Assignment 1

Wireless Technology

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Table of Content

Table of Participation

Student	Zigbee	WiMax	Bluetooth	WLAN
Akkarush	**100**	**100**		
Boontarika			**100**	**100**

WiMax

1. Protocol Architectures

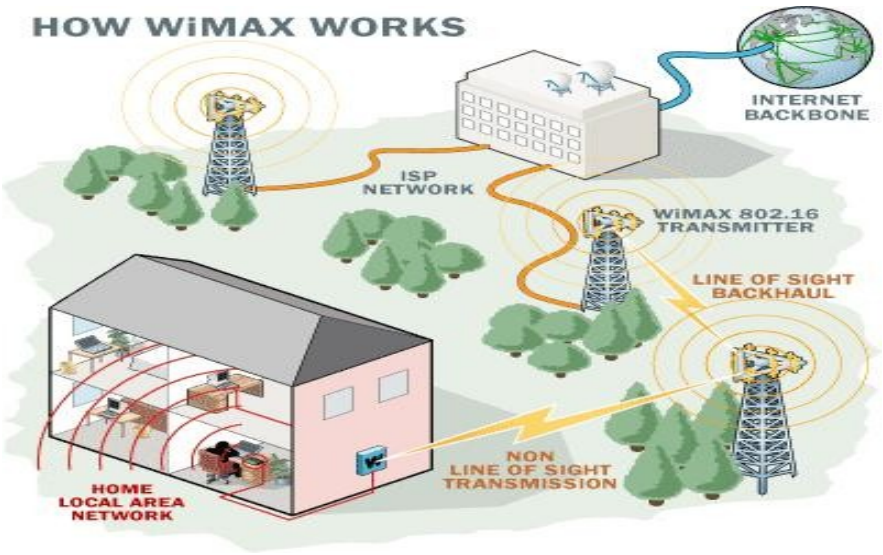


Figure 0 WiMax architechture

WiMax has three communication types are

1. **Point to Point (PTP)** is the connection between Base stations (BS)

2. **Point to Multipoint (PTM)** is the communication between Base station and subscriber stations (SS).

3. **Mesh Topology** is network topology is used in the WiMax which has direct-link to every station.

WiMax has a capability to communicate in Line of Sight and Non Line of Sight where LOS is communication between BS and NLOS is between BS and SS.

1.1 Layered Stacks

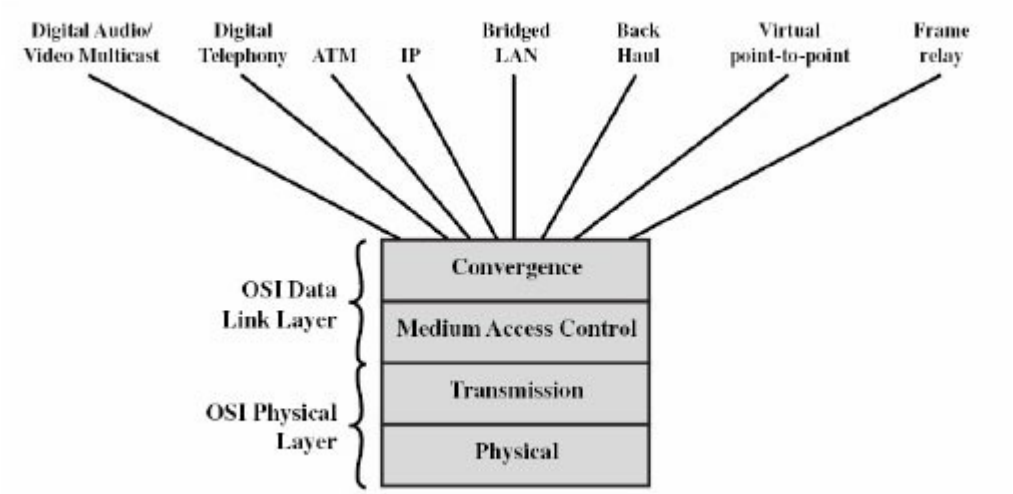


Figure 1. WiMax's layered stacks

In the physical and transmission layer, it is doing about

1.) Encoding and decoding of signals.

2.) Preamble generation and removal.

3.) Bit transmission and reception.

In the Medium Access Control layer, it is doing about

1.) On transmission, assemble data into a frame with address and error detection fields.

2.) On reception, disassemble frame and perform address recognition and error detection.

3.) Govern access to the wireless transmission medium.

In the convergence layer, it is doing about

1.) Encapsulate Protocol Data Unit (PDU) framing of upper layers into native 802.16 MAC/PHY frames

2.) Map upper layer's addresses into 802.16 addresses

3.) Translate upper layer Quality of Service (QoS) parameters into native 802.16 MAC format

4.) Adapt time dependencies of upper layer traffic into equivalent MAC service

1.2 Protocols

slotted TDMA protocol is using scheduling algorithm by separate communication channels which is used in MAC Layer

1.3 Standards

The IEEE 802.16 standard is the standard for public communication in Metropolitan Area Network (MAN). The 802.16 standard as five amendments as follows:

1) 802.16

This is the only standard which supports LoS (Line of Sight), which means that no objects must stand in between the sender and the receiver. It takes LMDS (Local Multipoint Distribution Systems) to use in the frequency range which is higher than 11GHz and in the distance of 1.6-4.8 kilometers.

2) 802.16a

This standard uses the 2-11 GHz frequency band in hope of competing with DSL and Cable modem. It can send information up to 70 Mbps within the 50 km radius. It supports NLoS (Non-Line-of-Sight). This means that WiMAX can support 60 T1-Type users and hundreds of DSL users at the same time.

3) 802.16 REVd

A combination and modification of 802.16a and 802.16c which completely replaces both, the 802.16 REVd incorporates MIMO (Multiple-Input-Multiple-Output). This means it uses more than two stations to increase the service area and data transfer rate. This is also easy to set up indoors.

4) 802.16d

The wireless network for non-mobile users, such as the desktop, 802.16d (aka Fixed WiMAX) is developed with the interoperability of devices from different manufacturers in mind. This is done in hope for WiMAX to gain acceptance and popularity.

5) 802.16e

This standard adds the mobility feature and has a smaller spectrum band (5 MHz), from 2 to 6 GHz. It has slower data transfer rate and smaller antennas so that it would be convenient to use on vehicles. It is the competitor of the Cellular system. It can be adapted for PDAs and notebooks within a 1.6-4.8 km radius without losing quality and stability.

1.4 Standard Organizations

The organization who is producing and improving this standard is Institute of Electrical and Electronics Engineers and also called IEEE.

2. Data Transmission

2.1 Spectrum and Frequency

Normally, WiMax could be deployed in a variety of spectrum bands in 2-11 GHz. The Most used spectrums are 2.3GHz, 2.5 GHz, 3.5GHz and 5.8 GHz.

In Thailand is now under researching on spectrum allocation at 3.5GHz which should be appropriated to Thailand because Thailand is a rainy country.

2.2 Bandwidth

The maximum bandwidth of WiMax is 75 Mbps which can be achieve by using 64 Quadrature Amplitude Modulation (QAM) ¾ modulations. However, Bandwidth can be reduced if there are many active users in a single sector.

2.3 Data Rates

In the Theory maximum could support approximately 75 Mbps per channel. But in practice will be lower to 45 Mbps per channel.

Transmission Media

3.1 Transmission Power

WiMax base stations (BS) transmit at power levels of approximately +43dBm or 20W and WiMax mobile stations (MS) typically transmit at +23 dBm or 200 mW

3.2 Receive Thresholds

Receiver sensitivity is a factor of bandwidth as follows:
Receiver sensitivity = -174 + 10log BW + NF of receive amp so, the narrower the bandwidth the lower the noise, hence the lower the receive threshold for narrower BW.

3.3 Antennas

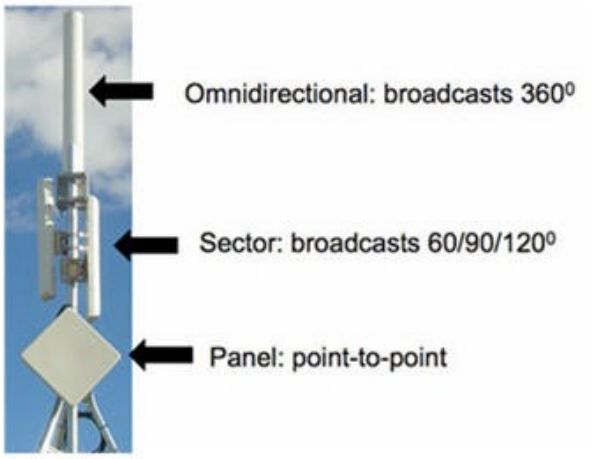


Figure 1 WiMax's antenna

WiMax's antenna has 3 types.

1.) **Omni directional antenna** is sending signal in form of Point-to-Multipoint communication. This part has a range likes a half cylinder. The Disadvantage is it has a weak transmission power. The range of this part is around 100 meters. Use for short range transmission but the advantage is it can communicate freedomly.

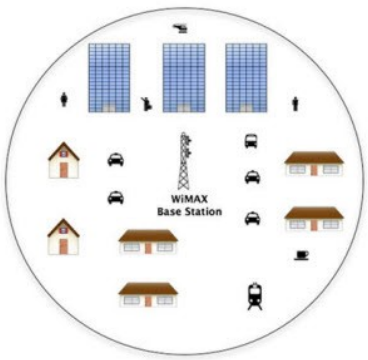


Figure 2 Omni Directional Antenna broadcast in 360 degree from base station

2.) **Sector antenna** is used to communicates among base station with a LOS specify transmission. The advantage is it has a strong transmission power and use for communicate in wide area but disadvantage is if the receivers are out of area. They cannot receive the signal at all. For the example in the below picture.

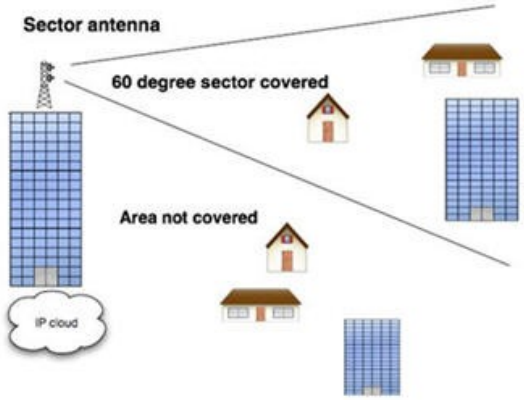


Figure 3 receiver cannot get a signal if out of the cover area

3.) **Panel antenna** is sending signal in form of Point-to-Point communication. It can uses in either indoor and outdoor but this depend on the weather and blocking object .

Figure 4 Panel antenna uses for Point-to-Point applications.

WiMax Radios uses to create the signal of WiMax and have to setup near the antenna but it must keep in the cover up material to elude from the weather.

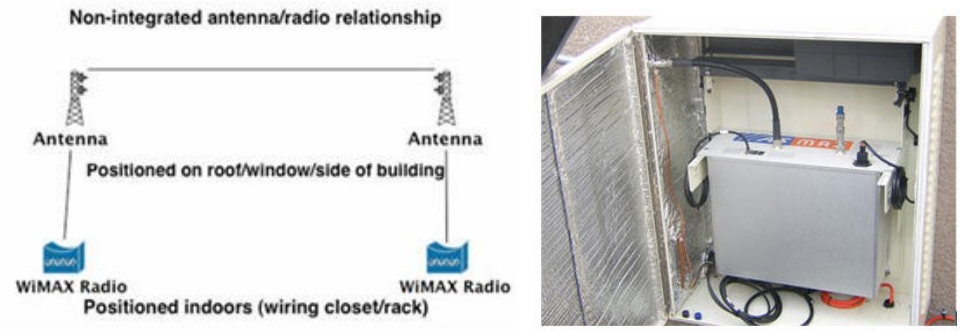


Figure 5. picture of WiMax Radios and relation between Antenna.

3.4 Distances

The distance of communication in WiMax is depends on which standard they use.

For the fixed station can be communicated in range of 50 km.

For the mobile station can be communicated in range of 1.6-4.8 km.

4. Signal Encoding Techniques

Diversity Technology

WiMax applies an advance technology to the transmitter and the receiver to separate the direct signal and the reflect signal.

Adaptive Modulation Technology

WiMax has a capability to mix or modulate various waves. This technique uses for optimize the signal by determine the transmission signal, the range of BS and SS and the level of noises. WiMax uses modulation by Binary Phase Shift Keying (BPSK) , Quadrature Phase Shift Keying (QPSK), 16-Quadrature Amplitude Modulation (16QAM) and 64-Quadrature Amplitude Modulation (64QAM)

5. Errors

5.1 Error detection and Error correction

Convolutional Encoding, Strong Reed Solomon FEC, and interleaving algorithms are used to detect and correct errors to increase throughput. frequency selective fading or bust errors may missing the error frames. To remove the errors , Automatic Repeat request is used which cannot be corrected by Forward Error Detection (FEC). To improve this , they use Bit Error Rate (BER) instead.

5.2 ARQ

WiMax can use ARQ or H-ARQ. In ARQ they use

- **the sliding window technique:**

Selective repeat is selected by default

Go back N algorithm in specified case

H-ARQ is Combination of FEC and Stop and Wait ARQ.

6. Applications

WiMax is the wireless broadband technology which expects to use in future. In the present, many country starting to setup WiMax already. The intention of WiMax is to creates network which cover in large area with high speed.

The typical user can uses WiMax service by just buying a WiMax device to connect through the public network.

Devices are used in WiMax in base station must have WiMax tower and circuit box which manage about bandwidth of uplink/downlink to destination antenna. For the subscriber station may uses WiMax USB, WiMax Gateway, Access Point or Router.

Figure 6. WiMax devices

The advantage of WiMax

1. Can transmit in very large area cover to countryside
2. High Data rates.
3. use encryption in security system and in inspecting usage
4. low setup cost
5. High efficiency with the mobile devices.
6. Internet service providers will be able to cater a wider variety of service plans**.**
7. Support VoIP , IPTV and other medias.
8. Increase internet users
9. Decrease the cost of installing wire LAN.
10. Countryside can lern from internet by using WiMax

The Disadvantage of WiMax

1. The Device has high cost.
2. Spectrums of WiMax are used in 2-6 GHz (802.16e) until 11 GHz (802.16d) in some country these frequency have been take controlled.
3. There are few manufacturers make use of WiMax Technology.
4. There are few devices which support WiMax.

7. Usage

In Thailand, WiMax is in researching process. There is no usage in Thailand but in the next further year hopefully will. In other countries , there are many country are using WiMax. In Europe and USA use WiMax to be the main technology to connect with the internet backbone. For example France, England, Sweden and in USA are Boston, Chicago, New York, San Francisco, Washington, California, Los Angeles. In an Africa, in Kenya, Nigeria, Lagos, Tanzania, Cameroon, Abuja and South Africa are starting to use WiMax by access from Modem or PCMCIA Card. In Asia, In Japan, Singapore, South Korea. Why WiMax did not extensively use in Thailand? Because WiMax is new

technology in Thailand. So it still has high setup cost and it does not have an agreement for which spectrum going to use.

8. Cost

Total cost is around 43,000$. This separate into

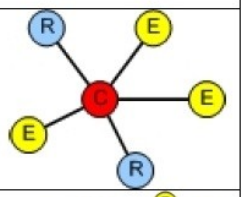
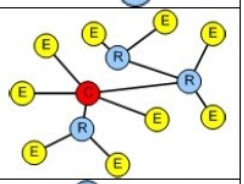
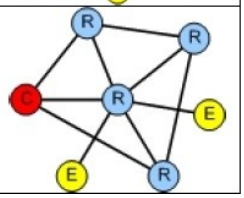
Base station 40,000$

Sector antenna 3000$

ZigBee

1. Protocol Architectures

Zigbee supports various network topologies that are differentiated by the addressing mechanism that the network uses to identify devices and parent/child relationship that are permitted.

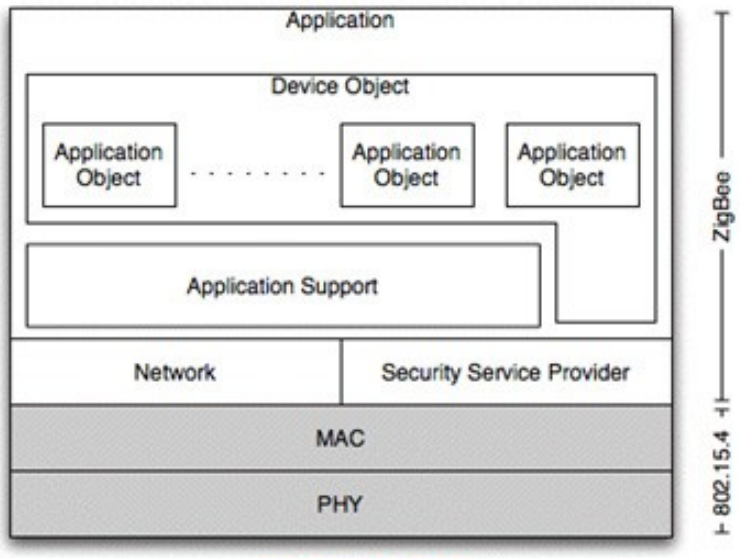
Topology Type	Addressing	Parent/Child	
Star	Distributed (structured)	Only one parent, all other devices are child devices	
Tree	Distributed (structured)	Multiple parents and child devices	
Mesh	Stochastic (random)	Multiple parents and child devices	

is a ZigBee Coordinator which is a device with routing capability that initiates the network. Usually the default Trust Center and Channel Manager of the network. Can act only as a parent

is a ZigBee Router which is a device with routing capability. Can be assigned the roles of Trust Center and Channel Manager. Can act as parent and/or child.

is a ZigBee End-Device which is a device with no routing capability. Can act only as a child.

1.1 Layered Stacks



شكل Zigbee Stack

PHY Layer

This layer concerns with the interface to physical transmission medium it exchanges data bits with this medium and exchanging data bits with the MAC layer

MAC Layer

This layer is in OSI data-link layer responsible for addressing.

- For outgoing data it determines where the data is going
- For incoming data it determines where the data has come from
- Assembling data packets or frames to be transmitted and decomposing received frames.

Network Layer

- Starting the network.
- Assigning network addresses.
- Adding devices to and removing them from the network.
- Routing messages to their intended destinations.

- Applying security to outgoing messages
- Implementing route discovery in Mesh topologies and storing routing table information.

Application Layer

- Communicating with the relevant application
- Maintaining binding tables and sending messages between bound nodes.

Security Layer

Different levels of security are available. The security functionality makes use of keys (one or two) at different layers, as well as challenge-authentication procedures. The keys can be pre-configured within devices to increase security.

1.2 Protocols

Protocol is used in Zigbee is Carrier Sense Multiple Access/Collision Avoidance (CSMA/CA) protocol which is the way of peer is communicating to.

1.3 Standards

IEEE 802.15.4 is intended for the device which using low-cost battery. This standard allows devices to communicate in a variety of network topologies and can have battery life lasting several years.

1.4 Standard Organizations

The organization who is producing and improving this standard is Institute of Electrical and Electronics Engineers and also called IEEE.

2. Data transmission

2.1 Spectrums and Frequencies

Zigbee could be deployed in a variety of Radio Frequency Band in

2.4 GHz with 16 channels global use.

915 MHz with 10 channels for N. America, Australia, and a few additional.

868 MHz with 1 channel for EU countries.

The center frequency for each channel can be calculated as, $F_C = (2405 + 5 * (ch - 11))$ MHz, where ch = 11, 12, ..., 26.

2.2 Bandwidths

Bandwidth of Zigbee is around 20 KB/s to 250 KB/s

2.3 Data Rates

Maximum data rate of ZigBee is approximately 100 to 250 KB/s. However this depending on the modulation method used.

3. Transmission media

3.1 Transmission power and Receive Thresholds

XBee Pro 60mW Chip Antenna XBP24-ACI-001 has transmission power 60mW (+18dBm) and Receiver Sensitivity is -100 dBm

3.2 Antennas

Zigbee antenna has 2 type

1. Chip Antenna
2. Wire Antenna

Antenna peak gain is > 0 dBi with the frequency range 902-928 MHz

3.3 Distance

The distance which is capable to communicate each other is around 1 meter to 100 meters or more.

4. Signal Encoding Techniques

Zigbee using Modulation technique to encode the signal

ASK,BPSK is used in 868 MHz and 915 MHz

QPSK is used in Worldwide RF which is 2.4 GHz

5. # Errors

5.1Error Detection and Error Correction

ZigBee uses FEC and CRC error correction to increase throughput and network performance.

Application

Zigbee is intended for communicate in the private area. Most of them are used in houses, industrial, offices and hospital etc. Typical user can use this technology by using their television or using car's remote or air conditioner's remote etc. ZigBee has many product.

The Advantage of ZigBee

1. Low cost

2. Low energy consumption

3. Support mesh topologies

4. Two way communication

The Disadvantage of ZigBee

1. Low Data rate
2. Shot range

Usage

In Thailand Zigbee Technology is very popular. There are many people use it

In their many activity. In another country ZigBee is one of Most of usage in the world

Because it support many device and make human lives comfortably.

Cost

ZigBee chipset cost about 7$

Bluetooth

Bluetooth wireless technology is a short-range communications technology intended to replace the cables connecting portable and/or fixed devices while maintaining high levels of security. The key features of Bluetooth technology are robustness, low power, and low cost. The Bluetooth Specification defines a uniform structure for a wide range of devices to connect and communicate with each other.

1. Protocol Architectures

1.1. Layered Stacks

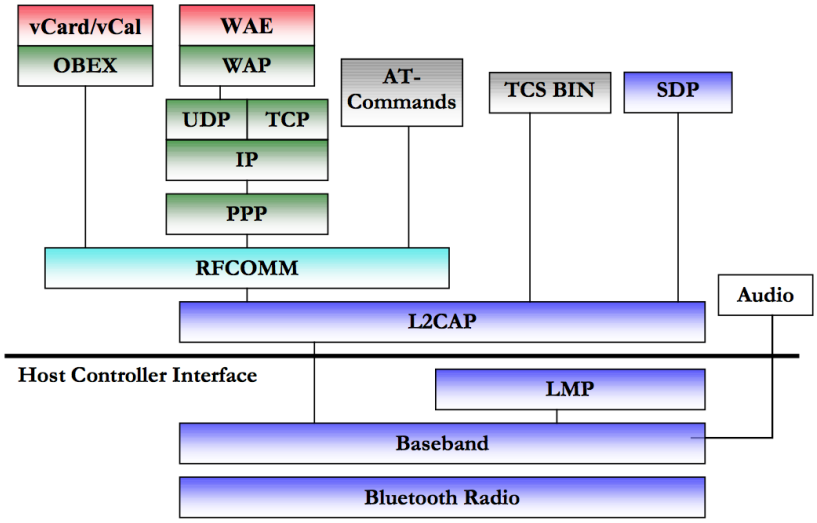


Figure: Bluetooth Protocols Stack

Radio Layer

The radio layer defines the sensitivity levels of the transceiver, establishes the requirements for using Spread-spectrum Frequency Hopping and classifies Bluetooth devices into three different power classes:

Baseband Layer

Baseband Layer, which is the physical layer of the Bluetooth. It is used as a link controller, which works with the link manager to carry out routines like creating link connections with other devices.

Link Manager Protocol

A Bluetooth device's Link Manager Protocol carries out link setup, authentication, link configuration and other protocols. It discovers other LMs within the area and communicates with them via the Link Manager Protocol

Host Controller Interface

Host Controller Interface allow command line access to the Baseband Layer and LMP for control and to receive status information. It's made up of three parts:

1) The HCI firmware, which is part of the actual Bluetooth hardware,
2) The HCI driver, which is found in the software of the Bluetooth device, and
3) The Host Controller Transport Layer, which connects the firmware to the driver.

Logical Link Control and Adaptation Protocol

Above the HCI level is the Logical Link Control and Adaptation Protocol, which provides data services to the upper level host protocols. The L2CAP plugs into the Baseband Layer and is located in the data link layer, rather than riding directly over LMP. It provides connection-oriented and connectionless data services to upper layer protocols.

RFCOMM

Above L2CAP, the RFCOMM protocol is what actually makes upper layer protocols think they're communicating over a RS232 wired serial interface, so there's no need for applications to know anything about Bluetooth.

Service Discovery Protocol

Also relying on L2CAP is the Service Discovery Protocol . The SDP provides a way for applications to detect which services are available and to determine the characteristics of those services.

1.2 Protocols

Protocol layer	Protocols in the stack
Bluetooth Core Protocols	Baseband [1], LMP [2], L2CAP [3], SDP [4]
Cable Replacement Protocol	RFCOMM [5]
Telephony Control Protocols	TCS Binary [6], AT-commands [7],[8],[9]
Adopted Protocols	PPP [10], UDP/TCP/IP [10], OBEX [11], WAP [12], vCard [13] , vCal [14], IrMC[1] [15], WAE [16]

Table: The Protocols and layer in the Bluetooth protocol stack

The Bluetooth protocol stack can be divided into four layers according to their purpose including the aspect whether Bluetooth SIG has been involved in specifying these protocols. The protocols belong into the layers in the following way.

1.3 Standards

Bluetooth 1.1 is a PAN standard that operates in the unrestricted 2.45 GHz ISM "free band", which is available globally, although slight variation of location and width of band apply at a PHY layer data rate of 1 Mbps

1.4 Standard Organizations

Bluetooth is standardized within the IEEE 802.15 Working Group for Wireless Personal Area Networks that formed in early 1999 as IEEE 802.15.1

2. Data Transmission

2.1 Spectrum and Frequency

Bluetooth technology operates in the unlicensed industrial, scientific and medical (ISM) band at 2.4 to 2.485 GHz, using a spread spectrum, frequency hopping, full-duplex signal at a nominal rate of 1600 hops/sec. The 2.4 GHz ISM band is available and unlicensed in most countries.

2.2 Bandwidth

Bluetooth was designed to allow low bandwidth wireless connections to become so simple to use that they seamlessly integrate into your daily life.

2.3 Data Rates

- 1 Mbps for Bluetooth low energy technology
- 1 Mbps for Version 1.2; Up to 3 Mbps supported for Version 2.0 EDR
- Up to 24 Mbps supported for Version 3.0 HS

3. Transmission Media

3.1 Transmission Power

The Bluetooth core specification classifies the transmitter equipment as having three classes of radio transmission power, namely 100mW(20dBm), 2.5mW(4dBm) and 1mW(0dBm). With 0dBm power, the communication range may be up to 10 meters (30 feet) while 20dBm transmit power increases the range to100 meters (328 feet). Above 4dBm, there is power control to transmit appropriate radio power corresponding to the communication distance.

3.2 Receive Thresholds

The actual sensitivity level is defined as the input level for which a raw bit error rate (BER) of 0.1% is met. The receiver sensitivity shall be below or equal to –70 dBm with any Bluetooth transmitter

3.3 Antennas

Bluetooth antenna products include dipole, high-gain, omnidirectional, internal, external and other services including antenna design and antenna development.

The Most Bluetooth technology is omni-directional and does not require line-of-sight positioning of connected devices

3.4 Distances

The range of Bluetooth wireless technologies are application specific. The Bluetooth Specification mandates operation over a minimum distance of 10 meters or 100 meters depending on the Bluetooth device class, but there is not a range limit for the technology.

- Class 1 radios – used primarily in industrial use cases – have a range of 100 meters or 300 feet
- Class 2 radios – most commonly found in mobile devices – have a range of 10 meters or 33 feet
- Class 3 radios – have a range of up to 1 meter or 3 feet

Class	Maximum Permitted Power		Range (approximate)
	mW	dBm	
Class 1	100	20	~100 meters
Class 2	2.5	4	~10 meters
Class 3	1	0	~1 meters

Table: Bluetooth RF Transmitter Power Classes

4. Signal Encoding Techniques

The Bluetooth modulation scheme is GFSK (Gaussian Frequency Shift Keying) with a symbol rate of 1Ms/s and modulation index between 0.28~0.35. The Gaussian-shaped, binary FSK modulation minimizes transceiver complexity.

5. Errors

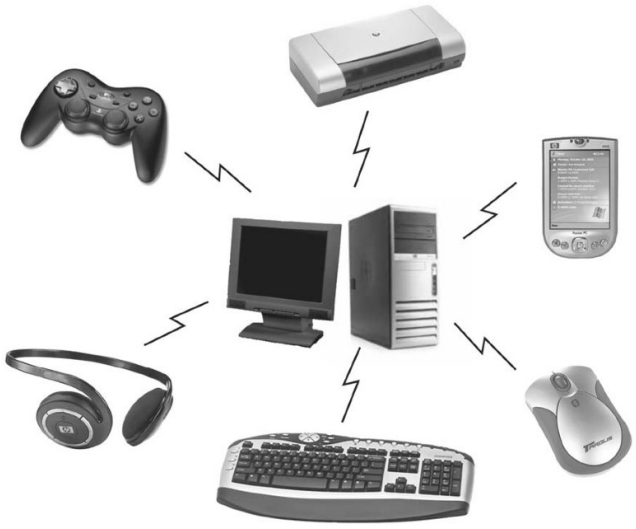
5.1 Error detection and Error correction

Three data error-correction schemes defined for the baseband controllers are: 1/3, 2/3 rate forward error correction code (FEC), and automatic repeat request (ARQ) 20scheme. FEC is implemented on the data payload to reduce the number of retransmissions. In a reasonable error-free environment, FEC adds unnecessary overhead, which reduces the throughput. 1/3 FEC uses a simple repetition code that repeats the bit three times. The 2/3 FEC scheme encodes data using a (15,10) shortened hamming code. Each block of 10 information bits is encoded into a 15-bit code word that can correct all single errors and detect all double errors in each codeword.

5.2 ARQ

In the ARQ scheme packets are transmitted and retransmitted until the transmitting device receives an acknowledgement of a successful reception. code word that can correct all single errors and detect all double errors in each codeword.

6. # Applications



To use Bluetooth wireless technology, a device must be able to interpret certain Bluetooth chips, which are definitions of possible applications and specify general behaviors that Bluetooth enabled devices use to communicate with other Bluetooth devices. Bluetooth exists in many products, such as telephones, the Wii, Playstation3, PSP, iPod Touch, iPhone, modems and headsets. The technology is useful when transferring information between two or more devices that are near each other in low-bandwidth situations. Bluetooth is commonly used to transfer sound data with telephones (i.e., with a Bluetooth headset) or byte data with hand-held computers (transferring files).

7. Usage

Almost everywhere in the world, Bluetooth enabled device to connect to other Bluetooth enabled devices located in proximity to one another. Connections between Bluetooth enabled electronic devices allow these devices to communicate wirelessly through short-range, ad hoc networks known as piconets. Mobility is at the center of this marriage, bridging the gap between computing and communications for a wide range of computing devices such as notebook

8. Cost

The cost of using Bluetooth wireless technology is limited to the cost of the product in which it is integrated. There is no account or service registry related to Bluetooth technology use. Bluetooth wireless technology operates on an unlicensed radio spectrum, which means there is no additional charge for communicating between two Bluetooth devices. However, any use of data or voice services while using your mobile phone is part of your regular mobile phone cost. This means that if you are using your Bluetooth enabled device, as a modem for your PC or for a similar application, there may be related data charges for the data that you send over the carrier network.

The cost of Bluetooth chips is under $3

Wireless LAN

A Wireless LAN typically extends an existing wired local area network. Wireless LAN is 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.

1. Protocol Architectures

1.1 Layered Stacks

<table>
<tr><td colspan="3">802.2</td><td rowspan="2">Data Link Layer</td></tr>
<tr><td colspan="3">802.11 MAC</td></tr>
<tr><td>FH</td><td>DS</td><td>IR</td><td>PHY Layer</td></tr>
</table>

In the 802.11 protocols, it's cover the MAC and Physical Layer

1.2 Protocols

All four use the Ethernet protocol and CSMA/CA for path sharing.

1.3 Standards

802.11: 802.11 operated in the 2.4 GHz range and was the original specification of the 802.11 IEEE standard. This specification delivered 1 to 2 Mbps using a technology known as phase-shift keying (PSK) modulation. This specification is no longer used and has largely been replaced by other forms of the 802.11 standard.

The Standard Use of Wireless LAN are base on IEEE's 802.11 has 3 Flavors:

- **802.11a:** Support data transfer rates up to 54Mbps, it is faster than 802.11b and can support more simultaneous connections. Operate in the 5GHz
- **802.11b:** It supports data transfer 1, 2, 5.5 and increased the performance to 11Mbps data rates in the 2.4 GHz

- **802.11g:** It is backward compatible with 802.11b Equipment, It's faster than 802.11b, and supporting data transfer rates up to 54Mbps. It has a slightly shorter range than 802.11b, but still better than 802.11a. It uses the 2.4GHz frequency, so it has the same problems with interference as 802.11b.

1.4 Standard Organizations

Institute of Electrical and Electronic Engineers (IEEE) is a professional organization that defines networking and other standards. The IEEE developed the widely used Wireless LAN standards IEEE 802.11.

2. Data Transmission

2.1 Spectrums and Frequency

Base on the FCC (federal communications commission) the license-free bands for the wireless community to utilize (ISM & U-NII bands). The 802.11b standard defines 14 frequency channels for use with this technology. Depending on the country a user lives in and where he or she will be installing a WLAN, They are:

- 900 MHz: 902-928 MHz
- 2.4 GHz: 2403-2483 MHz
- 5 GHz: 5725-5850 MHz, 5150-5250 MHz, 5250-5350 MHz, 5725-5825 MHz

2.2 Bandwidth

The speed at which a WLAN performs depends on the type and configuration of the devices within the network.

2.3 Data Rates

For the most widespread commercial wireless LANs are in the 1.6 Mbps range.I n the Theory maximum could support approximately 75 Mbps per channel. But in practice will be lower to 45 Mbps per channel11 Mbps - 55 Mbps

3. Transmission Media

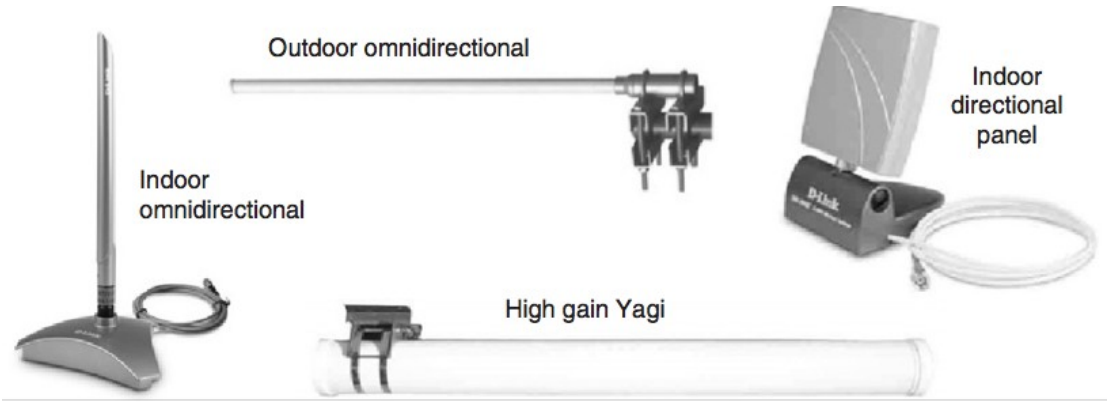
3.1 Transmission Power

Transmission power 20dbi

3.2 Receive Thresholds

Receive sensitivity 3 dBi

3.3 Antennas



There are two general types of antennas used for 802.11: directional and omnidirectional.

A directional antenna concentrates energy in a narrow conic path when sending and rejects signals outside a single direction when receiving.

An omnidirectional antenna transmits in a 360o arc and is capable of receiving signals from any direction.

3.4 Distance

Wireless LAN systems use RF because radio waves can penetrate many indoor walls and surfaces. The range or radius of coverage for typical WLAN systems varies up to 500 feet (164 meters) depending on the number and types of obstacles encountered. Coverage can be extended, and true freedom of mobility via roaming, provided through microcells.

4. Signal Encoding Techniques

The modulation used in 802.11 has historically been phase-shift keying (PSK). The modulation method selected for 802.11b is known as complementary code keying (CCK), which allows higher data speeds and is less susceptible to multipath-propagation interference.

5. Errors

5.1 Error detection and Error correction

The present invention provides a system for detecting errors in a wireless link of a local area network. In the wireless CRC or other error detection code or frame check sequence is appended to the packet to be transmitted across the wireless link. The receiving station recalculates the CRC to validate correct reception of the packet. This type of error detection is very good for detecting single bit errors, and will catch some multiple bit errors. Also, the error detection provided by the wireless CRC comes at the end of the packet, which induces some delay in detecting that bad data has been transmitted.

5.2 ARQ

In 802.11b operate at 2.4GHz; ARQ is implemented at the link layer. The link-layer ARQ employs the Stop & Wait ARQ scheme. With Stop & Wait ARQ, each transmitted packet must be acknowledged before the next packet can be sent. If either the packet or its acknowledgement is lost, the sender of the packet will not receive any acknowledgement, and the sender will retransmit the packet after a certain time -out period

6.Applications

Wireless LAN Device:

Wireless Network Interface Cards:

The wireless network interface card (NIC) turns a device such as a PDA, laptop or desktop computer into a wireless station and enables the device to communicate with other stations in a peer-to-peer network or with an access point.

Access Point

The access point is a device that links a wireless network to a wired LAN. It increases the effective range of a wireless network and provides additional network management and security features.

Wireless LAN Switches or Controllers

In a large wireless network, typically in a corporate environment with tens and perhaps hundreds of access points, the need to individually configure access points can make WLAN management a complicated task.

Router
A router is a device used for sharing a single Internet connection across multiple computers. This is ideal in the home or office where multiple computers and devices can be online at the same time with only a single Internet connection.

Wireless LAN Scenarios:

- LAN Extension: stations in large open areas
- Cross-Building Interconnect: connect nearby building
- Nomadic Access: connect mobile terminals with a LAN hub
- Adhoc Network : Spontanenous established temporary network

7. Usage

In all around the world, Wireless LAN is extensively used. Many routers act as WLAN access points. user can extend a WLAN's range with additional wireless access points in various locations. Receiving devices, such as laptops and some cell phones, must also be WLAN capable.

Wireless LANs frequently augment rather than replace wired LAN networks-often providing the final few meters of connectivity between a wired network and the mobile user. The following list describes some of the many applications made possible through the power and flexibility of wireless LANs:

8. Cost

A wireless LAN implementation includes both infrastructure costs, for the wireless access points, and user costs, for the wireless LAN adapters. Infrastructure costs depend primarily on the number of access points deployed; access points range in price from $800 to $2,000. The number of access points typically depends on the required coverage region and/or the number and type of users to be serviced. The coverage area is proportional to the square of the product range. Wireless LAN adapters are required for standard computer platforms, and range in price from $200 to $700.The cost of installing and maintaining a wireless LAN generally is lower than the cost of installing and maintaining a traditional wired LAN, for two reasons. First, a WLAN eliminates the direct costs of cabling and the labor associated with installing and repairing it. Second, because WLANs simplify moves, adds, and changes, they reduce the indirect costs of user downtime and administrative overhead.

Reference

wikipedia.org

scribd.com

wimax.com

siampolice.com

wimax360.com

adslthailand.com

airspan.com

vcharkarn.com

siamwimax.com

cpe.kmutt.ac.th

msit19-ite612.blogspot.com

zigbee.org

digi.com

digikey.com

parallax.com

fractus.com

tracglobal.com

thaieasyelec.com

wisegeek.com

freqchina.com

eprints.ecs.soton.ac.uk

bluetooth.com

netkrom.com

cisco.com

msdn.microsoft.com