effect.

2) 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, staticmode 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.

3) 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 ofthe 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 exceedsthe 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 (thatis, 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.

4) Configure 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.

5) Configure 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 accordingto 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.

5.2 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.

5.3 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.

5.4 Configure Link Aggregation

5.4.1 Link AggregationConfiguration List

Configuration Task	Description	Detailed Configuration

Configure a Static Aggregation Group	Required	5.4.2
Configure a Dynamic LACP Aggregation Group	Required	5.4.3
Display and Maintain Link Aggregation Configuration	Optional	5.4.4

5.4.2 Configure 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 bemanually added/removed to/from a static aggregation group.

Perform the configuration in global configuration mode.

Operation	Command	Remarks
Enter global configuration mode	**system-view**	
Create a static aggregation group	**channel-group** *channel-group-number*	*channel-group-number* ranges from 0 to 51.
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 interface range configuration mode	**interface range ethernet** *interface-list*	
Add a port to the aggregation group	**channel-group** *channel-group-number* **mode on**	

Delete a port from an aggregation group	**undo channel-group** *channel-group-number*	
Back to global configuration mode	**quit**	
Delete a static aggregation group	**undo channel-group** *channel-group-number*	

5.4.3 Configure Dynamic LACP

You can manually add/remove a port to/from a dynamic aggregation group, and a port can onlybe

manually added/removed to/from a dynamic aggregation group.

Operation	Command	Remarks
Enter global configuration mode	**system-view**	
Create a dynamic aggregation group	**channel-group** *channel-group-number*	*channel-group-number* ranges from 0 to 51
Configure load-balancing policy	**channel-group load-balance { dst-ip | dst-mac | src-dst-ip | src-dst-mac | src-ip | src-mac }**	Src-mac by default
Configure system priority	**lacp system-priority** *priority*	32768 by default
Enter interface configuration mode	**Interface thernet** *interface-num*	
Enter interface range configuration mode	**interface range ethernet** *interface-list*	
Add a port to the aggregation group	**channel-group** *channel-group-number* **mode** { **active | passive** }	
Configure port priority	**lacp port-priority** *priority*	128 by default
Delete a port from an aggregation group	**undo channel-group** *channel-group-number*	

Back to global configuration mode	**quit**	
Delete a dynamic aggregation group	**undo channel-group** *channel-group-number*	

5.4.4 Display and Maintain LACP

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

Operation	Command	Remarks
Display system LACP ID	**display lacp sys-id**	System LACP-ID consists of 16-bit system priority and 48-bit system MAC.
Display port member info of the aggregation group	**display lacp internal** [*channel-group-number*]	
Display neighbor port info of the aggregation group	**display lacp neighbor** [*channel-group-number*]	
Display packet statistics of the aggregation group	**display statistics channel-group** [*channel-group-id*]	
Display packet statistics of the aggregation group by dynamic	**display statistics dynamic channel-group**	
Display utilization statistics of the aggregation group	**display utilization channel-group**	

Clear packet statistics of the aggregation group	**clear channel-group** [*channel-group-id*]	