Basic LAN Devices

Repeaters
There are many types of media, and each one has advantages and disadvantages. One of the disadvantages of the type of cable that we primarily use (CAT5 UTP) is cable length. The maximum length for UTP cable in a network is 100 meters (approximately 333 feet). If we need to extend our network beyond that limit, we must add a device to our network. This device is called a *repeater*.
The term repeater comes from the early days of visual communication, when a man situated on a hill would repeat the signal he had just received from the person on the hill to his left, in order to communicate the signal to the person on the hill to his right. It also comes from telegraph, telephone, microwave, and optical communications, all of which use repeaters to strengthen their signals over long distances, or else the signals will eventually fade or die out.
The purpose of a repeater is regenerate and retime network signals at the bit level to allow them to travel a longer distance on the media. Repeaters are classified as Layer 1 devices in the OSI model, because they act only on the bit level and look at no other information.

Hubs
The purpose of a hub is to regenerate and retime network signals. This is done at the bit level to a large number of hosts (e.g. 4, 8, or even 24) using a process known as concentration. You will notice that this definition is very similar to the repeater's, which is why a hub is also known as a multi-port repeater. The difference is the number of cables that connect to the device. Two reasons for using hubs are to create a central connection point for the wiring media, and increase the reliability of the network. The reliability of the network is increased by allowing any single cable to fail without disrupting the entire network. This differs from the bus topology where having one cable fail will disrupt the entire network. Hubs are considered Layer 1 devices because they only regenerate the signal and broadcast it out all of their ports (network connections).
There are different classifications of hubs in networking. The first classification is active or passive hubs. Most modern hubs are active; they take energy from a power supply to regenerate network signals. Some hubs are called passive devices because they merely split the signal for multiple users, like using a "Y" cord on a CD player to use more than one set of headphones. Passive hubs do not regenerate bits, so they do not extend a cable's length, they only allow two or more hosts to connect to the same cable segment.
Another classification of hubs is intelligent or dumb. Intelligent hubs have console ports, which means they can be programmed to manage network traffic. Dumb hubs simply take an incoming networking signal and repeat it to every port without the ability to do any management.

Hub

Bridges
A bridge is a Layer 2 device designed to connect two LAN segments. The purpose of a bridge is to filter traffic on a LAN, to keep local traffic local, yet allow connectivity to other parts (segments) of the LAN for traffic that has been directed there. You may wonder, then, how the bridge knows which traffic is local and which is not. The answer is the same one that the postal service uses when asked how it knows which mail is local. It looks at the local address. Every networking device has a unique MAC address on the NIC, the bridge keeps track of which MAC addresses are on each side of the bridge and makes its decisions based on this MAC address list.

Switches
A switch is a Layer 2 device just as a bridge is. In fact a switch is called a multi-port bridge, just like a hub is called a multi-port repeater. The difference between the hub and switch is that switches make decisions based on MAC addresses and hubs don't make decisions at all. Because of the decisions

that switches make, they make a LAN much more efficient. They do this by "switching" data only out the port to which the proper host is connected. In contrast, a hub will send the data out all of its ports so that all of the hosts have to see and process (accept or reject) all of the data.

Switches at first glance often look like hubs. Both hubs and switches have many connection ports, since part of their function is connectivity concentration (allowing many devices to be connected to one point in the network). The difference between a hub and a switch is what happens inside the device. The purpose of a switch is to concentrate connectivity, while making data transmission more efficient. For now, think of the switch as something that is able to combine the connectivity of a hub with the traffic regulation of a bridge on each port. It switches frames from incoming ports (interfaces) to outgoing ports, while providing each port with full bandwidth (the transmission speed of data on the network backbone).
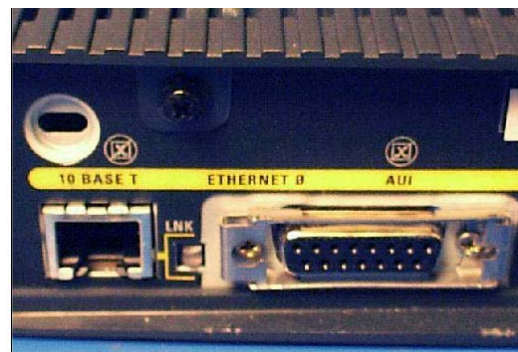

Switch

Routers

A router is a Layer 3 device. Working at Layer 3 allows the router to make decisions based on groups of network addresses (Classes) as opposed to individual Layer 2 MAC addresses. Routers can also connect different Layer 2 technologies, such as Ethernet, Token-ring, and FDDI. However, because of their ability to route packets based on Layer 3 information, routers have become the backbone of the Internet, running the IP protocol.

The purpose of a router is to examine incoming packets (Layer 3 data), choose the best path for them through the network, and then switch them to the proper outgoing port. Routers are the most important traffic-regulating devices on large networks. They enable virtually any type of computer to communicate with any other computer anywhere in the world! While performing these basic functions, routers can also execute many other tasks that are covered in later chapters.

In networking, there are two addressing schemes: one uses the MAC address, a data link (Layer 2) address; the other uses an address located at the network layer (Layer 3) of the OSI model. An example of a Layer 3 address is an IP address. A router is a type of internetworking device that passes data packets between networks, based on Layer 3 addresses. A router has the ability to make intelligent decisions regarding the best path for delivery of data on the network.

Router

Router