## Analyzing Wireless LAN Security

### Wireless Standards - 802.11b 802.11a 802.11g 802.11n - Which Is Best?

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**Definition:**

WLANs provide wireless network communication over short distances using radio or infrared signals instead of traditional network cabling.

A WLAN typically extends an existing wired local area network. WLANs are built by attaching a device called the access point (AP) to the edge of the wired network. Clients communicate with the AP using a wireless network adapter similar in function to a traditional Ethernet adapter.

Network security remains an important issue for WLANs. Random wireless clients must usually be prohibited from joining the WLAN. Technologies like WEP raise the level of security on wireless networks to rival that of traditional wired networks.

**Examples:**

For WLANs that connect to the Internet, Wireless Application Protocol (WAP) technology allows Web content to be more easily downloaded to a WLAN and rendered on wireless clients like cell phones and PDAs.

**Wireless Standards - 802.11b, 802.11a , 802.11g and 802.11n**

Home and business networkers looking to buy wireless local area network (WLAN) gear face an array of choices. Many products conform to the 802.11a, 802.11b, 802.11g, or 802.11n wireless standards collectively known as Wi-Fi technologies. Additionally, Bluetooth and various other non Wi-Fi technologies also exist, each also designed for specific networking applications.

This article describes the Wi-Fi and related technologies, comparing and contrasting them to help you make educated network building decisions.

- **802.11**

In 1997, the Institute of Electrical and Electronics Engineers (IEEE) created the first WLAN standard. They called it 802.11 after the name of the group formed to oversee its development. Unfortunately, 802.11 only supported a maximum network bandwidth of 2 Mbps - too slow for most applications. For this reason, ordinary 802.11 wireless products are no longer manufactured.

- **802.11b**

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

802.11b uses the same unregulated radio signaling frequency (2.4 GHz) as the original 802.11 standard. Vendors often prefer using these frequencies to lower

their production costs. Being unregulated, 802.11b gear can incur interference from microwave ovens, cordless phones, and other appliances using the same 2.4 GHz range. However, by installing 802.11b gear a reasonable distance from other appliances, interference can easily be avoided.

Pros of 802.11b - lowest cost; signal range is good and not easily obstructed

Cons of 802.11b - slowest maximum speed; home appliances may interfere on the unregulated frequency band

- **802.11a**

While 802.11b was in development, IEEE created a second extension to the original 802.11 standard called 802.11a. Because 802.11b gained in popularity much faster than did 802.11a, some folks believe that 802.11a was created after 802.11b. In fact, 802.11a was created at the same time. Due to its higher cost, 802.11a is usually found on business networks whereas 802.11b better serves the home market.

802.11a supports bandwidth up to 54 Mbps and signals in a regulated frequency spectrum around 5 GHz. This higher frequency compared to 802.11b shortens the range of 802.11a networks. The higher frequency also means 802.11a signals have more difficulty penetrating walls and other obstructions.

Because 802.11a and 802.11b utilize different frequencies, the two technologies are incompatible with each other. Some vendors offer hybrid 802.11a/b network gear, but these products merely implement the two standards side by side (each connected devices must use one or the other).

Pros of 802.11a - fast maximum speed; regulated frequencies prevent signal interference from other devices

Cons of 802.11a - highest cost; shorter range signal that is more easily obstructed

- **802.11g**

In 2002 and 2003, WLAN products supporting a newer standard called 802.11g emerged on the market. 802.11g attempts to combine the best of both 802.11a and 802.11b. 802.11g supports bandwidth up to 54 Mbps, and it uses the 2.4 Ghz frequency for greater range. 802.11g is backwards compatible with 802.11b, meaning that 802.11g access points will work with 802.11b wireless network adapters and vice versa. Pros of 802.11g - fast maximum speed; signal range is good and not easily obstructed

Cons of 802.11g - costs more than 802.11b; appliances may interfere on the unregulated signal frequency

Pros of 802.11g - fast maximum speed; signal range is good and not easily obstructed

Cons of 802.11g - costs more than 802.11b; appliances may interfere on the unregulated signal frequency

- **802.11n**

The newest IEEE standard in the Wi-Fi category is 802.11n. It was designed

to improve on 802.11g in the amount of bandwidth supported by utilizing multiple wireless signals and antennas (called MIMO technology) instead of one.

When this standard is finalized, 802.11n connections should support data rates of over 100 Mbps. 802.11n also offers somewhat better range over earlier Wi-Fi standards due to its increased signal intensity. 802.11n equipment will be backward compatible with 802.11g gear.

Pros of 802.11n - fastest maximum speed and best signal range; more resistant to signal interference from outside sources

Cons of 802.11n - standard is not yet finalized; costs more than 802.11g; the use of multiple signals may greatly interfere with nearby 802.11b/g based networks.

**What About Bluetooth and the Rest?**

Aside from these four general-purpose Wi-Fi standards, several other related wireless network technologies exist. Other IEEE 802.11 working group standards like 802.11h and 802.11j are extensions or offshoots of Wi-Fi technology that each serve a very specific purpose.

Bluetooth is an alternative wireless network technology that followed a different development path than the 802.11 family. Bluetooth supports a very short range (approximately 10 meters) and relatively low bandwidth (1-3 Mbps in practice) designed for low-power network devices like handhelds. The low manufacturing cost of Bluetooth hardware also appeals to industry vendors. You can readily find Bluetooth in the netowrking of PDAs or cell phones with PCs, but it is rarely used for general-purpose WLAN networking due to the range and speed considerations.

WiMax also was developed separately from Wi-Fi. WiMax is designed for long-range networking (spanning miles or kilometers) as opposed to local area wireless networking.

**IEEE 802.11 Working Group Standards**

The following IEEE 802.11 standards exist or are in development to support the creation of technologies for wireless local area networking: 802.11a - 54 Mbps standard, 5 GHz signaling (ratified 1999)

- 802.11b - 11 Mbps standard, 2.4 GHz signaling (1999)
- 802.11c - operation of bridge connections (moved to 802.1D)
- 802.11d - worldwide compliance with regulations for use of wireless signal spectrum (2001)
- 802.11e - Quality of Service (QoS) support (not yet ratified)
- 802.11F - Inter-Access Point Protocol recommendation for communication between access points to support roaming clients (2003)
- 802.11g - 54 Mbps standard, 2.4 GHz signaling (2003)
- 802.11h - enhanced version of 802.11a to support European regulatory requirements (2003)
- 802.11i - security improvements for the 802.11 family (2004)

- 802.11j - enhancements to 5 GHz signaling to support Japan regulatory requirements (2004)
- 802.11k - WLAN system management (in progress)
- 802.11l - skipped to avoid confusion with 802.11i
- 802.11m - maintenance of 802.11 family documentation
- 802.11n - 100+ Mbps standard improvements over 802.11g (in progress)
- 802.11o - skipped
- 802.11p - Wireless Access for the Vehicular Environment
- 802.11q - skipped
- 802.11r - fast roaming support via Basic Service Set transitions
- 802.11s - ESS mesh networking for access points
- 802.11T - Wireless Performance Prediction - recommendation for testing standards and metrics
- 802.11u - internetworking with 3G / cellular and other forms of external networks
- 802.11v - wireless network management / device configuration
- 802.11w - Protected Management Frames security enhancement
- 802.11x - skipped (generic name for the 802.11 family)
- 802.11y - Contention Based Protocol for interference avoidance

The Official IEEE 802.11 Working Group Project Timelines page is published by IEEE to indicate the status of each of the networking standards under development.

**References:**


1. The definitions, which are not defined in the thesis, are collected from the web page, **www.about.com**
2. [Baghaei03] Baghaei, Nilufar. *IEEE 802.11 Wireless LAN Security Performance Using Multiple Clients.* Department of Computer Science and Software Engineering. University of Canterbury, Christchurch, New Zealand, 2003.


## Summary


Nowadays WLAN plays a very important role in corporate network environments. It has become very famous for home network applications. Wireless accessibility has increased so much that hackers and thieves can easily abuse security systems that is why stronger security methods like advanced encryption algorithms and efficient authentication processes are being addressed more and more.