17.11 Multiple Switches And Shared VLANs

Switches are usually placed in physical proximity to computers. For example, an organization may choose to place a switch on each floor of a building, even if departments occupy a few offices on multiple floors. Locating a switch near a set of computers reduces the number of wires that must be run. Furthermore, conventional switches can be interconnected to form a single, large network. Thus, only a single cable needs to run between switches.

Can VLANs operate across multiple switches? No, not without additional support. To see why, consider the hardware. It is easy to imagine VLANs operating in a single VLAN switch, because configuration information can be passed to each hardware component. Thus, if a network administrator specifies that ports 1, 12, 18, and 46 are on a VLAN, each of the four hardware interfaces can be configured to send incoming broadcast packets to the other three. However, if a pair of switches is interconnected, port 1 on the first switch and port 1 on the second switch might be on different VLANs, which means a port number is not sufficient to identify a VLAN.

IEEE has extended the Ethernet standard to make it possible to configure VLANs that cross multiple switches. Each VLAN is assigned a unique number. Instead of sending normal Ethernet frames across the connection between switches, an extra field is added to the header of each packet. The extra field in the frame contains a 16-bit integer known as a *VLAN tag*†. A VLAN tag identifies the VLAN to which the sending computer has been assigned. That is, if a manager has configured port 5 on a switch to be part of VLAN 17, the switch inserts a tag with value 17 in the header after the frame is received. The switch only keeps the tag for internal use — before it delivers a frame to one of the attached computers, the switch removes the tag.

IEEE standard 802.1Q specifies the format of an Ethernet frame that contains a VLAN tag. Interestingly, the tag field is not placed at the beginning or end of the frame. Instead, a tag is inserted in the header between the source address and Ethernet type fields. Figure 17.8 illustrates the format of an 802.1Q frame; compare the format to that of a standard Ethernet frame shown in Figure 15.1‡.

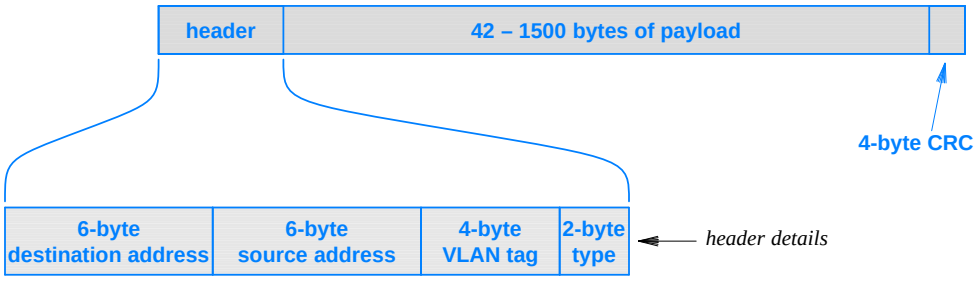

Figure 17.8 The format of an Ethernet frame with an 802.1Q VLAN tag.

†The 32-bit field is divided into a 16-bit header and a 16-bit VLAN tag.
‡Figure 15.1 can be found on page 256.