

In order to clarify how VLANs are created, it is useful to understand how the modification made to the original MAC filtering and forwarding rules allows for the implementation of VLANs. The following processes and rules are high-level and, therefore, are not intended to represent exactly how they may be implemented.

Non-VLAN-Capable Switch MAC Rules

Consider a switch consisting of four ports. The MAC address table is used to store MAC addresses and the associated port where each MAC address was learned. The switches then flood, filter, or forward frames, as described in these scenarios.

When a frame is received on a port, this process and these rules are applied.

The source MAC address is placed in the MAC address table, along with the port ID of the port on which it was received. If the MAC address was already in the table, its associated aging countdown timer is reset (300 seconds by default).

Then the MAC address table is searched using the destination MAC address to determine which action to take. (The appropriate action for each scenario is shown in brackets.)

- A. If the destination MAC address is a broadcast or multicast address, then the frame is sent to all ports, excluding the received port. [Flood]
- B. If the destination MAC address comes from the same port on which it was received, then there is no need to forward it, and it is discarded. [Filter]
- C. If the destination MAC address comes from another port within the switch, then the frame is sent to the identified port for transmission. [Forward]
- D. If the destination MAC address is not in the MAC address table, then the frame needs to be flooded and is sent to all ports except for the port through which it arrived. This action is known as unicast flooding. [Flood]

Table 1: MAC Address Table

Port	MAC Address
4	0000.001c.ac52
2	0000.00ac.3783
3	0000.00cc.1709
3	0000.00dc.1bc5
1	0000.00ec.29ae
2	0000.00fc.76fb
1	0000.020c.1234
3	001a.6c59.0d60
4	0034.00bc.1467

VLAN-Capable Switch MAC Rules

Consider the same physical switch consisting of four ports, except now with VLAN-capable switch MAC address table rules. In order to implement VLANs, a new parameter called VLAN ID is associated with each entry.

When a frame is received, this process and these rules are applied.

The source MAC address is copied into the MAC address table, along with the port ID and port VLAN ID of the port on which it was received. If an entry already exists, its associated aging countdown timer is reset (300 seconds by default).

The MAC address table is searched for an entry match, and only the table entries that match the port VLAN ID will be inspected. (The appropriate action for each scenario is shown in brackets.)

- A. If the destination MAC address is a broadcast or multicast address, then the frame is sent to all ports with the same VLAN ID, excluding the received port. [Flood]
- B. If the destination MAC address comes from the same port on which it was received, then there is no need to forward it, and it is discarded. [Filter]
- C. If the destination MAC address comes from another port within the switch, then the frame is sent to the identified port for transmission. (Due to the previous rule regarding VLAN ID matching, this port can ONLY be a port in the same VLAN as the source port of the frame.) [Forward]
- D. If the destination MAC address is not in the MAC address table, then the frame needs to be flooded and is sent to all ports with matching VLAN ID, except for the port through which it arrived. This action is known as unicast flooding. [Flood]

Notice that the table has now been effectively split into two parts; each part is a separate broadcast domain. As IP end stations locate each other using the Address Resolution Protocol (ARP) process, this in turn uses a broadcast. If an end station is NOT in the same broadcast domain, it will not be reachable (rule A). Indeed, even if an end station had statically configured an entry in its ARP table, reachability would not take place because the MAC address is not in the VLAN of the receiving port (rule D).

Table 2: Mac Address Table with VLANs

Port	VLAN ID	Port	MAC Address
1	1	4	0000.001c.ac52
1	1	3	0000.00cc.1709
1	1	3	0000.00dc.1bc5
1	1	3	001a.6c59.0d60
1	1	4	0034.00bc.1467
2	2	2	0000.00ac.3783
2	2	1	0000.00ec.29ae
2	2	2	0000.00fc.76fb
2	2	1	0000.020c.1234

This article has shown how VLANs are created and how they operate by assigning VLAN IDs to ports within a switch. Now test your understanding with the self-check questions on the next page.

Self-Check Questions

All questions refer to Table 2 on page 2.

Complete the information for each question. Also, would the frame be forwarded, flooded, or filtered, and would the frame be received by the destination end station?

Example)

Source MAC Address	Destination MAC Address		
0000.00fc.76fb	0000.020c.1234		
VLAN# <u>2</u> PORT# <u>2</u>	VLAN# <u>2</u> PORT# <u>1</u>	Forwarded	Yes

1)

Source MAC Address	Destination MAC Address		
0000.00cc.1709	0034.00bc.1467		
VLAN# ___ PORT# ___	VLAN# ___ PORT# ___	_____	_____

2)

Source MAC Address	Destination MAC Address		
001a.6c59.0d60	0000.00dc.1bc5		
VLAN# ___ PORT# ___	VLAN# ___ PORT# ___	_____	_____

3)

Source MAC Address	Destination MAC Address		
0000.00ec.29ae	0000.020c.1234		
VLAN# ___ PORT# ___	VLAN# ___ PORT# ___	_____	_____

4)

Source MAC Address	Destination MAC Address		
0000.020c.1234	0000.00ac.3783		
VLAN# ___ PORT# ___	VLAN# ___ PORT# ___	_____	_____

5)

Source MAC Address	Destination MAC Address		
0000.001c.ac52	0000.00ac.3783		
VLAN# ___ PORT# ___	VLAN# ___ PORT# ___	_____	_____

6)

Source MAC Address	Destination MAC Address		
0000.00ac.3783	0000.002d.5c37		
VLAN# ___ PORT# ___	VLAN# ___ PORT# ___	_____	_____

7)

Source MAC Address	Destination MAC Address		
0000.00ac.3783	0034.00bc.1467		
VLAN# ___ PORT# ___	VLAN# ___ PORT# ___	_____	_____

Self-Check Answers

1)

Source MAC Address	Destination MAC Address		
0000.00cc.1709	0034.00bc.1467		
VLAN# 1 PORT# 3	VLAN# 1 PORT# 4	Forward	Yes

2)

Source MAC Address	Destination MAC Address		
001a.6c59.0d60	0000.00dc.1bc5		
VLAN# 1 PORT# 3	VLAN# 1 PORT# 3	Filter	Yes

3)

Source MAC Address	Destination MAC Address		
0000.00ec.29ae	0000.020c.1234		
VLAN# 2 PORT# 1	VLAN# 2 PORT# 1	Filter	Yes

4)

Source MAC Address	Destination MAC Address		
0000.020c.1234	0000.00ac.3783		
VLAN# 2 PORT# 1	VLAN# 2 PORT# 2	Forward	Yes

5)

Source MAC Address	Destination MAC Address		
0000.001c.ac52	0000.00ac.3783		
VLAN# 1 PORT# 4	VLAN# 2 PORT# 2	Flood	No

6)

Source MAC Address	Destination MAC Address		
0000.00ac.3783	0000.002d.5c37		
VLAN# 2 PORT# 2	VLAN# 2 PORT# ?	Flood	Unknown

7)

Source MAC Address	Destination MAC Address		
0000.00ac.3783	0034.00bc.1467		
VLAN# 2 PORT# 2	VLAN# 1 PORT# 4	Flood	No