LAN Switching

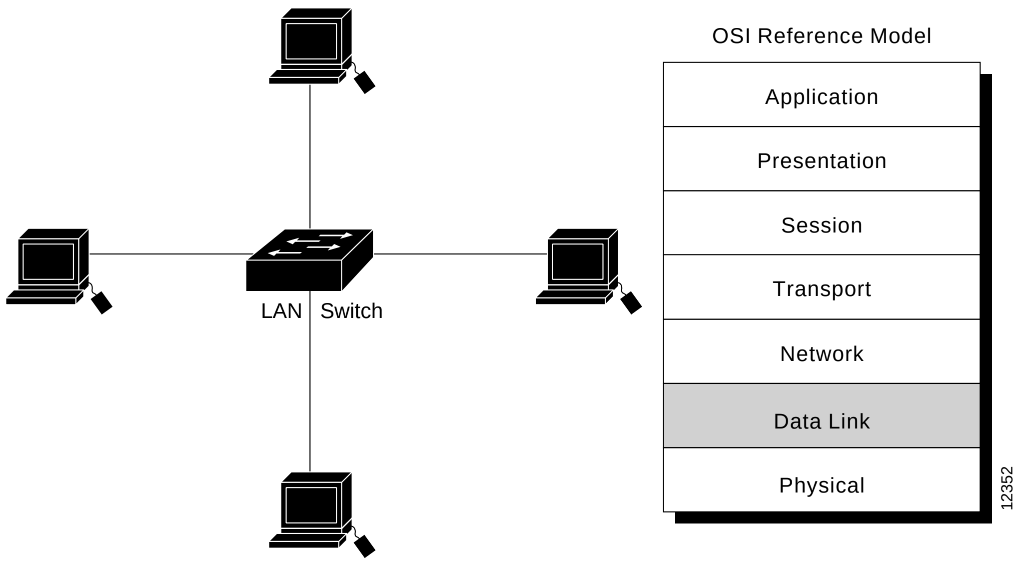
Background

A LAN switch is a device that provides much higher port density at a lower cost than traditional bridges. For this reason, LAN switches can accommodate network designs featuring fewer users per segment, thereby increasing the average available bandwidth per user. This chapter provides a summary of general LAN switch operation and maps LAN switching to the OSI reference model.

The trend toward fewer users per segment is known as *microsegmentation*. Microsegmentation allows the creation of private or dedicated segments, that is, one user per segment. Each user receives instant access to the full bandwidth and does not have to contend for available bandwidth with other users. As a result, collisions (a normal phenomenon in shared-medium networks employing hubs) do not occur. A LAN switch forwards frames based on either the frame's Layer 2 address (Layer 2 LAN switch), or in some cases, the frame's Layer 3 address (multi-layer LAN switch). A LAN switch is also called a frame switch because it forwards Layer 2 frames, whereas an ATM switch forwards cells. Although Ethernet LAN switches are most common, Token Ring and FDDI LAN switches are becoming more prevalent as network utilization increases.

Figure 22-1 illustrates a LAN switch providing dedicated bandwidth to devices, and it illustrates the relationship of Layer 2 LAN switching to the OSI data link layer:

Figure 22-1 A LAN switch is a data link layer device.



History

The earliest LAN switches were developed in 1990. They were Layer 2 devices dedicated to solving bandwidth issues. Recent LAN switches are evolving to multi-layer devices capable of handling protocol issues involved in high-bandwidth applications that historically have been solved by routers. Today, LAN switches are being used to replace hubs in the wiring closet because user applications are demanding greater bandwidth.

LAN Switch Operation

LAN switches are similar to transparent bridges in functions such as learning the topology, forwarding, and filtering. These switches also support several new and unique features, such as dedicated communication between devices, multiple simultaneous conversation, full-duplex communication, and media-rate adaption.

Dedicated collision-free communication between network devices increases file-transfer throughput. Multiple simultaneous conversations can occur by forwarding, or switching, several packets at the same time, thereby increasing network capacity by the number of conversations supported. Full-duplex communication effectively doubles the throughput, while with media-rate adaption, the LAN switch can translate between 10 and 100 Mbps, allowing bandwidth to be allocated as needed.

Deploying LAN switches requires no change to existing hubs, network interface cards (NICs), or cabling.

LAN Switching Forwarding

LAN switches can be characterized by the forwarding method they support. In the store-and-forward switching method, error checking is performed and erroneous frames are discarded. With the cut-through switching method, latency is reduced by eliminating error checking.

With the store-and-forward switching method, the LAN switch copies the entire frame into its onboard buffers and computes the cyclic redundancy check (CRC). The frame is discarded if it contains a CRC error or if it is a *runt* (less than 64 bytes including the CRC) or a *giant* (more than 1518 bytes including the CRC). If the frame does not contain any errors, the LAN switch looks up the destination address in its forwarding, or switching, table and determines the outgoing interface. It then forwards the frame toward its destination.

With the cut-through switching method, the LAN switch copies only the destination address (the first 6 bytes following the preamble) into its onboard buffers. It then looks up the destination address in its switching table, determines the outgoing interface, and forwards the frame toward its destination. A cut-through switch provides reduced latency because it begins to forward the frame as soon as it reads the destination address and determines the outgoing interface.

Some switches can be configured to perform cut-through switching on a per-port basis until a user-defined error threshold is reached, when they automatically will change to store-and-forward mode. When the error rate falls below the threshold, the port automatically changes back to store-and-forward mode.

LAN Switching Bandwidth

LAN switches also can be characterized according to the proportion of bandwidth allocated to each port. Symmetric switching provides evenly distributed bandwidth to each port, while asymmetric switching provides unlike, or unequal, bandwidth between some ports.

An asymmetric LAN switch provides switched connections between ports of unlike bandwidths, such as a combination of 10BaseT and 100BaseT. This type of switching is also called *10/100 switching*. Asymmetric switching is optimized for client-server traffic flows where multiple clients simultaneously communicate with a server, requiring more bandwidth dedicated to the server port to prevent a bottleneck at that port.

A symmetric switch provides switched connections between ports with the same bandwidth, such as all 10BaseT or all 100BaseT. Symmetric switching is optimized for a reasonably distributed traffic load, such as in a peer-to-peer desktop environment.

A network manager must evaluate the needed amount of bandwidth for connections between devices to accommodate the data flow of network-based applications when deciding to select an asymmetric or symmetric switch.

LAN Switch and the OSI Model

LAN switches can be categorized according to the OSI layer at which they filter and forward, or switch, frames. These categories are: Layer 2, Layer 2 with Layer 3 features, or multi-layer.

A Layer 2 LAN switch is operationally similar to a multiport bridge but has a much higher capacity and supports many new features, such as full-duplex operation. A Layer 2 LAN switch performs switching and filtering based on the OSI data link layer (Layer 2) MAC address. As with bridges, it is completely transparent to network protocols and user applications.

A Layer 2 LAN switch with Layer 3 features can make switching decisions based on more information than just the Layer 2 MAC address. Such a switch might incorporate some Layer 3 traffic-control features, such as broadcast and multicast traffic management, security through access lists, and IP fragmentation.

A multi-layer switch makes switching and filtering decisions on the basis of OSI data link layer (Layer 2) and OSI network-layer (Layer 3) addresses. This type of switch dynamically decides whether to switch (Layer 2) or route (Layer 3) incoming traffic. A multi-layer LAN switch switches within a workgroup and routes between different workgroups.