Wi-Fi Technology Glossary

Contents

Wi-Fi Protocols

The overall set media access control specifications that governs wireless operation in Wi-Fi is *IEEE 802.11*. There are different protocols within this, such as 802.11a, 802.11b, or 802.11g. Routers that boast compatibility for these protocols will often label themselves “802.11bgn” or “802.11b/g/n”, indicating that they support 802.11b, 802.11g, and 802.11n.

So what do all these letters actually mean?

Over the past few years, Wi-Fi technology has progressed tremendously, and 802.11n was heralded as the biggest advancement yet. . Here’s a simple chart that explains the differences between the most common commercially available Wi-Fi protocols:

802.11 Protocol	**Release Date**	**Frequency (GHz)**	**Data Speed (Mbps)**	**Range Indoor (ft)**	**Outdoor (ft)**
a	Sept. 1999	5	12, 24, 54	115	390
b	Sept. 1999	2.4	5, 11, 22	115	460
g	Jun. 2003	2.4	12, 24, 54	125	460
n	Oct. 2009	2.4 / 5	150, 300, 600	230	820
ac	Dec. 2013	5	433, 1300, 2600	115	460

The letters of 802.11 basically indicate a progression of quality over time. 802.11a/b were released together to serve two different needs (see our article on Frequency for more detail), 802.11g incorporated the speed and the range of the two into one uncompromised format, and 802.11n dramatically improved on its predecessor.

You can see Just looking at the speed and the range, that WI-Fi performance made a very significant jump from 802.11g to 802.11n. With “N” we can get up to about *twelve times* the speed at about *twice* the range. This mean overall better performance and coverage for Play-Fi products. They can stay in tighter sync with one another while being able to live throughout your home.

Understanding the benefits of 802.11n, it’s clear that having a home router that supports this standard will bring all kinds of performance improvements with it, and not just for Play-Fi products. A router that supports speeds of 300Mbps or higher, is even better. If you want more detail on the impact that Frequency and Data Speeds can have on your network, follow those links to learn more.

Frequency

Wi-Fi operates on many frequencies but there are two that are generally available for public consumer use. They are the 2.4 GHz band, and the 5 GHz band. Which band is available to you will depends on which Wi-Fi Protocol your router supports.

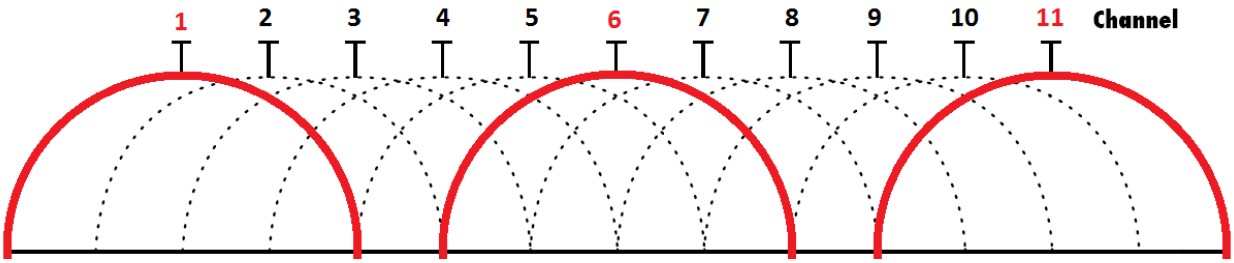
Each band spans a range within its frequency, so 2.4 GHz really means 2.412 – 2.484 GHz and 5 GHz means 5.18 – 5.825 GHz, though this varies by country. Specific points in these ranges are referred to as *channels*.

Generally, your router selects a channel within that range to broadcast its signal. It tries to pick a point in that frequency that is uninhabited, because if there is something else broadcasting there, that will cause interference. That means slow speeds and dropouts.

Let's take a closer look at these two bands.

2.4 GHz

This frequency band has been primarily used for Wi-Fi due to its general availability and overall coverage. Its major downside is that it has many opportunities for interference. Let's take a look at this image,



These are the channels available to the 2.4 GHz band in the United States, and other territories. The channels highlighted in red (1, 6, and 11) are the channels that should be used if you want to avoid interference. Routers will let users select the other channels, but because routers broadcast at a rate of 20 MHz, it generates a level of coverage across the frequency range that would otherwise overlap the neighboring channels, as depicted.

For this reason, 2.4 GHz has a high probability for interference by its very nature. When we factor in other elements, like microwaves, Bluetooth equipment, and other devices that also use the 2.4 GHz frequency, this further increases those chances.

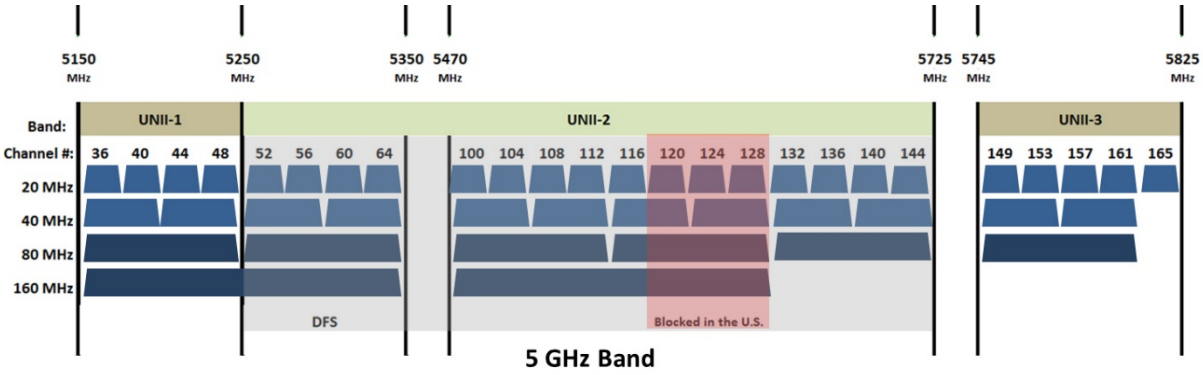
If we're in an environment that doesn't have a lot of other broadcasting devices, then 2.4 GHz can be especially beneficial for its greater coverage, which is typically double that of 5 GHz. That coverage comes at reduced speeds: approximately half of what 5GHz offers. However, if you're using 802.11n, you should still be able to achieve adequate speeds for Play-Fi. See our Wi-Fi Protocols article for a chart comparison.

To sum up, use 2.4 GHz if interference is not a factor and you need the added coverage, like in a modern suburban home.

5 GHz

This frequency saw some limited use in 802.11a in the early 2000s, but really hasn't made a comeback until recently, thanks to the ubiquity of wirelessly broadcasting devices. Since it operates on a less common

frequency range and also spans much larger than the 2.4 GHz spectrum, it offers a great solution to circumvent interference. Let's see the chart below:



So this chart is more complicated and has a few layers, but let's start simply. Take a look at the 20 MHz row and notice the brown columns, ignoring the darkened section. These are the channels available for selection in the U.S. At the same broadcast rate at 2.4 Ghz, you can see that we have *three times* the available non-overlapping channels. And U.S. routers cannot select the channels between, so there' no opportunity for that sort of overlap, even in crowded Wi-Fi environment.

Because of this, many 5GHz routers will allow you to increase the broadcast rate from 20 MHz, effectively doubling the speed at each interval. Since it is still extremely uncommon for there to be multiple broadcast over 5GHz in an area, and there are so many available channels, most users will be able to increase broadcast rates and enjoy speeds quadruple that of 2.4GHz, without the worry of interference.

The one downside to all of this is that the effective coverage is half that of 2.4GHz, so your data speeds will suffer if you get too far from the router, or if there are more walls in the way of the router and the device. We go into detail on this falloff in that link.

To sum up, 5GHz is effective for areas with lots of interference and moderate sized spaces, like apartments, condos, or individual sections of homes.

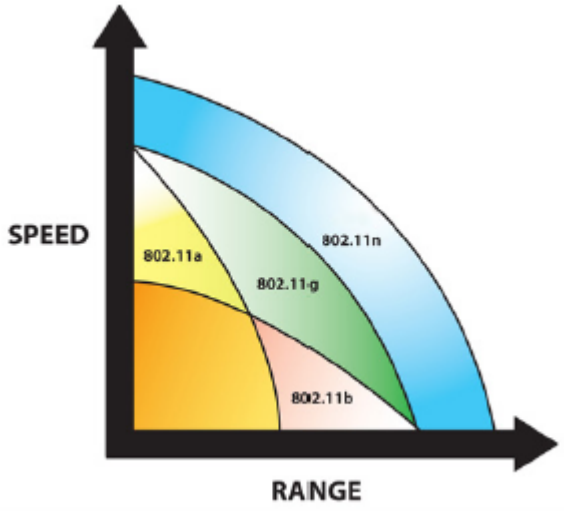
Data Speed Rates or Throughput

The quality of your network performance, which will also include Play-Fi's performance, is measured by its Data Speed Rates. This is a factor that is measure in Megabits per second (Mbps), and it's something you may see advertised on the box for your router. Internet speeds are measured in the same way, but unless you're streaming from a high quality service over the Internet, it won't impact Play-Fi and other local network activities in the same way.

One similarity this measurement has with that of your Internet Service Provider is that it is advertised as "Reach speeds *up to* xxx Mbps!" which we know means that you won't always be getting that speed. Though the way it works on your home router is different than the way your ISP nebulously provides it.

Range, Distance, and Coverage

A simple way to look at the issue, while comparing the most common protocols, is as below:

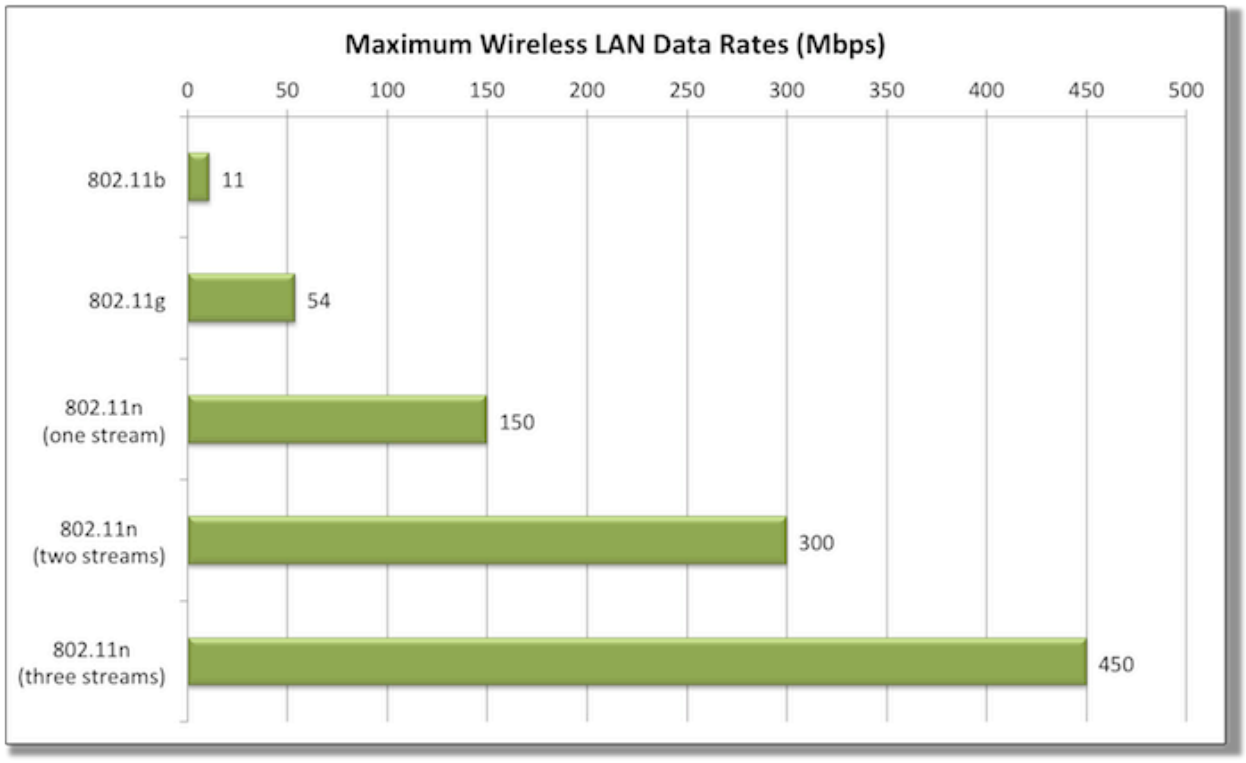


As you increase range or distance from the router, your data speeds begin to take a nose dive. The router broadcasts in a circle around you to maximize coverage, and the connection speed is strongest in the center (close to the router) and weaker the further you go out (far from the router), until it completely dissipates and you lose connection.

Newer technologies like 802.11n offer better performance over greater ranges, and this is one reason why you should at least have a router that supports the modern protocol. It's also good to keep this in mind if you're noticing poor performance of any of your wireless devices. Moving the device closer, moving the router to a more central location, or introducing a wired access point, can help your data speeds greatly.

Antennas and Streams

With the Introduction of 802.11n, routers have been able to increase their amount of antennas to thereby increase the number of concurrent spatial streams and effectively increasing their maximum data speeds by the equivalent multiple. These are some complicated words, but what does it boil down to? This:

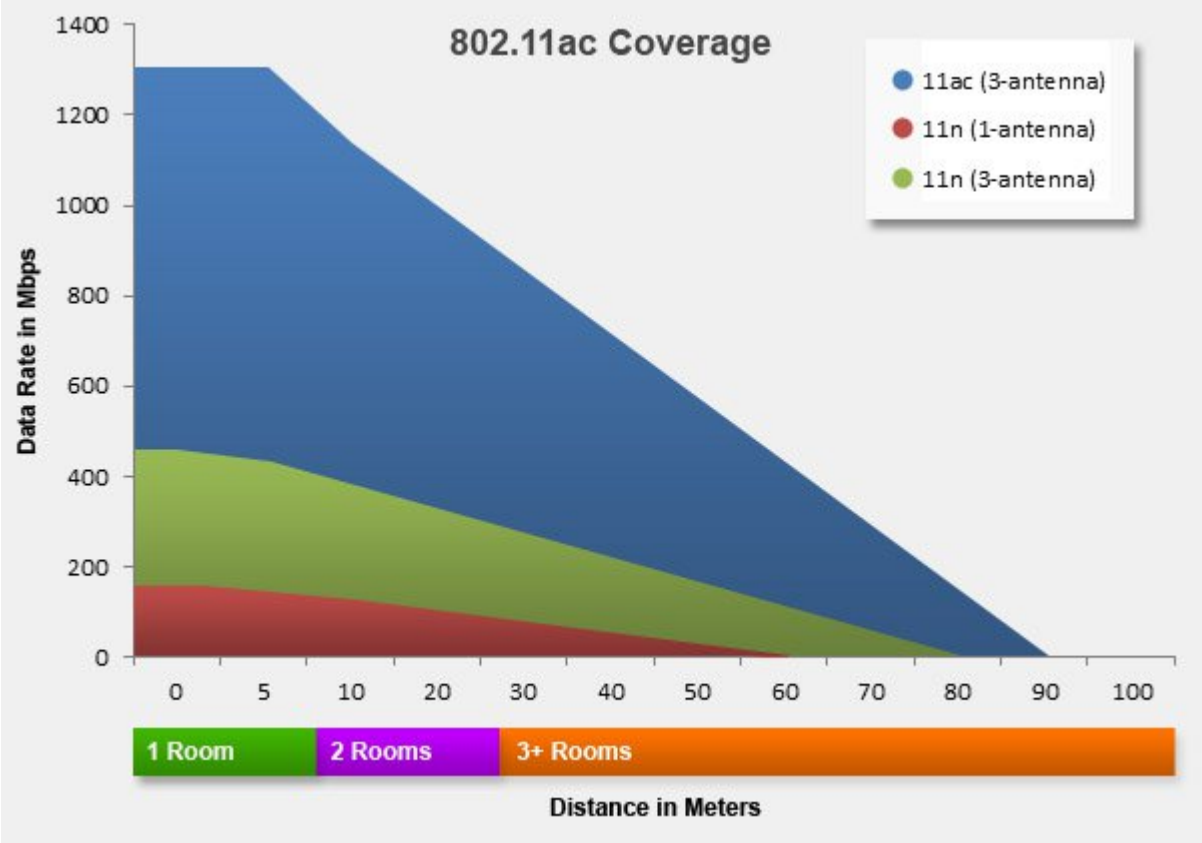


802.11n has a base rate of 150 Mbps, and the more antennas you add, the more of those 150 Mbps streams you add. 802.11n is capable of having 4 spatial streams for a maximum of 600 Mbps and 802.11ac is capable of having 8 spatial streams, for a current maximum of 2600 Mbps!

Routers with more streams will be more expensive, with current models of high-end 802.11ac routers reaching pretty large sums, but your typical 300 Mbps 802.11n router can be had for a modest price and can still offer great Wi-Fi (and Play-Fi) performance with decent coverage.

Data Falloff

After a certain distance your advertised rates will begin to not only diminish, but they'll begin to get cut in half, even with large advertised speeds, we see tremendous falloff:



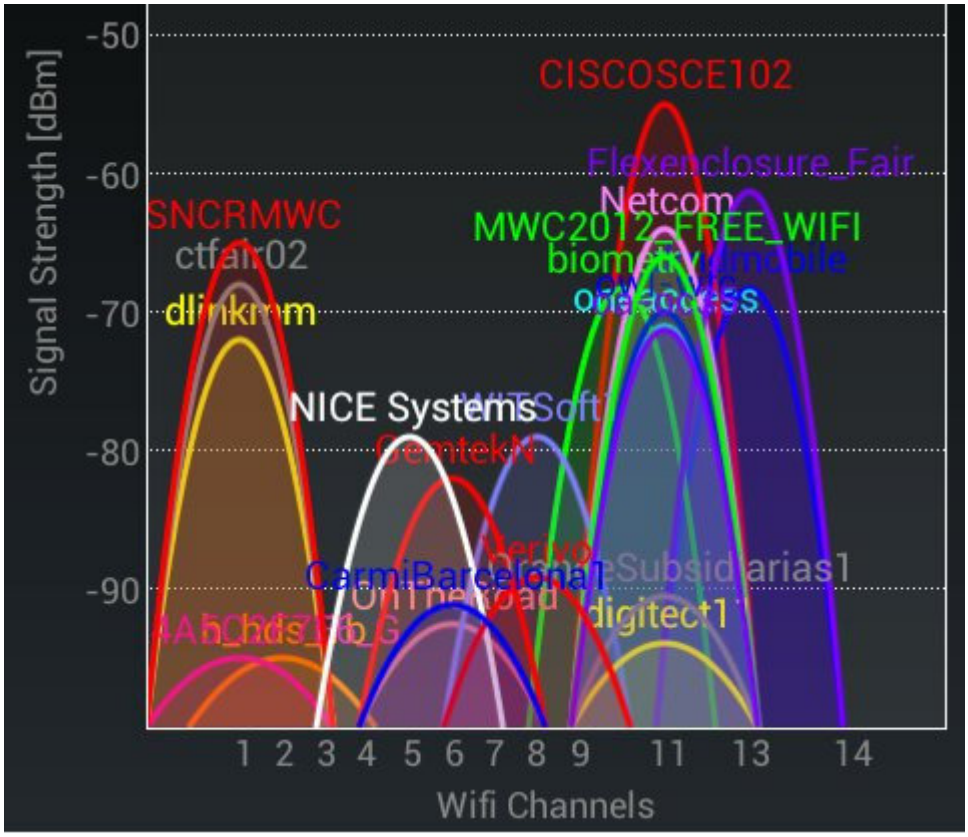
In the same room as the router, we should get our advertised speeds (unless your room is a ballroom), but go two or three rooms away and we begin to lose a significant portion of that speed and overall throughput, and this is heightened with routers with greater speeds (though you'll still achieve better performance with more antennas and 802.11ac).

If you're seeing significant falloff or dropouts and your devices are far from the router, consider moving things around, or adding wired access points to increase your coverage.

Interference

Wi-Fi is a wonderful means to send data or information, without requiring any cabling or hard connections between devices. However, anyone who's ever had the radio turn to static when passing by radars or when Bluetooth connections flare up, will know that wireless is prone to wireless interference.

Interference is basically when two wireless broadcasts overlap on the same frequency, and one essentially overpowers the other. In the case of Wi-Fi, this can be visualized using a program like Wi-Fi Analyzer as below:



If your network looks like this, chances are you're experiencing some level of drop-outs and lost packets due to interference from these other broadcasting networks. To learn more about specific Wi-Fi overlap, take a look at our section on Frequency.

But interference doesn't just come from other Wi-Fi broadcasts. It can come from other devices such as:

- Microwaves
- Bluetooth devices
- Wireless Keyboards/Mice
- Remote Transmitters
- Proprietary Video Transmitters
- Certain LCDs or Monitors that introduce harmonic interference

These devices more often affect 2.4 GHz broadcast, so switching your devices or router to 5 GHz can alleviate the trouble.

In addition to these items, materials that are a part of the home or office structure can either absorb or reflect wireless broadcasts, which can create unsuitable environments for wireless audio products. Problem materials include on a scale of “Not Good” to “Worst”:

- Not Good
    - Water
    - Bricks
    - Marble
- Bad
    - Plaster
    - Concrete
- Worst
    - Metal

These combinations are often found altogether in places like the bathroom, basement, or garage, which makes them a poor option for Wi-Fi streaming. Every home is different, so your experience may vary. Keep these materials in mind if you are having trouble in a particular location and consider moving your Wi-Fi devices elsewhere, or try switching to 2.4 GHz if not already, as 5 GHz is more prone to these coverage-limiting barriers.