Research on high reliability in redundant link aggregation mode

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Abstract. Now, with the rapid development of the Internet, the requirement of bandwidth and reliability of backbone link is higher. In traditional Ethernet networks, it needs to pay a high price to increase the network bandwidth, if you use high-speed equipment, so not only the cost is high, but also the network is not flexible enough. In order to ensure the stability and reliability of Ethernet network, this paper proposes a redundant link aggregation technique, without replacing the equipment, and bundling multiple physical interfaces into a logical interface to increase the bandwidth of the link, dynamic and effective backup links can also be used to improve the reliability of links between devices. Redundant link aggregation can not only improve network bandwidth resources, but also solve the problem of network congestion.

1. Introduction
In the ethernet network, devices are often connected by multiple cables. When the bandwidth in the network is not enough, can we logically bind multiple links to it, so as to improve the network link bandwidth? [1]

2. Concept description
Redundant aggregate links, it means that multiple physical member interfaces with the same speed, the same mode and the same port mode are bundled into one logical interface, and the formed link comes from multiple logical interfaces. Load and traffic distribution is realized through dynamic backup link, at the same time, it can improve the reliability of the link. According to the load state of the port, the devices share the link bandwidth evenly when the link is stable, when the detection member port link fails, stop sending packets on this port, recalculate the sending port of the message in the link without failure, until the fault port is recovered, it will act as the transceiver port again. [2]

3. Spanning tree protocol
In the ethernet network, we know that the switch runs the STP protocol by default. The principle of STP is that no matter how many links are connected between operating devices, there is only one link that can forward data at the same time, the bandwidth of multiple links is greatly wasted, the redundant links cannot work at the same time. When we aggregate these redundant links, then these redundant links can work at the same time, it can not only forward data at the same time, but also improve the link bandwidth.
At the same time, it can share the link load dynamically, real time detection of link failure, The reliability of network system is guaranteed.

4. Aggregation mode
There are two main aggregation modes of redundant links in Ethernet: Manual mode and *LACP* mode.

![Figure 1. Aggregation mode](image)

4.1. Manual mode
Manual mode, it is a basic link aggregation technology, there is no link aggregation protocol in this mode, the eth-trunk interface is completely manually bound to the member interface, and all member interfaces participate in traffic sharing and data forwarding. In this mode, *LACP* is closed, all redundant links are active after aggregation, and there is no more than one backup link.

4.2. *LACP* mode
*LACP* mode is divided into static *LACP* mode and dynamic *LACP* mode, there are not only active links, but also backup links.

In static *LACP* mode, when configuring the eth-trunk interface, the member interface is added manually, when a group of member interfaces are added to the eth- trunk interface, it mainly negotiates which interfaces are used as active interfaces and which interfaces are used as backup interfaces through *LACP* protocol messages.

In dynamic *LACP* mode, the addition of member interface, the establishment of eth-trunk interface and the selection of active interface and backup interface are all completed by *LACP* protocol. When dynamic *LACP* is enabled, two directly connected devices no longer need to create an eth-trunk interface, it is no longer necessary to specify which interfaces are aggregate member interfaces, the link aggregation between devices is completed automatically through *LACP* negotiation.

5. Aggregation rules
In principle, eth-trunk links can only be bundled up to 8 links, when aggregating links, the number of bound member interfaces, duplex mode, rate and port type must be consistent. In real networks, no matter how many lines are bundled, when the links are aggregated, data traffic is not evenly distributed after link aggregation, the specific allocation process is determined by the dynamic equilibrium allocation algorithm, in order to balance the load sharing of links, it is recommended that the number of bundled links should be even, odd number of links will lead to unbalanced load sharing.

6. Aggregation test

6.1. Manual mode configuration test
- Display device STP information
  
  [LSW1]display stp brief
Because the device runs STP protocol by default, through the analysis of STP data information, it can be found that the three interfaces of LSW1 are in forwarding state. In LSW2, only one interface is in forwarding state and the other two interfaces are in discarding state.

- Manual mode configuration

[LSW1] interface Eth-Trunk 12
[LSW1-Eth-Trunk12]trunkport Ethernet 0/0/1 to 0/0/3
[LSW2] interface Eth-Trunk 12
[LSW2-Eth-Trunk12]trunkport Ethernet 0/0/1 to 0/0/3
[LSW1]display stp brief

MSTID Port Role STP State Protection
0 Ethernet0/0/1 DESI FORWARDING NONE
0 Ethernet0/0/2 DESI FORWARDING NONE
0 Ethernet0/0/3 DESI FORWARDING NONE

By displaying the brief information of STP, it is found that the three interfaces of LSW1 and LSW2 are combined into one eth-trunk12 interface, and it is in forwarding state.

6.2. LACP mode configuration test

We set interfaces E0/0/1 and E0/0/2 as active, set interface E0/0/3 as backup link.

[LSW1]int Eth-Trunk 12
[LSW1-Eth-Trunk12]mode lacp-static
[LSW1-Eth-Trunk12]trunkport Ethernet 0/0/1 to 0/0/3
[LSW1]display stp brief

MSTID Port Role STP State Protection
0 Eth-Trunk12 DESI FORWARDING NONE

By displaying the brief information of STP, it is found that the three interfaces of LSW1 and LSW2 are combined into one eth-trunk12 interface, and it is in forwarding state.

It can be seen from the display eth trunk 12, the system priority of both devices is 32768, we can see that the three interfaces of the two devices are all in the selected state, And the port PRI is 32768. The value of this parameter can be changed by device priority and interface priority, the smaller the parameter, the higher the priority.
Reduce the priority of LACP, set LSW1 as the main device of LACP, reduce LACP priority of LSW1 interface 0/0/1 and 0/0/2 to 100, set the maximum number of active links to 2, LACP preemption mode activated.

[SW1] lacp priority 100
[SW1] int Ethernet 0/0/1
[SW1-Ethernet0/0/1] lacp priority 100
[SW1] int Ethernet 0/0/2
[SW1-Ethernet0/0/2] lacp priority 100
[SW1] int Eth-Trunk 12
[SW1-Eth-Trunk12] max active-linknumber 2
[SW1-Eth-Trunk12] lacp preempt enable
[SW1] display eth-trunk 12

System Priority: 32768 Max Active-linknumber: 2

| ActorPortName | Status | PortType | PortPri | PortNo | PortKey | PortState | Weight |
|---------------|--------|----------|---------|--------|---------|-----------|--------|
| Ethernet0/0/1 | Selected | 100M | 100 | 2 | 3105 | 10111100 | 1 |
| Ethernet0/0/2 | Selected | 100M | 100 | 3 | 3105 | 10111100 | 1 |
| Ethernet0/0/3 | Unselected | 100M | 32768 | 4 | 3105 | 10111100 | 1 |

[LSW1] dis int Eth-Trunk 12
Eth-Trunk12 current state : UP
Line protocol current state : UP
Maximal BW: 300M, Current BW: 200M.
The Number of Ports in Trunk : 3 The Number of UP Ports in Trunk : 2

After setting the above parameters, display eth trunk 12 information, it can be seen that interfaces 1 and 2 are selected as the primary link, while interface 3 is not selected as the backup link.

If one of the main links fails, the backup link will be activated immediately to ensure reliable link bandwidth. If i turn off primary link interface 1, it can be found that interface 2 and 3 are selected as the primary link, and interface 1 is not selected as the backup link.

When we reset interface 1, LACP preemption mode activated. 30 seconds later, interface 1 and 2 are selected as the primary link, and interface 3 is unselected as the backup link.

7. Conclusion
This paper is one of the achievements of the school level project "Research on the application of dual spatial modulation in wireless LAN based on WiFi", and the project number is ky202024. This paper emphasizes the redundant links in ethernet network to improve and ensure the high availability of the network. The concept, significance, rules and the principle of spanning tree of link aggregation are described in detail. Through the simulation test, we understand the high reliability of redundant links in link aggregation mode. When the link bandwidth is not enough, different aggregation methods can be used to improve the effective bandwidth of links, and reduce network costs, eliminate the loop impact of redundant links on the network, make full use of network redundant link resources, and ensure the stability and reliability of the network.

References
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