WIRELESS COMMUNICATION

PREPARED BY

RANJITH.R

PRADHEEP.J.V

EZHILARASUN.P

BALAMURUGAN.V

PRIYADARSHAN.M.J

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**INTRODUCTION:**

**Wireless communication** is the transfer of information over a distance without the use of electrical conductors .The distances involved may be short (a few meters as in television remote control) or long (thousands or millions of kilometers for radio communications). When the context is clear, the term is often shortened to "wireless". Wireless communication is generally considered to be a branch of  telecommunications.

**Wireless operations** permits services, such as long range communications, that are impossible or impractical to implement with the use of wires. The term is commonly used in the telecommunications industry to refer to telecommunications systems (e.g., radio transmitters and receivers, remote controls, computer networks, network terminals, etc.) which use some form of energy (e.g. radio frequency(RF), [infrared](http://en.wikipedia.org/wiki/Infrared) light, [laser](http://en.wikipedia.org/wiki/Laser) light, visible light, acoustic energy, etc.) to transfer information without the use of wires. Information is transferred in this manner over both short and long distances.The term "wireless" has become a generic and all-encompassing word used to describe communications in which electromagnetic waves or RF (rather than some form of wire) carry a signal over part or the entire communication path. Common examples of wireless equipment in use today include:

* Professional LMR (Land Mobile Radio) and SMR (Specialized Mobile Radio) typically used by business, industrial and Public Safety entities
* Consumer Two Way Radio including FRS (Family Radio Service), GMRS (General Mobile Radio Service) and Citizens band ("CB") radios
* The Amateur Radio Service (Ham radio)
* Consumer and professional Marine VHF radios
* Cellular telephones and pagers: provide connectivity for portable and mobile applications, both personal and business.
* Global Positioning System (GPS): allows drivers of cars and trucks, captains of boats and ships, and pilots of aircraft to ascertain their location anywhere on earth.
* Cordless computer peripherals: the cordless mouse is a common example; keyboards and printers can also be linked to a computer via wireless.
* Cordless telephone sets: these are limited-range devices.
* Satellite television: allows viewers in almost any location to select from hundreds of channels.
* Wireless gaming: new gaming consoles allow players to interact and play in the same game regardless of whether they are playing on different consoles. Players can chat, send text messages as well as record sound and send it to their friends. Controllers also use wireless technology. They do not have any cords but they can send the information from what is being pressed on the controller to the main console which then processes this information and makes it happen in the game. All of these steps are completed in milliseconds.

Wireless networking is used to meet many needs. Perhaps the most common use is to connect laptop users who travel from location to location. Another common use is for mobile networks that connect via satellite. A wireless transmission method is a logical choice to network a LAN segment that must frequently change locations. The following situations justify the use of wireless technology:

* To span a distance beyond the capabilities of typical cabling,
* To avoid obstacles such as physical structures, EMI, or RFI,
* To provide a backup communications link in case of normal network failure,
* To link portable or temporary workstations,
* To overcome situations where normal cabling is difficult or financially impractical, or
* To remotely connect mobile users or networks.

**Wireless communication can be via:**

* [radio](http://en.wikipedia.org/wiki/Radio) frequency communication,
* [microwave](http://en.wikipedia.org/wiki/Microwave) communication

Bluetooth technology is considered to be the most advanced technologies in the communication engineering. It is the low power microwave wireless link, which does not require the line of sight positioning

* [infrared](http://en.wikipedia.org/wiki/Infrared) (IR) short-range communication, for example from [remote controls](http://en.wikipedia.org/wiki/Remote_control) or via [IRDA](http://en.wikipedia.org/wiki/IRDA).

**Wi-Fi**

Wi-Fi stands for wireless fidelity. Wireless operates in a frequency band of 2.4 GHz with a maximum data rate of 11Mbps. A station (STA) is a network node that is equipped with a wireless network device. A personal computer with a wireless network adapter is known as a wireless client. Wireless clients can communicate directly with each other or through a wireless access point (AP).

WIRELESS ACCESS POINT is a wireless network node that acts as a bridge between

STAs and a wired network. A wireless AP contains:

· At least one interface that connects the wireless AP to an existing wired network.

· A wireless network device with which it creates wireless connections with STAs.

· IEEE 802.1D bridging software, so that it can act as a transparent bridge between the wireless and wired networks.

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It operates in two modes Ad hoc mode and Infrastructure mode.

**AD HOC MODE:**

In ad hoc mode, also known as peer-to-peer mode, wireless clients communicate directly with each other (without the use of a wireless AP). Two or more wireless clients who communicate using ad hoc mode form an Independent Basic Service Set (IBSS). Ad hoc mode is used to connect wireless clients when a wireless AP is not present.



**INFRA STRUCTURE MODE:**

In infrastructure mode, there is at least one wireless AP and one wireless client. The wireless client uses the wireless AP to access the resources of a wired network. The wired network can be an

organization intranet or the Internet, depending on the placement of the wireless AP .The infrastructure network structure in the 802.11 protocol A single wireless AP that supports one or multiple wireless clients is known as a Basic Service Set (BSS). A set of two or more wireless APs that are connected to the same wired network is known as an Extended Service Set(ESS).



Wi-Fi network uses radio technology to provide secure, fast, reliable, wireless connectivity.

**OPERATION BASICS**

When a wireless adapter is turned on, it begins to scan across the wireless frequencies for wireless APs and other wireless clients in ad hoc mode. Assuming that the wireless client is configured to operate in infrastructure mode, the wireless adapter chooses a wireless AP with which to connect. This selection is made automatically by using SSID and signal strength and frame error rate information. Next, the wireless adapter switches to the assigned channel of the selected wireless AP and negotiates the use of a port. This is known as establishing an association.

If the signal strength of the wireless AP is too low, the error rate too high, or if instructed by the operating system (in the case of Windows XP), the wireless adapter scans for other wireless APs to determine whether a different wireless AP can provide a stronger signal or lower error rate. If such a wireless AP is located, the wireless adapter switches to the channel of that wireless AP and negotiates the use of a port. This is known as reassociation.

**ADVANTAGES:**

**It’s fast:** From 11 to 54 Mbps throughput and advanced roaming capabilities provide reliable access to e-mail, the Internet, file sharing and other network resources away from the desk.

**It’s cost-effective:** Expand and extend your existing network by simply adding more adapters and access points. Planning is a no brainier as you need to buy only what you need.

**LIMITATIONS:**

It has a limited bandwidth of about 83.5 MHz.

Security techniques are not reliable yet.

**WiMAX**

WiMAX would operate similar to Wi-Fi but at higher speeds, over greater distances and for a greater number of users. WiMAX could potentially erase the suburban and rural blackout areas that currently have no broadband Internet access because [phone](http://computer.howstuffworks.com/telephone.htm) and [cable](http://computer.howstuffworks.com/cable-tv.htm) companies have not yet run the necessary wires to those remote locations.

  
Photo courtesy [Intel](http://computer.howstuffworks.com/framed.htm?parent=wimax.htm&url=http://www.intel.com)  
**WiMAX transmitting tower**

A WiMAX system consists of two parts:

* A **WiMAX tower**, similar in concept to a cell-phone tower - A single WiMAX tower can provide coverage to a very large area -- as big as 3,000 square miles (~8,000 square km).
* A **WiMAX receiver** - The receiver and antenna could be a small box or [PCMCIA card](http://computer.howstuffworks.com/removable-storage.htm), or they could be built into a laptop the way WiFi access is today.

WiMAX operates on the same general principles as WiFi -- it sends data from one computer to another via [radio](http://computer.howstuffworks.com/radio.htm) signals. A computer (either a desktop or a laptop) equipped with WiMAX would receive data from the WiMAX transmitting station, probably using[encrypted](http://computer.howstuffworks.com/encryption.htm) data keys to prevent unauthorized users from stealing access.

The fastest WiFi connection can transmit up to 54 megabits per second under optimal conditions. WiMAX should be able to handle up to **70 megabits per second**. Even once that 70 megabits is split up between several dozen businesses or a few hundred home users, it will provide at least the equivalent of cable-modem transfer rates to each user.

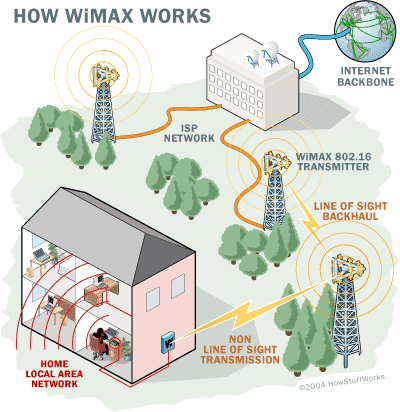
The biggest difference isn't speed; it's **distance**. WiMAX outdistances WiFi by miles. WiFi's range is about 100 feet (30 m). WiMAX will blanket a radius of**30 miles** (50 km) with wireless access. The increased range is due to the frequencies used and the power of the transmitter. Of course, at that distance, terrain, weather and large buildings will act to reduce the maximum range in some circumstances, but the potential is there to cover huge tracts of land.

**SPECIFICATIONS:**

* Range - 30-mile (50-km) radius from base station
* Speed - 70 megabits per second
* Line-of-sight not needed between user and base station

Frequency bands - 2 to 11 GHz and 10 to 66 GHz (licensed and unlicensed bands)

**WORKING:**

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* There is the **non-line-of-sight**, WiFi sort of service, where a small antenna on your computer connects to the tower. In this mode, WiMAX uses a **lower frequency range** -- 2 GHz to 11 GHz (similar to WiFi). Lower-wavelength transmissions are not as easily disrupted by physical obstructions -- they are better able to diffract, or bend, around obstacles.
* There is **line-of-sight** service, where a fixed dish antenna points straight at the WiMAX tower from a rooftop or pole. The line-of-sight connection is stronger and more stable, so it's able to send a lot of data with fewer errors. Line-of-sight transmissions use **higher frequencies**, with ranges reaching a possible 66 GHz. At higher frequencies, there is less interference and lots more bandwidth.

Wi-Fi-style access will be limited to a 4-to-6 mile radius (perhaps 25 square mile s or 65 square km of coverage, which is similar in range to a cell-phone zone). Through the stronger line-of-sight antennas, the WiMAX transmitting station would send data to WiMAX-enabled computers  set up within the transmitter's 30-mile radius (2,800 square miles or 9,300 square km of coverage). This is what allows WiMAX to achieve its maximum range

**ADVANTAGES:**

* The **high speed** of broadband service
* **Wireless** rather than wired access, so it would be a lot less expensive than cable or DSL and much easier to extend to suburban and rural areas
* Broad **coverage** like the [cell phone](http://computer.howstuffworks.com/cell-phone.htm) network instead of small Wi-Fi hotspots

WiMAX is short for **Worldwide Interoperability for Microwave Access**.

**GSM**

GSM stands for **G**lobal **S**ystem for **M**obile Communication and is an open, digital cellular technology used for transmitting mobile voice and data services

The GSM is the name of a standardization group established in 1982 to create a common European mobile telephone standard.

The GSM standard is the most widely accepted standard and is implemented globally.

The GSM is a circuit-switched system that divides each 200kHz channel into eight 25kHz time-slots.

The GSM makes use of narrowband **Time Division Multiple Access (TDMA)** technique for transmitting signals.

The GSM was developed using digital technology. It has an ability to carry 64 kbps to 120 Mbps of data rates.

The GSM provides basic to advanced voice and data services including Roaming

Service

A GSM digitizes and compresses data, then sends it down through a channel with two other streams of user data, each in its own time slot. It operates at either the 900 MHz or 1,800 MHz frequency band.

**GSM - Architecture**

A GSM network consists of several functional entities whose functions and interfaces are defined. The GSM network can be divided into following broad parts.

· The Mobile Station(MS)

· The Base Station Subsystem (BSS)

· The Network Switching Subsystem (NSS)

· The Operation Support Subsystem(OSS)

Following is the simple architecture diagram of GSM Network.



**GPRS**

**General Packet Radio Service (GPRS)** is a Mobile Data Service available to users of GSM and IS-136 mobile phones. GPRS data transfer is typically charged per megabyte of transferred data, while data communication via traditional circuit switching is billed per minute of connection time, independent of whether the user has actually transferred data or has been in an idle state. GPRS can be utilized for services such as WAP access, SMS and MMS, but also for Internet communication services such as email and web access. 2G cellular systems combined with GPRS is often described as "2.5G", that is, a technology between the second (2G) and third (3G) generations of mobile telephony. It provides moderate speed data transfer, by using unused TDMA channels in for example the GSM system

**GPRS basics**

GPRS is different from the older Circuit Switched Data (or CSD) connection included in GSM standards. In CSD, a data connection establishes a circuit, and reserves the full bandwidth of that circuit during the lifetime of the connection. GPRS is packet-switched which means that multiple users share the same transmission channel, only transmitting when they have data to send. This means that the total available bandwidth can be immediately dedicated to those users who are actually sending at any given moment, providing higher utilisation where users only send or receive data intermittently. Web browsing, receiving e-mails as they arrive and instant messaging are examples of uses that require intermittent data transfers, which benefit from sharing the available bandwidth. Usually, GPRS data are billed per kilobytes of information transceived while circuit-switched data connections are billed per second. The multiple access methods used in GSM with GPRS are based on frequency division duplex (FDD) and FDMA. During a session, a user is assigned to one pair of uplink and downlink frequency channels.This is combined with time domain statistical multiplexing, i.e. packet mode communication, which makes it possible for several users to share the same frequency channel. The packets have constant length, corresponding to a GSM time slot. In the downlink, first-come first-served packet scheduling is used. In the uplink, a scheme that is very similar to reservation ALOHA is used

**The GPRS capability classes**

Class A

Can be connected to GPRS service and GSM service (voice, SMS), using both at the same time.

Such devices are known to be available today.

Class B

Can be connected to GPRS service and GSM service (voice, SMS), but using only one or the other at a given time. During GSM service (voice call or SMS), GPRS service is suspended, and then resumed automatically after the GSM service (voice call or SMS) has concluded. Most GPRS mobile devices are Class B.

Class C

Are connected to either GPRS service or GSM service (voice, SMS). Must be switched manually between one or the other service.

A true Class A device may be required to transmit on two different frequencies at the same time, and thus will need two radios. To get around this expensive requirement, a GPRS mobile may implement the dual transfer mode (DTM) feature. A DTM-capable mobile may use simultaneous voice and packet data, with the network coordinating to ensure that it is not required to transmit on two different frequencies at the same time. Such mobiles are considered to be pseudo Class A.

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