

White Paper Differences Between Switches and Hubs

A hub, also known as a repeater, is a simple device that connects Ethernet nodes. Hubs forward data packets they receive from a single workstation to ALL ports. All users connected to a single hub or interconnected hubs share the same bandwidth. As nodes are added to the network, they compete for a finite amount of bandwidth (typically 10 or 100 Mbs). Therefore, data collisions are guaranteed when a hub is used and network determinism (the ability to guarantee a packet is sent/received in a finite amount of time) is impossible. This is the primary reason Ethernet has had historical problems in control applications. Most control systems have a definite time requirement for packet transmission (< 100ms). This cannot be guaranteed with a hub and is highly unlikely to happen if the network is busy. You can imagine the problems this can cause in a mission critical control application.

This is analogous to a single lane road. You cannot get onto the road until traffic is clear. With a hub, you cannot send a packet until network traffic is clear.

Another analogy is a party line phone. If you shared a party line phone with 8 users, anytime any of the users received a call, your phone would ring. All users would have to answer to determine if the call was for them. In addition, no other user can use the phone while someone else is using it.

A switch, also known as a switching hub, is a more complex device with built in intelligence to connect Ethernet nodes. The switch eliminates the problem of network determinism by providing full bandwidth with storage to a node or group of nodes. The switch eliminates all collisions that typically make Ethernet nondeterministic. A switch sends data only to the appropriate network port or segment, not the entire network as a hub does. The switch forwards data based on the MAC address contained in the data packet. The switch must store the MAC addresses of every device it communicates with, requiring high speed SRAM (hubs have no memory requirements). It determines the location of the node and establishes a temporary connection between itself and the node and terminates once the packet is transferred.

Using our highway analogy, we have turned the single lane road into an 8-lane highway. A lane can be dedicated to mission critical nodes insuring traffic can always get through in a pre-determined time.

Using the phone analogy, your phone rings only when the call is for you and you can use the phone when other people are using it.

In summary, a switch increases network bandwidth and provides network determinism for control applications.