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An Introduction to Wireless Networking

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Wireless networking has been around a long time now, and most people have probably used a wireless network at some point. That doesn't mean, however, that state-of-the-art wireless technologies are self-explanatory. In this article, we'll shed some light on the technologies and techniques available for wireless home networking, as well as to identify which ones are actually worth investing your time and money in. We'll also take a quick look at how to best match wireless networking and broadband services your specific needs.

A Brief History of Wireless Networking Standards

Wireless networking first came on the scene in the late 1990s, but most consumers probably didn't learn of wireless networking until the early 2000s, when the 802.11b standard became available, operating at a rated speed of 11 megabits/second (Mbps). The faster 54Mbps 802.11g standard came out in 2003, finally making the use of wireless networking a reasonable alternative to a wired network. The most common standard today is 802.11n, which is typically rated at up to 300Mbps (but goes as high as 450Mbps in some high-end products).

The importance of wireless technology has increased significantly in the past few years, as consumers are moving away from traditional desktop computers, which can easily be connected via an ethernet cable, to portable devices, which rarely can used wired networks, especially in the case of tablets, which are displacing laptops in many people's eyes (and shopping carts).

Tales of Frequencies and Throughput

When discussing wireless networking products, it will help to keep in mind the definition of two relevant terms:

- Throughput - the speed of data transmission (in megabits per second or "Mbps")
- Frequency Band - the type of electromagnetic wave used for data transmission (either 2.4 or 5.0 GHz)

Throughput, sometimes referred to as bandwidth, can be converted to the megabytes per second (MB/s) by dividing by eight, e.g., 8mbps is 1MB/s. Because file sizes are often measured in MB (like a photo file, for example), it's often helpful to make this conversion. Unfortunately, this doesn't help overcome another challenge in throughput ratings: the vast gulf between theoretical and actual speeds, which we'll return to a little later in this guide.

The frequency band indicates the type of electromagnetic wave transmitted by the wireless device - for networking devices, it can either be a 2.4GHz or a 5GHz wave. Generally speaking, the higher the GHz rating of a computer processor, the faster the processor is. But this doesn't apply with electromagnetic waves - they all travel at the speed of light! How much data they can carry in those lightspeed transmissions (i.e., the throughput), however, varies greatly. One of the factors that determines throughput is the frequency band, so while they are separate concepts, they are definitely linked.

The 5GHz band has come into favor recently because there is much less interference present in that band. As we all use and increasing number of electronic devices operating on the 2.4GHz band (baby monitors, cordless phones, wireless mice), these products create and encounter greater interference. Wireless networking on the 5GHz band has a better chance of making it from one device to another, at least for now, and therefore generally allows greater throughput (even for two products rated at the same throughput...yes, we're getting to that!). But even products on the 2.4GHz band can vary dramatically in their throughput - witness, for instance, the Linksys WRT54GL router pictured above, which is the most popular router ever sold. It proudly states its 2.4GHz frequency band right on the front panel, but it is signficantly slower than most 2.4GHz routers sold today, due to its use of 802.11g transmission standard. Let's take a closer look at the technology that's come in the years since the venerable Linksys WRT54GL first appeared in 2005.

The Current State-of-the-Art: 802.11ac

First announced in late 2011 and brought to market in mid-2012, the 802.11ac standard is the fastest home networking standard to date. It is a significant jump up from 802.11n, particularly run-of-the-mill 802.11n on the 2.4GHz band, and a huge leap up from 802.11g. One of the reasons for this improvement is that 802.11ac by design *only* functions on the 5GHz band, which as discussed above typically allows for higher throughput than the 2.4GHz band does, even at the same "rated" speed. In fact, some of the first wireless networking products, based on the 802.11a standard, ran on the 5GHz, offering a very fast (for the time) 54Mbps rated speed. But it took a long time for engineers to get around the inherently shorter range of signal transmission on the 5GHz band.

The fastest 802.11ac products use three 433.3Mbps "streams" to achieve throughput of 1300Mbps, up from the 450Mbps of the highest-rated 802.11n devices. To achieve that rated 1300Mbps, however, the devices have to be bulky, and so most compact devices (think USB adapters and laptops, and in the near future, tablets) use only one or two streams, resulting in peak rated throughput of 433Mbps or 866Mbps, respectively.

Those are some pretty high numbers, aren't they? What was it we were saying about real-world speeds again...

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