

# Wireless Networking

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## ABSTRACT

Business network today are evolving to support people who are on the move. Employees and employers, students and faculty, government agents and those they serve, sports fans and shoppers, all are mobile and many of them are connected. Perhaps everyone has a mobile phone that we route instant messages to when we are away from our computer. This is the vision of mobility—an environment where people can take their connection to the network along with them on the road. We continue this motivation for wireless technology as a first step in our wireless exploration.

## 1. INTRODUCTION

Wireless networks utilize radio waves and/or microwaves to maintain communication channels between computers. Wireless networking is a more modern alternative to wired networking that relies on copper and/or fiber optic cabling between network devices. A wireless network offers advantages and disadvantages compared to a wired network. Advantages of wireless include mobility and elimination of unsightly cables. Disadvantages of wireless include the potential for radio interference due to weather, other wireless devices, or obstructions like walls. Wireless is rapidly gaining in popularity for both home and business networking. Wireless technology continues to improve, and the cost of wireless products continues to decrease. Popular wireless local area networking (WLAN) products conform to the 802.11 "Wi-Fi" standards. The gear a person needs to build wireless networks include network adapters (NICs), access points (APs), and routers. Following figure shows the basic model of wireless network and some components required for the wireless communication.

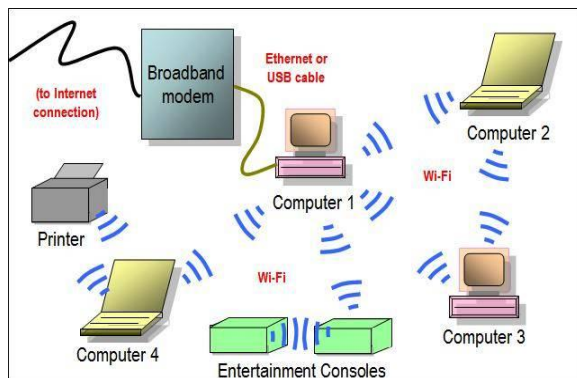


Fig. (1):- Wireless Network and its Component.

Types Of wireless Networks:

1. Wireless LAN
2. Wireless MAN
3. Wireless WAN

## 2. TYPES OF WIRELESS NETWORK

### 1. Wireless LAN:

WLANs are extensions of Ethernet LANs. Figure (2) illustrates a WLAN topology that we use reference topology through this paper. A wireless local area network (WLAN) links two or more devices over a short distance using a wireless distribution method, usually providing a connection through an access point for Internet access. The use of spread-spectrum or OFDM technologies may allow users to move around within a local coverage area, and still remain connected to the network. WLANs uses radio frequency (RF) instead of cables at the physical layer and MAC sub layers of the data link layer because RF does not have boundaries, such as the limits of a wire in a sheaths. The lack of such boundary allows data frames travelling over the RF media to be available to anyone who can receive the RF signal. RF bands are regulates differently in each country. The uses of WLANs are subject to a additional regulation and sets of standards that are not applied to wired LANs.

WLAN connect client to the network through a wireless access point (AP) instead of an Ethernet switch. WLANs connect mobile devices that are often battery powered, in contrast to plugged in LAN devices. Medium access control protocols define the rules that allow devices to share the medium in an efficient and orderly manner. In contrast to the wired LAN MAC protocols, wireless LAN MAC protocols should cope with the unique properties of wireless medium: half duplex mode, time varying and bursty channel, location dependent carrier sensing, hidden and exposed terminal problems, etc. These properties of the wireless medium make the design of MAC protocols particularly difficult and challenging.

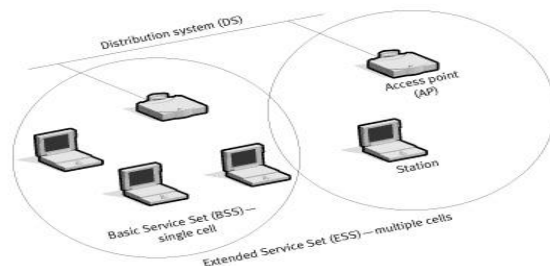


Fig. (2):- Wireless LAN

Wireless MAC issues in which we are currently interested are as follows:

- ◆ Distributed and Centralized MAC Protocols
- ◆ IEEE 802.11 MAC Protocol Family (802.11a/b/e)
- ◆ ETSI HIPERLAN Type 2
- ◆ Providing QoS Guarantees in Wireless MAC Protocols.

## 2. Wireless MAN:

Wireless metropolitan area networks are a type of wireless network that connects several wireless LANs. WiMAX is a type of Wireless MAN and is described by the IEEE 802.16 standard.

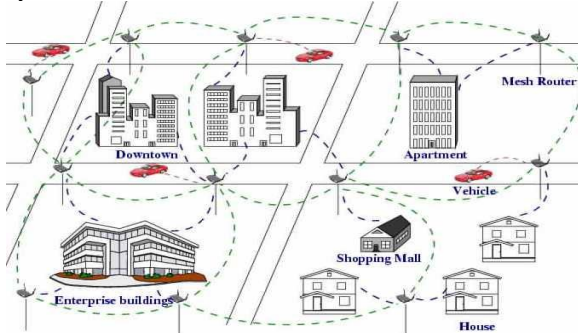


Fig (3):- Wireless MAN

## 3. Wireless WAN:

Wireless wide area networks are wireless networks that typically cover large areas, such as between neighboring towns and cities, or city and suburb. These networks can be used to connect branch offices of business or as a public internet access system. The wireless connections between access points are usually point to point microwave links using parabolic dishes on the 2.4 GHz band, rather than omnidirectional antennas used with smaller networks. A typical system contains base station gateways, access points and wireless bridging relays. Other configurations are mesh systems where each access point acts as a relay also. When combined with renewable energy systems such as photovoltaic solar panels or wind systems they can be stand alone systems.

Some examples of usage include cellular phones which are part of everyday wireless networks, allowing easy personal communications. Another example, Inter-continental network systems, use radio satellites to communicate across the world. Emergency services such as the police utilize wireless networks to communicate effectively as well. Individuals and businesses use wireless networks to send and share data rapidly, whether it be in a small office building or across the world.

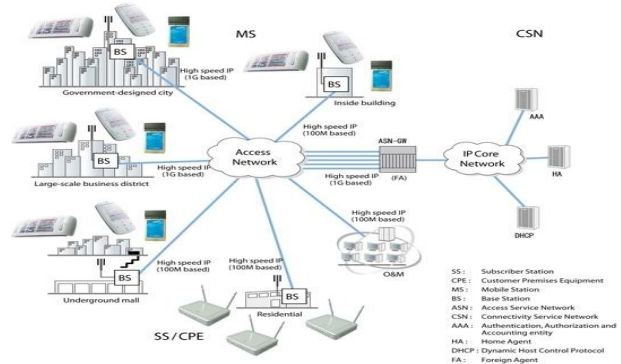


Fig.(4):- Wireless WAN

## 3. WIRELESS NETWORKING STANDARD

### 1. 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.

### 2. 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.

### 3. 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

#### 4. 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

#### 5. 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.

The following table provides some comparative communications distances at various data communications speeds for each of the 802.11 standards.

The following table provides information on data rates for each standard. Note that 802.11g systems operate significantly faster when there are no 802.11b clients in the network.

**Table 1. : 802.11 a, b, g Range Comparison**

Data Rate (Mbps)	802.11a (40 mW with 6dBi diversity antenna)	Range with gain patch antenna	802.11g (30 mW with 2.2 dBi gain dipole antenna)	Range with 2.2 dBi gain dipole antenna
54	13 m		27 m	
48	15 m		29 m	
36	19 m		30 m	
24	26 m		42 m	
18	33 m		54 m	
12	39 m		64 m	
11	-		48 m	45 m
9	45 m		76 m	
6	50 m		91 m	
5.5	-		67 m	67 m
2	-		82 m	82 m
1	-		124 m	124 m

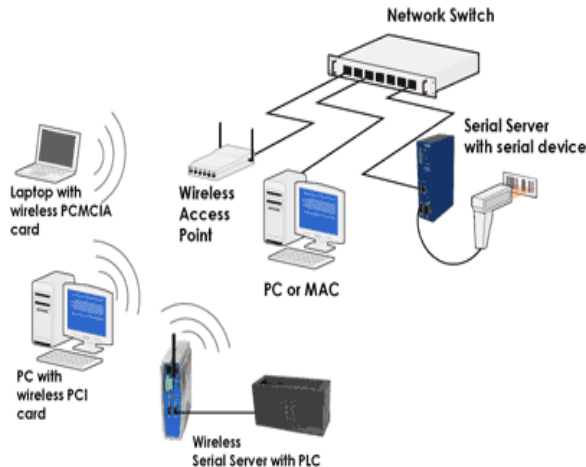
The following table provides information on data rates for each standard. Note that 802.11g systems operate significantly faster when there are no 802.11b clients in the network.

**Table 2. : 802.11a, b, g Data Rate Comparison**

	Data Rate (Mbps)	Throughput (Mbps)	Throughput as a % of 802.11b throughput
802.11 b	11	6	100%
802.11g (with .11b clients in cell)	54	14	233%
802.11g (no .11b clients in cell)	54	22	367%
802.11a	54	25	417%

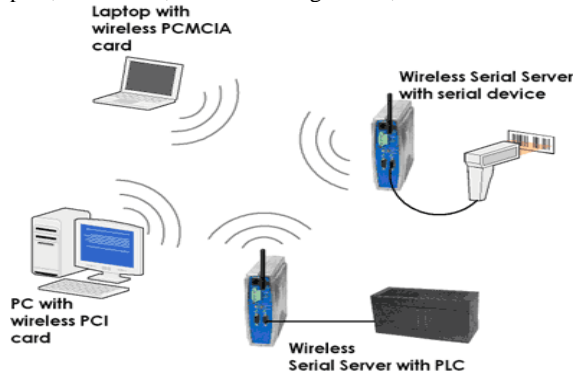
#### 4. Basic Wireless Network Topology

To give either of these existing networks wireless capability, connect a wireless access point (AP) to the network switch as shown in figure below. Laptop or desktop computers equipped with wireless cards, or other wireless devices such as wireless serial servers, communicate with each other and the wired network via the AP. Wireless devices connect to the switch as if they are connected via a normal network cable. A major benefit to adding the wireless segment is that you can avoid running new cables. Another is that you can add up to 32 wireless computer users without having to buy a bigger switch with more ports.



**Fig (5). Infrastructure Wireless Network**

Wireless devices also can be set up as a peer to peer, or Ad Hoc, network configuration, as shown below.



**Fig. (6). Adhoc Wireless Network**

## 5. PERFORMANCE

Each standard varies in geographical range, thus making one standard more ideal than the next depending on what it is one is trying to accomplish with a wireless network. The performance of wireless networks satisfies a variety of applications such as voice and video. The use of this technology also gives room for future expansions. As wireless networking has become commonplace, sophistication increased through configuration of network hardware and software.

## 6. APPLICATIONS

### 1. General:

In a general sense, wireless networks offer a vast variety of uses by both business and home users. Now, the industry accepts a handful of different wireless technologies. Each wireless technology is defined by a standard that describes unique functions at both the Physical and the Data Link layers of the OSI Model. These standards differ in their specified signaling methods, geographic ranges, and frequency usages, among other things. Such differences can make certain technologies better suited to home networks and others better suited to network larger organizations.

### 2. Space:

Space is another characteristic of wireless networking. Wireless networks offer many advantages when it comes to difficult-to-wire areas trying to communicate such as across a street or river, a warehouse on the other side of the premise or buildings that are physically separated but operate as one. Wireless networks allow for users to designate a certain space which the network will be able to communicate with other devices through that network. Space is also created in homes as a result of eliminating clutters of wiring. This technology allows for an alternative to installing physical network mediums such as TPs, coaxes, or fiber-optics, which can also be expensive.

### 3. Home:

For homeowners, wireless technology is an effective option as compared to ethernet for sharing printers, scanners, and high speed internet connections. WLANs help save from the cost of installation of cable mediums, save time from physical installation, and also creates mobility for devices connected to the network.<sup>[10]</sup> Wireless networks are simple and require one single wireless access point connected directly to the Internet via a router.

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