

WiFi - 802.11b, 802.11a, 802.11g, 802.11n and 802.11ac standards

This article will describe the standards WiFi 802.11b, 802.11a, 802.11g, 802.11n, 802.11ac and related technologies, to help you better understand the development of WiFi technology, from there. Make the right decision while designing a WiFi network or buying suitable network devices.

When buying a network device you will face a lot of options. Products compatible with 802.11a, 802.11b / g / n or 802.11ac wireless standards are called WiFi technologies. So what is the WiFi 802.11 standard, how are they different?

This article will describe WiFi standards and related technologies, compare to help you better understand the development of WiFi technology, thereby making the right decision while designing a good WiFi network. Purchase suitable network equipment.

1. What is MU-MIMO? Why should your next WiFi router have MU-MIMO?

WiFi - 802.11b, 802.11a, 802.11g, 802.11n and 802.11ac standards

1. First WiFi standard 802.11
2. WiFi 802.11b standard (new name WiFi 1)
3. WiFi 802.11a standard (new name WiFi 2)
4. 802.11g WiFi standard (new name WiFi 3)
5. 802.11n WiFi standard (new name WiFi 4)
 1. The main wireless technology in 802.11n
 2. 802.11n performance
 3. 802.11n network devices compared to previous standards
 4. Next generation of 802.11n
6. 802.11ac WiFi standard (new name WiFi 5)
7. Bluetooth and the rest

Summary table of WiFi standards:

CÁC CHUẨN WIFI 802.11					
Chuẩn IEEE	802.11a	802.11b	802.11g	802.11n	802.11ac
Năm phát hành	1999	1999	2003	2009	2013
Tần số	5 GHz	2.4 GHz	2.4 GHz	2.4/5 GHz	5 GHz
Tốc độ tối đa	54 Mbps	11 Mbps	54 Mbps	600 Mbps	1 Gbps
Phạm vi trong nhà	100 ft.	100 ft.	125 ft.	225 ft.	90 ft.
Phạm vi ngoài trời	400 ft.	450 ft.	450 ft.	825 ft.	1,000 ft.

First WiFi standard 802.11

In 1997, the Institute of Electrical and Electronics Engineers (IEEE) introduced a first standard for WLAN. This standard is called *802.11* after the name of the group is set up to monitor its development. However, 802.11 only supports the maximum network bandwidth of up to 2Mbps - too slow for most applications. For that reason, the original 802.11 standard wireless products were no longer produced.

WiFi 802.11b standard (new name WiFi 1)

IEEE expanded on the original 802.11 standard in July 1999, creating the *802.11b* standard . This standard supports bandwidth up to 11Mbps, equivalent to traditional Ethernet.

802.11b uses unregulated radio signal frequency (2.4 GHz) like the original 802.11 standard. Suppliers like to use this frequency to reduce production costs. 802.11b devices can be interfered with wireless devices (extended), microwaves or other devices using the same 2.4 GHz frequency range. However, by installing devices 802.11b away from such devices can reduce this interference phenomenon.

1. **Advantages of 802.11b** - lowest cost; signal range is good and not easily obstructed.
2. **Disadvantages of 802.11b** - the lowest maximum speed; Household appliances may interfere with the radio frequency that 802.11b has captured.

WiFi 802.11a standard (new name WiFi 2)

While 802.11b is still being developed, IEEE created a second extension to the 802.11 standard called *802.11a* . Because 802.11b is widely used too fast compared to 802.11a, some people believe that 802.11a was created after 802.11b. However, in fact, 802.11a and 802.11b are created simultaneously. Because of the higher cost, 802.11a is often used in enterprise networks, and 802.11b is more suitable for the home network market.

802.11a supports bandwidth up to 54 Mbps and signals in a specified frequency spectrum around 5GHz. The frequency of 802.11a is higher than that of 802.11b, thus making the scope of this system narrower than that of 802.11b networks. With this frequency, 802.11a signals are also more difficult to penetrate walls and other

obstructions.

Because 802.11a and 802.11b use different frequencies, these two technologies cannot be compatible with each other. As a result, some vendors have provided hybrid network devices for **802.11a / b**, but these products merely implement these two standards in parallel (each connected device must use either, cannot simultaneous use of both).

1. **Advantages of 802.11a** - super fast speed; The controlled frequency should avoid interference from other devices.
2. **Disadvantages of 802.11a** - expensive; narrow range and easily obstructed.

802.11g WiFi standard (new name WiFi 3)

In 2002 and 2003, WLAN products supporting a newer *standard*, *802.11g*, were highly valued in the market. 802.11g is an attempt to combine the advantages of 802.11a and 802.11b standards. It supports bandwidth up to 54Mbps and uses 2.4 Ghz frequency for wide range. 802.11g is compatible with 802.11b standards, which means that 802.11g access points will work with 802.11b wireless network adapters and vice versa.

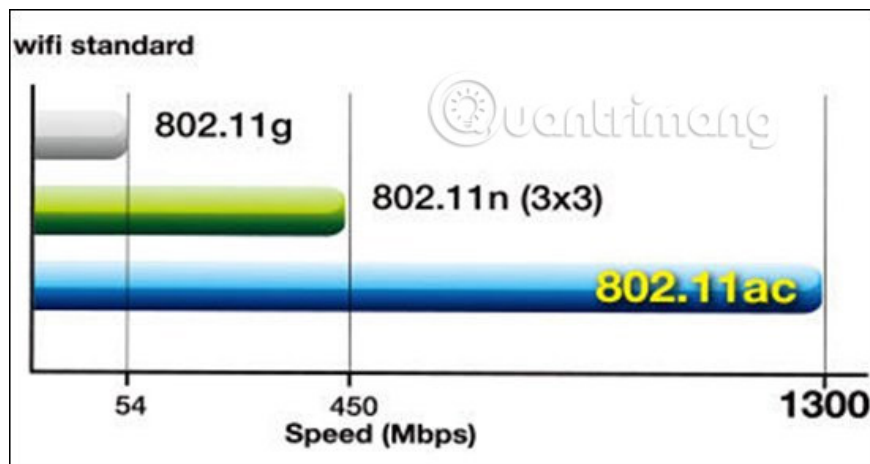
1. **Advantages of 802.11g** - super fast speed; signal range is good and less obstructed.
2. **Disadvantages of 802.11g** - more expensive than 802.11b; devices can be interfered with from household appliances that use the same uncontrolled radio signal frequency.

802.11n WiFi standard (new name WiFi 4)

802.11n (sometimes referred to as Wireless N) is designed to improve 802.11g in total bandwidth supported by leveraging multiple wireless signals and antennas (*MIMO* technology).

802.11n was approved in 2009 with specifications such as providing maximum bandwidth of up to 600 Mbps. 802.11n also offers better range than previous WiFi standards because its signal strength has increased, and 802.11n has backward compatibility with 802.11b, 802.11g devices.

1. **Advantages of 802.11n** - fastest maximum speed and best signal range; Better anti-interference ability from external sources.
2. **Disadvantages of 802.11n** - more expensive than 802.11g; The use of multiple signals may interfere with nearby 802.11b and 802.11g networks.



802.11n is an IEEE industry standard for Wi-Fi wireless network communications. Although 802.11n is designed to replace older 802.11a, 802.11b and 802.11g Wi-Fi technologies, it has been replaced by 802.11ac. Each new standard is often faster and more reliable than the previous standard. On any Wi-Fi device you buy will reflect which standards will support that device.

The main wireless technology in 802.11n

802.11n uses many parallel wireless antennas to transmit and receive data. The term MIMO (Multiple Input, Multiple Output) refers to the ability of 802.11n and similar technologies to coordinate multiple radio signals simultaneously. 802.11n supports up to 4 streams simultaneously. MIMO helps increase the range and throughput of wireless networks.

An additional technique used by 802.11n involves increasing channel bandwidth. As in the 802.11a / b / g network connection, each 802.11n device uses the built-in Wi-Fi channel to transmit. The 802.11n standard uses a larger frequency range than previous standards, increasing data throughput.

802.11n performance

802.11n connectivity supports theoretical maximum bandwidth of up to 300Mbps depending mainly on the number of wireless radios integrated in the devices. 802.11n devices operate in both the 2.4 GHz and 5 GHz bands.

802.11n network devices compared to previous standards

For several years before 802.11n was officially ratified, network device manufacturers sold so-called N testing devices, based on a preliminary draft of this standard. This hardware is usually compatible with the existing 802.11n device, although it may be necessary to upgrade the firmware for these older devices.

Next generation of 802.11n

802.11n served as the fastest Wi-Fi standard in five years before the 802.11ac protocol was approved in 2014. 802.11ac provides speeds from 433Mbps to several gigabits per second, close to the speed and performance of wired connections. It operates entirely in the 5GHz band and supports up to 8 streams simultaneously.

802.11ac WiFi standard (new name WiFi 5)

802.11ac is the latest, most commonly used WiFi standard. 802.11ac uses dual band wireless technology, supporting simultaneous connections on both the 2.4 GHz and 5 GHz bands. 802.11ac provides interoperability with 802.11b, 802.11g, 802.11n and bandwidth up to 1,300 Mbps on the 5 GHz band, 450 Mbps on 2.4GHz.

Bluetooth and the rest

In addition to the four common Wi-Fi standards above, there are still a few other wireless networking technologies still in existence.

1. The standards of 802.11 groups like 802.11h and 802.11j are extensions of Wi-Fi technology, each of which serves a specific purpose.
2. Bluetooth is another wireless network technology. This technology supports a very narrow range (approximately 10m) and low bandwidth (1-3Mbps) designed for low-power network devices like handhelds. The low production cost of Bluetooth hardware also appeals to manufacturers in this area. You can find Bluetooth in a PDA or mobile phone connection with PC computers, but it is rarely used for WLAN connectivity in general because of the range and speed.
3. WiMax is also developed separately with Wi-Fi. WiMax is designed to be able to connect to the network in a wider range (spanning miles or kilometers).

The following IEEE 802.11 standards exist or are being developed to support the creation of technologies for WLAN:

1. 802.11a - 54 Mbps, 5 GHz signal (approved in 1999)
2. 802.11ac - 3.46Gbps, supports 2.4 and 5GHz frequencies through 802.11n
3. 802.11ad - 6.7Gbps, 60GHz signal (2012)
4. 802.11ah - creating Wi-Fi networks with extended range beyond the range of conventional 2.4-5GHz networks
5. 802.11aj - approved in 2017, used primarily in China.
6. 802.11ax - waiting for approval, is expected in 2018, if approved this is the Wifi 6 standard that people are looking forward to.
7. 802.11ay - pending approval, is expected in 2019
8. 802.11az - waiting, expected to be approved in 2019
9. 802.11b - Standard 11 Mbps, 2.4 GHz signal (1999)
10. 802.11c - operation of bridge connections (switch to 802.1D)
11. 802.11d - global standard for wireless signal spectrum regulations (2001)
12. 802.11e - Support for Quality of Service (QoS) (unapproved)
13. 802.11F - Inter-Access Point Protocol, proposed for communication between access points to support roaming clients (2003)
14. 802.11g - 54 Mbps, 2.4 GHz signal (2003)
15. 802.11h - enhanced version of 802.11a to support European regulatory requirements (2003)
16. 802.11i - security enhancements for 802.11 series (2004)
17. 802.11j - improvements to the 5 GHz signal to support Japanese regulatory requirements (2004)

18. 802.11k - manage WLAN systems
19. 802.11l - skip to avoid confusion with 802.11i
20. 802.11m - upgrade documentation for 802.11 standard
21. 802.11n - improved 100+ Mbps on 802.11g (2009)
22. 802.11o - missed
23. 802.11p - wireless access for vehicle environments
24. 802.11q - skip
25. 802.11r - support fast roaming via basic service Forwarding
26. 802.11s - ESS networks for access points
27. 802.11T - Wireless Performance Prediction - proposal for testing standards and indicators
28. 802.11u - interworking with 3G networks, mobile networks and other types of external networks
29. 802.11v - wireless network management, device configuration
30. 802.11w - enhances security for protected management frames
31. 802.11x - omitted (generic name for both 802.11 standard lines)
32. 802.11y - context-based protocol to avoid conflict

You can refer to more details at the official IEEE 802.11 website:
http://grouper.ieee.org/groups/802/11/Reports/802.11_Timelines.htm

Having fun!

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