

Q. What is the difference between a router, a switch and a hub?

Let's assume we have a small office with 6 computers in it, and we want to network them with each other. We'll call them Smith, Jones, Welenzsky, Kowalski, McFadden and McDuff. What will we need for this job?

The quick answer is that we need either a switch or a hub, as each of these is used to link together computers which are close to each other on the logical (but not necessarily physical) network. So how do we know which of those we need?

Well, as it turns out they both do the exact same thing from the point of view of low-end to average users who aren't hard-core computer geeks like me. That is, if you read E-Mail, surf a bit of the web and so on, then both a switch and a hub will give you connectivity between your 6 machines which is several 10s of times faster than even a high-speed Internet connection. Both will be found commonly in 10Mbit, 100Mbit and in larger offices some amount of 1Gbit is showing up, though primarily on servers and office-to-office links right now. High-speed home DSL is commonly in the ballpark of 1Mbit "downstream" and about 1/10th that or 120Kbit "upstream" (to the Internet). With "corporate" level service that can be up to 8Mbit "downstream" (from the Internet) and 1 to 1.5Mbit up.

Anyway, the big difference in these two guys is that a hub is just a dumb-old box that for all intents and purposes can be considered a single wire to which all 6 computers are connected. And as it so happens the ethernet protocol knows how to negotiate access to a single wire (or so it's called - ethernet actually uses 4 wires) when many computers are attached to it. The thing is, however, that only 2 computers may talk on the wire at a time, so that if Smith were talking to Jones, all of Welenzsky, Kowalski, McFadden and McDuff would remain silent. A switch on the other hand has a central intelligent processing core commonly known as a "backplane", and where the hubbed network can be viewed as a single wire, a switched network is more like the radials of a spider's web, with your 6 computers one at the end of each radian.

This intelligent "backplane" of a switch allows for Smith to talk to Jones, while Walenzsky talks to Kowalski, and McFadden talks to McDuff. Furthermore, since each computer has it's own private or "dedicated" wire from itself to the "backplane", full-duplex mode can be used which allows for simultaneous transmission in both directions. In the first instance the "dedicated" bandwidth means that a 100Mbit switch can actually allow 100Mbit conversations in both directions, which in turn means that if the conversation or rather information were roughly the same in both directions, then we'd actually have 200Mbits of bandwidth. So if you then consider that the backplane could allow 3 of these conversations to take place at once, we have a 600Mbit potential on that switch's backplane. In fact, since most switches come with at least 8 to 12 ports, the potential throughput on it is up to 1.2Gbit if this does not surpass the speed of the backplane (which it should not for most good switches these days). But even if you had 12 computers connected to a hub (or "dumb hub" as they are often redundantly called), your maximum potential throughput is still only 100Mbit. And forget about full-duplex, don't forget.

Where switches and hubs are used to connect computers on the local network, routers are used to connect these local networks together, making larger LANs, MANs and WANs (Local Area Networks, Metro Area Networks and Wide Area Networks, respectively). Where switches and hubs generally (though not always - some swithes have Gig ports, and some higher end ones

even have ATM) have ports of the same type (e.g. 100Mbit ethernet), routers almost by definition will have different types of ports like 10/100/1000 ethernet, ATM, dialup, ISDN BRI, T1, Frame Relay and so on. And in technical jargon a switch operates at "Layer 2" and a router at "Layer 3", but layers are a topic for another discussion.

So in short, switches and hubs are similar devices used to connect computers together on the same local network, and routers are then used to connect those smaller networks to each other and to the rest of the world.

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Ed: Minor changes were made to the original text to correct typographical errors and redundancies. Bass Home Electronics thanks Alan McKay for this helpful article.

One more thing that wasn't mentioned is the difference between 10 and 100-Mbit speeds.

Generally speaking, you're not too likely to find a hub that will auto-switch between devices that operate at different speeds. They have to either all be 100-Mbit, or you'll end up with everything running at 10.

On the other hand, most switches will autosense the speed of each device connected to it, and negotiate the traffic at the highest speed possible for a given transfer. So having one 10-Mbit device on a switch doesn't slow everything else down.

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