Application of the Stacking and LACP Technology in Communications Networks

Huarong Wang

School of Electrical and Mechanical Engineering, Guangdong University of Science and Technology, Guangdong 523083, China

Corresponding author’s email: Wanghuarong1977@126.com

Abstract. A key factor that has been winning market competitive advantage by carrier markets is how to solve the selection of equipments with lowest cost which provides a reasonable solution on network security and topology. By introducing the stacking technology, this paper gives a detailed explanation on how to use the lowest cost to solve the equipment selection problem and the devices’ hot backup. As the same time, it is shown that the network link aggregation hot backup is resolved by using the Link Aggregation Control Protocol (LACP). Once there is a failure in both a link and an equipment, the system would detect the failure and automatically switch to the backup link and equipment to ensure the network security.

Keywords. Switches; Stack; LACP; hot backup

1. Introduction

What kind of network switch should be chosen to have the lowest investment, the most reasonable network arrangement, the most secure network arrangement and the greatest profit at the same time are the key considerations for operators and companies that need to establish large networks when planning their networks. Due to the number of users developed and the business changes required by users, the required switches will be different, while the current switch equipment produced by manufacturers have basically the same business functions and interfaces. How do we use the switches provided by equipment manufacturers to plan the network? This is a technical issue. We are using a switch with high processing power and will not be able to achieve maximum utilization, leaving many ports idle. If a switch with low processing power is used, there will be too few ports and not enough processing power to support the business requirements. Using the cascaded mode of switch will produce many cascaded points, increase the delay and do not meet the network planning requirements. This article explains the use of stacking technology to solve this problem, increase the backplane capacity of access ports and devices through the superposition of several devices, several devices can be regarded as a whole without cascading, at the same time, it will not increase the point of failure, meet the network planning and networking requirements, achieve the hot backup of the equipment, and solve the problem that the device cannot be switched in the early stage due to equipment failure, which affects the user's network usage. Use LACP (Link Aggregation Control Protocol, Link Aggregation Control Protocol) link aggregation to solve the hot backup of the link, treat the device
uplink several links as one link, and monitor the security status of the link through the LACP protocol. When the channel is interrupted, the service can be automatically switched to another one or several normal links for uplink without affecting the user's use. Using the combination of these two technologies fundamentally solves the user's business protection problem. [1]

2. Introduction to Stacking and LACP Protocol

2.1 Introduction to stacking
Insert refers to the combination of more than one switch to work together, the gate in a limited space to provide the placement of more than one port. Multiple switches are stacked to form a stacking unit. There is a "maximum stackable number" parameter in the stackable switch performance indicators. It refers to the maximum number of switches that can be stacked in a stacking unit, and represents the maximum port density that a stacking unit can provide [2].

At present, mainstream switches on the market can be subdivided into two categories: stackable and non-stackable. In switches that are known to be stackable, there are virtual stacking and real stacking. The so-called virtual stack is actually a cascade between switches. Switches are not stacked through dedicated stacking modules and stacking cables, but stacked through Fast Ethernet ports or GigaEthernet ports. In fact, this is a disguised cascade. Even so, multiple switches in a virtual stack can already be managed as a logical device in the network, making network management easier. The specific diagram of the switch stack is shown in Figure 1.

![Figure 1. Switch stacking diagram](image)

2.2 The introduction of LACP
LACP based on the IEEE802.3ad standard is a protocol for dynamic link aggregation. The LACP protocol exchanges information with the peer through LACPDU (Link Aggregation Control Protocol Data Unit, link aggregation control protocol data unit) [3].

When the LACP protocol for a port is enabled, the port informs the counterparty of its system priority, system MAC address, port priority, port number, and operation Key by sending the LACPDU. After receiving the information, the opposite end compares the information with the information stored in other ports to select a port that can be aggregated, so that both parties can reach an agreement on the port joining or leaving a dynamic aggregation group. The operation key is a configuration combination generated by the LACP protocol according to the port configuration (speed, duplex, basic configuration, and management key) when ports are aggregated. After the LACP protocol is enabled on the dynamic aggregation port, its management key defaults to zero. After LACP is enabled on a static aggregation port, the management key of the port is the same as the aggregation group ID. For dynamic aggregation groups, members of the same group must have the same operation key, while in manual and static aggregation groups, active ports have the same operation key. Port aggregation refers to the pooling of multiple ports to form an aggregation group, so as to realize the sharing of inbound and outbound load among all member ports in the aggregation group and provide higher connection reliability at the same time.
LACP is divided into static LACP and dynamic LACP.

2.2.1 Static LACP
Static LACP aggregation is manually configured by the user, and the system is not allowed to automatically add or delete ports in the aggregation group. The aggregation group must contain at least one port. When the aggregation group has only one port, the port can only be deleted from the aggregation group by deleting the aggregation group.

The LACP protocol of the static aggregation port is enabled. When a static aggregation group is deleted, its member ports will form one or more dynamic LACP aggregations and keep LACP enabled. Forbid the user to close the LACP protocol of the static aggregation port [4].

2.2.2 Dynamic LACP
Dynamic LACP aggregation is an aggregation that the system automatically creates and deletes. Users are not allowed to add or delete member ports in a dynamic LACP aggregation. Only ports with the same speed and duplex properties, connected to the same device, and the same basic configuration can be dynamically aggregated. Even if there is only one port, a dynamic aggregation can be created. At this time, it is a single-port aggregation. In dynamic aggregation, the LACP protocol of the port is enabled.

3. The situation before the network transformation

![Network diagram of equipment before reconstruction](image)

**Figure 2.** Network diagram of equipment before reconstruction

It can be seen from Figure 2 that there are many problems in the topology of the network of its equipment: First, the nodes from the OLT and the user’s CE below are all single chains, and there is no link protection. If an uplink is interrupted, the device of the node hanging down will be interrupted, which will affect the user's network usage, and the security of the network cannot be guaranteed. Second, there is no protection between the switches. When one of the switches fails, the OLT B, C and the user-side CE router will definitely fail and cannot be protected. Third, Switch B and C are in the
same computer room. For example, all the ports of Switch C are used up, and in order to develop business, a Switch B is added in front to connect equipment and business, thus increasing the number of cascades and fault points, which does not meet the requirements of network flattening. In order to solve the above problems, switch stacking and LACP technology are used to solve them.

4. Technical implementation using stacking and LACP protocol

Through the above analysis, before the transformation, we realized that the uplink of each device was guaranteed to have two uplinks, realized LACP link aggregation uplink, used switch stacking to realize switch hot backup, and solved the cascade problem.

Since Switch B and Switch C are in the same equipment room, the two devices can be stacked using stacking cables. The stacking cable is mainly connected from the "UP" stacking port of one switch to the "DOWN" stacking port of another switch through a dedicated connection cable provided by the manufacturer. Corresponding ports are generally on the back of the switch and are unique, and there will be no connection errors. These two devices can be regarded as one device and can be seen as a whole. Regard Switch B as the primary stacking device and switch C as the backup stacking device. The following three OLTs and one CE adopt LACP dual link aggregation access to Switch B and Switch C, so as to ensure the safety of the link, realize the hot backup of the line, ensure the normal operation, and increase the uplink bandwidth to ensure the stability of the broadband service, as shown in Figure 3.

![Figure 3. Network diagram of equipment after transformation](image_url)

The original Switch C device is Huawei's S3328, whose port is 24 gigabit serial ports and 4 gigabit optical ports. The current price is about RMB 3,000 yuan for one. Switch B is Huawei's S5328, whose port is 24 gigabit optical ports and 4 gigabit Ethernet ports, and the price is RMB 8,000 yuan for one. If Switch C is replaced with S9303 in the early stage, the price is 100,000 yuan, and the number of ports is 48 Ethernet ports of 100 megabytes, 48 gigabit optical ports, and 8 10GE optical ports. If the business increment is not doubled, such advanced equipment is not needed temporarily. The S5328 and S3328 can be used to complete the user access needs for the next three years here. In this way, we have saved about 90,000 yuan in cost. At the same time, the two OLTs and one CE originally connected to Switch C reduce the access cascade. The number of faults is reduced, and the requirements for flat network planning are met.

The original OLT and user's CE are changed to LACP dual link aggregation uplink access to the two switches to ensure the thermal backup of the link. The details are shown in Figure 3. At the
convergence layer, add a switch Switch D for the access of the nodes below, and implement switch stacking with Switch A to become a device, and implement hot backup for Switch A to ensure the security of the entire network.

5. Data operation of the switch
Connect switches B and C using stacking cables, and then perform the following data operations:

5.1 Configure SwitchB's stacking chassis priority to 255, and enable the CSS function.
① Configure stackboxes with priority 255.

<Quidway> system-view
[Quidway] sysname SwitchB
[SwitchB] set css priority 255
② Enable CSS function [5].
[SwitchB] css enable

5.2 Configure the stacking chassis ID of Switch C to 2, enable the CSS function, and set the priority to the default level.
① Configure the stacking chassis ID to 2 [5].

<Quidway> system-view
[Quidway] sysname SwitchC
[SwitchC] set css id 2
② Enable CSS function [5].
[SwitchC] css enable

5.3 Complete LACP data
This article takes the uplink LACP link aggregation data of Switch B and Switch C as an example. The other data is basically the same. The following detailed introduction completes the uplink LACP link aggregation uplink data of Switch B and Switch C:

<Switch> system-view
[Switch] interface Eth-Trunk1
[Switch-Eth-Trunk1] port link-type trunk
[Switch-Eth-Trunk1] port trunk allow-pass vlan 706 712 730
[Switch-Eth-Trunk1] bpdru enable
[Switch-Eth-Trunk1] mode lacp-static
[Switch-Eth-Trunk1] quit
[Switch] interface G1/0/0/1
[Switch-GigabitEthernet1/0/0/1] eth-trunk 1
[Switch-GigabitEthernet1/0/0/1] quit
[Switch] interface G2/0/0/1
[Switch-GigabitEthernet2/0/0/1] eth-trunk 1
[Switch-GigabitEthernet2/0/0/1] quit
Then the uplink LACP link aggregation uplink data of Switch B and Switch C has been completed, so that LACP link protection can be realized.

6. Conclusion
The selection of switch equipment and the protection of the network are currently the key considerations of various operators. Through the stacking of switch equipment, this article allows operators to select specific equipment according to the development of users, solve the problem of equipment investment waste, and use superposition to solve the hot backup of equipment. Secondly, the introduction of the LACP link aggregation protocol and its application in the network can solve the hot backup of the equipment uplink for operators and realize the protection of the link.
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