Fundamentals of 802.1Q VLAN Tagging

Virtual Local Area Networks, or VLANs, segregate traffic within a network. VLANs keep traffic from different networks separated when traversing shared links and devices within a topology. This process, also known as VLAN tagging, is invaluable to limiting broadcast network traffic, and securing network segments. VLAN tagging is an integral part of networks of all sizes and is supported on the MX Security Appliances, MR Access Points, and the MS Series Switches. This can be done for both data, and management traffic independently.

Common Terms

- **VLAN** - Virtual Local Area Network, logical identifier for isolating a network
- **Trunk** - A port enabled for VLAN tagging
- **Access** - A port that does not tag and only accepts a single VLAN
- **Encapsulation** - The process of modifying frames of data to include additional information
- **802.1Q** - The most common encapsulation method for VLAN tagging. This is the method used by Meraki devices.
- **Native VLAN** - The VLAN associated with all untagged traffic on a trunk

Best Practices

VLAN enabled ports are generally categorized in one of two ways, tagged or untagged. These may also be referred to as "trunk" or "access" respectively. The purpose of a tagged or "trunked" port is to pass traffic for multiple VLAN's, whereas an untagged or "access" port accepts traffic for only a single VLAN. Generally speaking, trunk ports will link switches, and access ports will link to end devices.

Trunk ports require more steps to successfully negotiate as a trunk.

Both ends of the link must have the following in common:

- Encapsulation
- Allowed VLAN’s
- Native VLAN

While a link may successfully establish as up with mismatched allowed or native VLAN's, it is best practice to have both sides of the link configured identically. Mismatched native VLAN's or allowed VLAN's can have unforeseen consequences. Recall that the native VLAN is the VLAN associated with untagged traffic. Mismatched native VLAN’s on opposite sides of a trunk can inadvertently create "VLAN hopping". This is often a method of intentional attack used to sneak into a network and is an open security risk. Consider the following example and diagram.

A client is plugged in to a VLAN 1 access port and desires an address from the DHCP server on the VLAN 1 subnet (192.168.1.0/24). There is a native VLAN mismatch on the trunk link between the two switches, which will prevent the client from receiving the appropriate address. Coming from an access VLAN 1 port, when the DHCP request gets to the trunk on the switch, it will be untagged traffic, as the native VLAN is 1. When the traffic gets to the other switch on the other side of the trunk, the native VLAN is 10. The untagged traffic from the switch on the right will be treated as VLAN 10 on the switch on the left. The DHCP server will reply to the DHCP request for VLAN 10 (192.168.10.0/24) and send the address back to the client. Once again, as VLAN 10 is untagged on the left switch, it
will be treated as VLAN 1 on the right switch because of the native VLAN mismatch, and the client will ultimately obtain an address in the wrong subnet.

This, along with all other trunk configuration, must be identical for the entire path through the network that traffic will follow. For example, if there are 3 switches between a client and a gateway on VLAN 100, VLAN 100 must be trunked through all the switches connecting links (shown below).

While VLAN's are effective for separating network segments and limiting broadcast traffic, it is often a requirement for subnets separated by VLAN's to be able to communicate. This can be accomplished only through a Layer 3 enabled device that can route between the VLAN's. Even if both VLAN's exist on a device, their traffic will be segregated unless mediated by a layer 3 routing device.