

The Differences Between Hubs, Switches and Routers

Some technicians have a tendency to use the terms routers, hubs and switches interchangeably. One minute they're talking about a switch. Two minutes later they're discussing router settings. Throughout all of this, though, they're still looking at only the one box. Ever wonder what the difference is among these boxes? The functions of the three devices are all quite different from one another, even if at times they are all integrated into a single device. Which one do you use when? Let's take a look...

Hub, Switches, and Routers: Getting Started with Definitions

Hub

A common connection point for devices in a network. Hubs are commonly used to connect segments of a LAN. A hub contains multiple ports. When a packet arrives at one port, it is copied to the other ports so that all segments of the LAN can see all packets.

Switch

In networks, a device that filters and forwards packets between LAN segments. Switches operate at the data link layer (layer 2) and sometimes the network layer (layer 3) of the OSI Reference Model and therefore support any packet protocol. LANs that use switches to join segments are called *switched LANs* or, in the case of Ethernet networks, *switched Ethernet LANs*.

Router

A device that forwards data packets along networks. A router is connected to at least two networks, commonly two LANs or WANS or a LAN and its ISP.s network. Routers are located at gateways, the places where two or more networks connect. Routers use headers and forwarding tables to determine the best path for forwarding the packets, and they use protocols such as ICMP to communicate with each other and configure the best route between any two hosts.

The Differences Between These Devices on the Network

Today most routers have become something of a Swiss Army knife, combining the features and functionality of a router and switch/hub into a single unit. So conversations regarding these devices can be a bit misleading — especially to someone new to computer networking.

The functions of a router, hub and a switch are all quite different from one another, even if at times they are all integrated into a single device. Let's start with the hub and the switch since these two devices have similar roles on the network. Each serves as a central connection for all of your network equipment and handles a data type known as frames. Frames carry your data. When a frame is received, it is amplified and then transmitted on to the port of the destination PC. The big difference between these two devices is in the method in which frames are being delivered.

In a hub, a frame is passed along or "broadcast" to every one of its ports. It doesn't matter that the frame is only destined for one port. The hub has no way of distinguishing which port a frame should be sent to. Passing it along to every port ensures that it will reach its intended destination. This places a lot of traffic on the network and can lead to poor network response times.

Additionally, a 10/100Mbps hub must share its bandwidth with each and every one of its ports.

So when only one PC is broadcasting, it will have access to the maximum available bandwidth. If, however, multiple PCs are broadcasting, then that bandwidth will need to be divided among all of those systems, which will degrade performance.

A switch, however, keeps a record of the [MAC addresses](#) of all the devices connected to it. With this information, a switch can identify which system is sitting on which port. So when a frame is received, it knows exactly which port to send it to, without significantly increasing network response times. And, unlike a hub, a 10/100Mbps switch will allocate a full 10/100Mbps to each of its ports. So regardless of the number of PCs transmitting, users will always have access to the maximum amount of bandwidth. It's for these reasons why a switch is considered to be a much better choice than a hub.

Routers are completely different devices. Where a hub or switch is concerned with transmitting frames, a router's job, as its name implies, is to route [packets](#) to other networks until that packet ultimately reaches its destination. One of the key features of a packet is that it not only contains data, but the destination address of where it's going.

A router is typically connected to at least two networks, commonly two Local Area Networks ([LANs](#)) or Wide Area Networks ([WAN](#)) or a LAN and its [ISP's](#) network. For example, your PC or workgroup and EarthLink. Routers are located at [gateways](#), the places where two or more networks connect. Using headers and forwarding tables, routers determine the best path for forwarding the packets. Routers use protocols such as [ICMP](#) to communicate with each other and configure the best route between any two hosts.

Today, a wide variety of services are integrated into most broadband routers. A router will typically include a 4 - 8 port Ethernet switch (or hub) and a **Network Address Translator** ([NAT](#)). In addition, they usually include a Dynamic Host Configuration Protocol (DHCP) server, Domain Name Service (DNS) proxy server and a hardware firewall to protect the LAN from malicious intrusion from the Internet.

All routers have a WAN Port that connects to a [DSL](#) or [cable modem](#) for broadband Internet service and the integrated switch allows users to easily create a LAN. This allows all the PCs on the LAN to have access to the Internet and Windows file and printer sharing services.

Some routers have a single WAN port and a single LAN port and are designed to connect an existing LAN hub or switch to a WAN. Ethernet switches and hubs can be connected to a router with multiple PC ports to expand a LAN. Depending on the capabilities (kinds of available ports) of the router and the switches or hubs, the connection between the router and switches/hubs may require either straight-thru or crossover (null-modem) cables. Some routers even have [USB](#) ports, and more commonly, wireless access points built into them.

Some of the more high-end or business class routers will also incorporate a serial port that can be connected to an external dial-up modem, which is useful as a backup in the event that the primary broadband connection goes down, as well as a built in LAN printer server and printer port.

Besides the inherent protection features provided by the NAT, many routers will also have a built-in, configurable, hardware-based firewall. Firewall capabilities can range from the very basic to quite sophisticated devices. Among the capabilities found on leading routers are those that permit configuring TCP/UDP ports for games, chat services, and the like, on the LAN behind the firewall.

So, in short, a hub glues together an Ethernet network segment, a switch can connect multiple Ethernet segments more efficiently and a router can do those functions plus route [TCP/IP](#) packets between multiple LANs and/or WANs; and much more of course.