Chapter 8: VLAN

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Chapter 8 VLAN

8.1 VLAN Overview

Virtual Local Area Network (VLAN) groups the devices of a LAN logically but not physically into segments to implement the virtual workgroups. IEEE issued the IEEE 802.1Q in 1999, which was intended to standardize VLAN implementation solutions.

Through VLAN technology, network managers can logically divide the physical LAN into different broadcast domains. Every VLAN contains a group of workstations with the same demands. The workstations of a VLAN do not have to belong to the same physical LAN segment.

With VLAN technology, the broadcast and unicast traffic within a VLAN will not be forwarded toother VLANs, therefore, it is very helpful in controlling network traffic, saving device investment,simplifying network management and improving security.
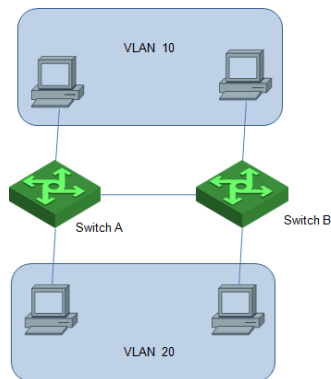
A VLAN can span across multiple GPONes, or even routers. This enables hosts in a VLAN to be dispersed in a looser way. That is, hosts in a VLAN can belong to different physical networksegment. Compared with the traditional Ethernet, VLAN enjoys the following advantages.

1) Broadcasts are confined to VLANs. This decreases bandwidth utilization and improves network performance.

2) Network security is improved. VLANs cannot communicate with each other directly. That is, a host in a VLAN cannot access resources in another VLAN directly, unless routers or Layer 3 GPONes are used.

3) Network configuration workload for the host is reduced. VLAN can be used to group specific hosts. When the physical position of a host changes within the range of the VLAN, you need not change its network configuration.

8.1.1 VLAN Principles

VLAN tags in the packets are necessary for the GPON to identify packets of different VLANs. The GPON works at Layer 2 (Layer 3 GPONes are not discussed in this chapter) and it can identify the data link layer encapsulation of the packet only, so you can add the VLAN tag fieldinto only the data link layer encapsulation if necessary.

In 1999, IEEE issues the IEEE 802.1Q protocol to standardize VLAN implementation, definingthe structure of VLAN-tagged packets.

IEEE 802.1Q protocol defines that a 4-byte VLAN tag is encapsulated after the destination MAC address and source MAC address to display the information about VLAN.
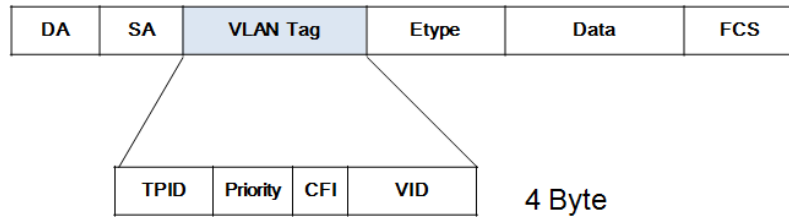
As shown in Figure 1-2, a VLAN tag contains four fields, including TPID (Tag ProtocolIdentifier), priority, CFI (Canonical Format Indicator), and VID (VLAN ID).

TPID is a 16-bit field, indicating that this data frame is VLAN-tagged. By default, it is 0x8100. **Priority** is a 3-bit field, referring to 802.1p priority. Refer to section "QoS & QoS profile" fordetails.

CFI is a 1-bit field, indicating whether the MAC address is encapsulated in the standard formatin different transmission media. This field is not described in detail in this chapter.

VID (VLAN ID) is a 12-bit field, indicating the ID of the VLAN to which this packet belongs. It isin the range of 0 to 4,095. Generally, 0 and 4,095 is not used, so the field is in the range of 1 to4,094.

VLAN ID identifies the VLAN to which a packet belongs. When the GPON receives an un-VLAN-tagged packet, it will encapsulate a VLAN tag with the default VLAN ID of the inbound port for the packet, and the packet will be assigned to the default VLAN of the inboundport for transmission. For the details about setting the default VLAN of a port, refer to section "02-Port Configuration"

8.2 Configure 802.1Q VLAN

8.2.1 802.1Q VLAN Configuration List

Configuration Task	Description	Detailed Configuration
Create and Modify VLAN	Required	8.2.2
Delete Port Members from a VLAN	Optional	8.2.3
Delete VLAN	Optional	8.2.4
Configure Interface Default vlan ID	Optional	8.2.5
Configure Interface VLAN Mode	Optional	8.2.6
VLAN Attributes Based on Hybrid Interface	Optional	8.2.7
VLAN Attributes Based on Trunk Interface	Optional	8.2.8
Configure Port Priority	Optional	8.2.9
Configure Ingress Filtering	Optional	8.2.10
Configure Types of Interface acceptable-frame	Optional	8.2.11
Display VLANconfiguration	Optional	8.2.12

8.2.2 Create and Modify VLAN

GPON supports 4094 VLANs.

Perform following commands in privilege mode.

Operation	Command	Remarks
Enter global configuration mode	**system-view**	
Create a vlan and enter vlan configuration mode	**vlan** *vlan-list*	
Add port member to a vlan	**port ethenet** *interface-num*	
Configure vlan description	**description** *vlan-name*	By default, vlan description is empty.
Display the related information about VLAN	**display vlan** { *vlan-id*	**brief** }	

Note：If the VLAN to be created exists, enter the VLAN mode directly. Otherwise, create the VLAN first, and then enter the VLAN mode.

Vlan-id allowed to configure is in the range of 1 to 4094. Vlan-list can be in the form of discrete number, a sequence number, or the combination of discrete and sequence number, discrete number of which is separate by comma, and sequence number of which is separate by subtraction sign, such as: 2, 5, 8, 10-20.

8.2.3 Delete Port Members from a VLAN

Perform following commands in privilege mode.

Operation	Command	Remarks
Enter global configuration mode	**system-view**	
Create a vlan and enter vlan configuration mode	**vlan** *vlan-list*	
Delete port member from VLAN	**undo port** { **all	ethernet** *interface-num* }	
Display the related information	**display vlan** { *vlan-id*	**brief** }	

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8.2.4 Delete VLAN

Perform following commands in privilege mode.

Operation	Command	Remarks
Enter global configuration mode	**system-view**	
Delete VLAN	**undo vlan** { *vlan-list* | **all** }	
Display the related information about VLAN	**display vlan** { *vlan-id* | **brief** }	

8.2.5 Configure Interface Default VLAN ID

Perform following commands in privilege mode.

Operation	Command	Remarks
Enter global configuration mode	**system-view**	
Enter Interface configuration mode	**interface ethernet** *interface-num*	
Configure interface pvid	**port default vlan** *vlan-id*	
Configure interface default pvid	**undo port default vlan**	Vlan1 by default
Display interface detailed configurations	**display interface ethernet** *interface-num*	

Display interface brief configurations	**display interface brief ethernet** [*interface-num*]	

8.2.6 Configure Interface VLAN Mode

Interface VLAN mode can be divided into three types according to the different process modesthe interface performs on tag label:

Access: the interface only belongs to one vlan, and it usually is used to connect the terminal device.

Trunk: the interface can be able to receive and forward multiple vlans. When the packet is forwarded, the default vlan packet will not carry the tag whereas the other vlan will carry the tag, and the tag is applied to the GPON interface.

Hybrid: the interface can be able to receive and forward multiple vlans, and it allows multiple vlans to carry the tag or not carry the tag.

Interface VLAN mode	Processing on receiving message		Processing on forwarding message
	Untag	**Tag**	
Access	Receive it and add a tag of pvid to it.	If the VLAN ID of the packet is a VLAN that the port allows to pass through, the packet will	If the VLAN ID carried in a packet is the VLAN ID that the port allows to pass through, the VLAN tag will be striped and the packet will be forwarded.
Hybrid			1. If the VLAN ID carried in the packet is the UNTAG VLAN ID the port allows to pass through, the VLAN tag will be striped and the packet will be forwarded. 2. If the VLAN ID carried in the packet is the TAG VLAN ID the port allows to

			pass through, the VLAN tag will remain and the packet will be forwarded.
Trunk		be accepted. Otherwise, the packet will be discarded.	When the VLAN ID carried in a packet is the VLAN ID that the port allows to pass through:: 1. If the VLAN ID is not consistent with the port PVID, VLAN tag will be remained and the packet will be forwarded. 2. If the VLAN ID is consistent with theport PVID, VLAN tag will be stripped andthe packet will be forwarded.

Configure interface vlan mode

Operation	Command	Remarks
Enter global configuration mode	**system-view**	
Enter Interface configuration mode	**interface ethernet** *interface-num*	
Configure interface vlan mode	**port mode** { **access**	**hybrid**	**trunk** }	Hybrid by default.

8.2.7 VLAN Attributes Based on Hybrid Interface

Operation	Command	Remarks
Enter global configuration mode	**system-view**	
Enter Interface configuration mode	**interface ethernet** *interface-num*	
Configure interface vlan mode	**port mode hybrid**	

		"tagged" means that the vlan packet carries tag; "untagged" means that the vlan packet does not carry tag;
Allow the specified vlan to pass through this hybrid port	**port hybrid** { **tagged** | **untagged** } **vlan** { *vlan-list* | **all** }	
Does not allow the specified vlan to pass this hybrid port	**undo port hybrid vlan** *vlan-list*	

8.2.8 VLAN Attributes Based on Trunk Interface

Operation	Command	Remarks
Enter global configuration mode	**system-view**	
Enter Interface configuration mode	**interface ethernet** *interface-num*	
Configure interface vlan mode	**port mode trunk**	
Allow the specified vlan to pass through this trunk port	**port trunk allowed vlan** { *vlan-list* | **all** }	

Do not allow the specified vlan to pass through this trunk port	**undo port trunk allowed vlan** { *vlan-list* | **all** }	

8.2.9 Configure Port Priority

If GPON receives a untagged packet, system will add a vlan tag to the packet in which the vidvalue in the tag is the PVID value and the priority value is the port priority value.

Operation	Command	Remarks
Enter global configuration mode	**system-view**	
Enter Interface configuration mode	**interface ethernet** *interface-num*	
Configure port priority	**priority** *value*	
Restore default priority	**undo priority**	0 by default
Display the port detailed configurations	**display interface ethernet** *interface-num*	
Display the port brief configurations	**display interface brief ethernet** [*interface-num*]	

8.2.10 Configure Ingress Filtering

By default, interface will check whether the receiving packet belongs to the vlan, if it does, the

interface will perform the forward processing. Otherwise, it will discard the packet. Thisprocess is called ingress filtering. GPON will enable this function by default and this function isallowed to be disabled.

Operation	Command	Remarks
Enter global configuration mode	**system-view**	
Enter Interface configuration mode	**interface ethernet** *interface-num*	
Configure ingress filtering	[**undo**] **ingress filtering**	Enabled by default
Display the configuration information	**displayress** [**interface** *interface-num*]	

8.2.11 Configure Types of Interface Acceptable-frame

By default, regardless of any type of packet (tag or untag) received by the GPON, it is allowedto change the port to receive only tag packets.

Operation	Command	Remarks
Enter global configuration mode	**system-view**	
Enter Interface configuration mode	**interface ethernet** *interface-num*	
Configure interface priority	**ingress acceptable-frame** { **all**	**tagged** }	"all" means it can receive the tag packets and untag packets;

		"tagged" means it can only receive the tag packets.
Display the configuration information	**display ingress** [**interface** *interface-num*]	

8.2.12 Display VLANconfiguration

Operation	Command	Remarks
Display VLANconfiguration by vlanid	**display vlan** [*vlan-id*]	
Display VLAN configuration by brief	**display vlan brief**	
Display VLAN configuration by interface	**display vlan interface** [**ethernet** *interface-num*]	

8.3 Configure MAC-Based VLAN

8.3.1 MAC-Based VLAN Overview

As noted earlier, a single port in the campus network has multiple services, and each service belongs to different VLANs. So the flexible configuration of VLAN under the GPON port to identify different services has become a key issue of the campus network management.

In order to solve the above-mentioned problems, the MAC-based VLAN is proposed. MAC (Media Access Control) address is burnt on a Network Interface Card (NIC), also known as thehardware address. It's composed of 48 bits long (6 bytes), 16 hex digits.

MAC-based VLAN is another way to distinguish VLAN that tag of VLAN is added to packet according to the source MAC address. This is often in combination with security technologies (such as 802.1X) to achieve the purpose of the terminal's safety and flexible access.

8.3.2 ConfigureMAC-Based VLAN

Users should bind the terminal MAC address with VLAN via the command line, and the devicewill generate a corresponding MAC VLAN table.

The implementation of this approach is simple, only involved in access equipment. But in this way, it is necessary to manually configure the MAC VLAN of the terminal on terminal accessable ports. It was a big project.

Operation	Command	Remarks
Enter global configuration mode	**system-view**	
Configure static vlan-mac table	**mac-vlan mac-address** *mac-address vlan* [*priority*]	
Delete vlan-mac table	**undo mac-vlan** [**mac-address** *mac-address*]	
Display vlan-mac table	**display vlan-mac-table** [*mac-address*]	

8.4 Configure Protocol-Based VLAN

8.4.1 Protocol-Based VLAN Overview

Protocol-based VLAN: the packet distributes different VLAN ID according to the receiving

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protocol types and encapsulation formats. "Protocol types + encapsulation formats" is also called model agreement. One protocol vlan can be able to bind multiple model agreements. Different model agreements can be distinguished by the vlan-protocol table index. Agreement profile is referenced to the port, and then you can modify the packet vlan according to the model agreements.

Untagged packet processing (no vlan tag):

1.   If the packet protocol types and encapsulation formats are conform to the model agreements, it will be tagged with the protocol vlan-id.

2.   If the packet protocol types and encapsulation formats are not conforming to the model agreements, it will be tagged with the port default VLAN ID.

Tagged packet processing (has vlan tag):

1.   If the packet protocol types and encapsulation formats are conform to the model agreements, the outer vlan information will be modified to be the protocol vlan-id.

2.   If the packet protocol types and encapsulation formats are not conform to the model agreements, the processing mode will be the same as the port-based vlan.

This feature is mainly applied to bind the service type with VLAN, providing convenient management and maintenance.

There are two types' configuration modes of protocol-based VLAN. Please choose the suitableone according to the equipment type.

8.4.2 ConfigureProtocol-Based VLAN

Operation	Command	Remarks
Enter global configuration mode	**system-view**	

Configure protocol profile	**protocol-vlan profile** *index* **frame-type** *eth-type*	
Delete protocol profile	**undo protocol-vlan profile** [*index*]	
Enter Interface configuration mode	**interface ethernet** *interface-num*	
Bind protocol-vlan profile	**protocol-vlan profile** *index* **vlan** *vlan-id* [**priority** *priority*]	
Undo bind protocol-vlan profile	**undo protocol-vlan profile** [*index*]	
Display protocol-vlan profile	**display protocol-vlan profile** [*index*]	
Display protocol-vlan profile bind	**display protocol-vlan interface** [**ethernet** *interface-num*]	

8.5 Configure IP-subnet VLAN

8.5.1 IP-subnet VLAN Overview

IP subnet-based vlan is divided according to packet source IP address and subnet mask. Afterdevice received packets from the interface, it will confirm the packets belonging to which VLANand then automatically divide these packets to specified VLAN.

8.5.2 ConfigureIP-subnet VLAN

Operation	Command	Remarks
Enter global configuration mode	**system-view**	
Configure ip-subnet-vlan table	**ip-subnet-vlan ipv4** *ip-address* **mask** *mask* **vlan** *vlanid* [**priority** *priority*]	
Delete ip-subnet-vlan table	**undo ip-subnet-vlan** [**ipv4** *ip-address* **mask** *mask*]	
Enable the IP subnet-based VLAN	**ip-subnet-vlan precede**	
Disable the IP subnet-based VLAN	**undo ip-subnet-vlan precede**	
Display ip-subnet-vlan table	**display ip-subnet-vlan** [**ipv4** *ip-address* **mask** *mask*]	