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Cost

Wimax

Type of costs are 2 part, First part is cost of clients. Intel and Fujitsu are the Manufacturer of semiconductor equipment sector for clients. So cost of WiMAX is decrease. The price of equipment of WiMAX more than Wifi a little bit.

Second, Base station equipment of WiMAX is simple structure and easy to install. In each base station can combine function in one. So it is easy to management.

Bluetooth

The only cost the consumer receives is the cost of the actual product that is enabled with Bluetooth technology. However, any use of Bluetooth technology, data, or voice, using your cell phone is part of your regular cell phone bill. There is no account or service registry associated with using Bluetooth technology.

ZigBee

The CTI-SB series of stubby ZigBee antennas comprises three models with a choice of straight and right-angle SMA male and SMA male RS connectors. For increased signal strength, the slightly longer CTI-RA series of rubber ZigBee antennas, which offers a choice of SMA male RS and TNC male RS connectors, provides a gain of up to 9dBi. These antennas employ co-linear elements contained within a robust, semi-flexible rubber housing to maximise RF efficiency. They feature an integral swivel joint to facilitate orientation. Both series are suitable for use with any IEEE 802.15.4 standard ZigBee system and accommodate vertically and horizontally polarised signals.

Wireless LAN

the cost will less than the cost of wired networks. Because of wireless LANs have only two components. There are a wireless router and a wireless adapter installed. It no need the cable on the floor. So it means decrease about the cost.

such as Japan has Wimax services in the center of Tokyo, in China is trial begin use WiMAX , in Singapore is preparing for WiMAX service but in South Korea has develop WiBro instead of Wimax and develop is to has standard equal to Wimax.

-In Thailand

In Thailand market, suitable for Wimax because in some place difficult to setup the cable or antenna. Now Intel setup Wimax in country of Nakhon Ratchasima , ChiangMai ,Roi Et for education, health public, SME and Voice over IP.

Wireless LAN

They use extensively in Thailand and other countries. For example use this technology to connect the network in organization

Wireless LAN

Why we use Wireless LANs?

We have 4 factors. There are convenience, mobility, range and

For the convenience, it easy to connect to the wireless router. For example in public locations. if you have lunch in the restaurants. You can connect the internet in easy way without the cable.

For mobility, it can use mobile devices such as laptops. It is too easy to the movement.

For range, the wireless LANs can have a greater rang than wired networks.

For cost, the cost will less than the cost of wired networks. Because of wireless LANs have only two components. There are a wireless router and a wireless adapter installed. It no need the cable on the floor. So it means decrease about the cost.

ZigBee

Application of Zigbee is mostly about sensor warning for personal health care, home control, industrial control, telecom services, PC and peripherals. Examples of application are light control, mouse , m-commerce info services object interaction, patient monitoring etc.

In ZigBee application use nodes for sending the signal to receiver. The sensor will catching the motion and then send the data to receiver by muti-hop routing for expand radius of signal.

Usage

Bluetooth

In Thailand, bluetooth technology is popular because nowadays mobile phones were installed Bluetooth mostly and most people use Bluetooth in handset in car. The usage of bluetooth in other is like in Thailand because function of bluetooth is likely

WiMax

-In other countries

European Union (EU)

WiMAX is used to Internet Backbone but available in some countries such as in French use for voice Over WiMAX in Sweden use ,in high speed internet, in England use, in communicate with the train London to Bristan, in USA begin use in internet and voice service.

Africa Continent

In Kenya , Nigeria, Lagos, Tanzania, Cammeroon, Arbuja, South Africa are begin use by accessed modem or PCMCIA card.

Asia Continent

WiMAX is used in some countries mostly in Develop countries

- Students at universities use wireless LANs to learning, exchange the knowledge and contract with instructors.

The wireless LANs are not suitable in the small offices. Because of it not worthy for installation and maintenance.

WiMax

WiMAX are technology the combine between WiFi and Cellular.It can create connection in form of point to multipoint and high speed motion in radius 30 miles so its importance is obvious in areas which are sparsely settled, across difficult terrains and in areas where it is not feasible to run cables. Therefore this leads to inexpensive deployment of the network and ubiquitous broadband access. It is a wireless alternative to many existing wired backhaul and last mile coverage deployments such as Cable Modems, Digital Subscriber Line (DSL), T and E-Carrier systems and Optical carrier technologies.

WiMAX technology offers higher bandwidth and greater range as compared to Wi-Fi based wireless systems provide broadband Internet access with transmission rates over >2 Mb/s.

WiMAX and IPTV (Internet Protocol Television) is application of the adoption of television technology which broadcast images and sound through the spectrum applied by running over the internet is to sent multimedia audio and video. Heighlight of IPTV is abroadcast signal that interactive, that is audience can respond back to the station such as use VoIP (Voice Over IP) to respond or send the message.

Application

Bluetooth

Bluetooth is the technology that generate for communicate between device, reduce the cable and limit of place that store the cable which are complex for user and data may loss during send because sometime the cable may damage. This technology is suitable for mobile device that can hold to anywhere, require short distance and limit of power because the consumption of Bluetooth is low while compare to other wireless technology. For Bluetooth connection, the router is not use. For example use Bluetooth to connect keyboard with computer or connect the mobile to each other. The device that require for this technology is only Bluetooth receptor.

Wireless LANs

A wireless LAN saves the cost of LAN cabling and eases to movement and other modifications to network structure.

Wireless LAN use for buildings with large open areas, such as manufacturing plants, stock exchange trading floors, and warehouses;

For example of some application :

- In hospitals, doctors and nures have many personal computer and notebook computers. They use wireless LANs to sent the information of patients immediately.
- Warehouse workers use wireless LANs to exchange informations with central databases.

Signal Encoding

From Bluetooth technolog use the Gaussian frequency-shift keying (GFSK) modulation. About WiMax use QPSK and QAM (Quadrature Phase Shift Keying).QPSK use group code data modulation model 2 bit signal stronger than BPSK .For Quadrature Amplitude Modulation (QAM) 16-QAM and 64-QAM change amplitude of two sinusoidal carrier depend on order digital must send – receive. ZigBee use DSSS (Direct-sequence spread spectrum) ,Wireless LANs use DSSS.

The link for Signal encoding

Signal Encoding of Wireless LANs

http://www.wildpackets.com/elements/whitepapers/Wireless_LAN_Analysis.pdf

Signal Encoding of ZigBee

http://info.bioenabletech.com/technologies/**zigbee**/**ZigBee**.ppt

Error

	ZigBee	**Bluetooth**	**Wireless LANs**	**Wimax**
Error correction	-	FEC,ARQ	ARQ	FEC

Link for the zigbee:

http://dspace.cusat.ac.in/dspace/bitstream/123456789/2153/1/ZIGBEE.pdf

For ZigBee technology

ZigBee antennas comprises three models with a choice of straight and right-angle SMA male and SMA male RS connectors. For increased signal strength, the slightly longer CTI-RA series of rubber ZigBee antennas, which offers a choice of SMA male RS and TNC male RS connectors, provides a gain of up to 9dBi. These antennas employ co-linear elements contained within a robust, semi-flexible rubber housing to polarize RF efficiency. They feature an integral swivel joint to facilitate orientation. Both series are suitable for use with any IEEE 802.15.4 standard ZigBee system and accommodate vertically and horizontally polarized signals.

For Antennas of Wireless LANs.

We select Wireless CardBus Adapter for example of antennas. We use the information of this product to compare in the Transmission Media table. Which has transmit power receive sensitivity and distance.

For the transmit power we use 802.11b/g: • 13 dBm (20 mW) @ 1, 2, 5.5, 6, 9, 11, 12, 18, 24, 36, 48, 54 Mbps and •10 dBm (10 mW) @ 1, 2, 5.5, 6, 9, 11, 12, 18, 24, 36, 48, 54 Mbps. The receive sensitivity we use • -71 dBm @ 54 Mbps. And the distance we use 90 ft (27 m). To compare with another technologies

Details of this product

The Cisco® Aironet® 802.11a/b/g Wireless CardBus Adapter provides high-performance 54-Mbps connectivity in the 2.4- and 5-GHz bands.

Antenna Integrated dual-band 2.4/5-GHz, 1-dBi, effective-gain antenna on a two-meter cable **Weight** 1.6 oz (44.0 g)

In fact the maximum distance of each technology are not static. It may effected by environment.

Antennas

For the WiMax technology

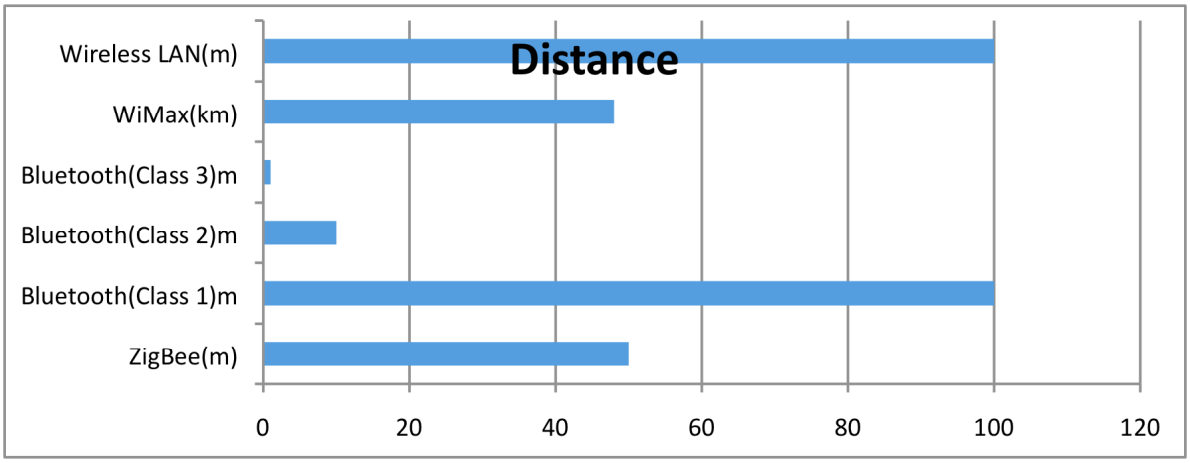
For the WiMax technology the antennas can be dividing into 3 type first Omni directional antenna is a Point-to-Multipoint antenna is a half-sphere with a radius above the ground from the center. Signal transmitted from the antenna will have a radius distance and relatively weak signals. Often works well with the receiver in a radius distance. Will be no more than 100 meters radius from the center. The advantages is signal independently.

Second is the Sector antennas. The characteristics will be waves to a specific point or one point. Signal of this antenna is LOS signal is within the transmission signal is strong and can often be far. Disadvantage of this antenna is, if the receiver is outside the transmission radius will not be able to sign it.

Final is the Panel antennas. the characteristics to other antennas. It is Point-to-Point and must use in indoor and outdoor but depend on weather and no barrier.

For Bluetooth technology

About Bluetooth technology. The antennas manufacture of each company. For example in USA the RIANSUN designs and manufactures Bluetooth with LTCC technology. These small size antenna with peak gain ~ 3dBi can be used for single or dual-band applications. The CTI-SB series of stubby.

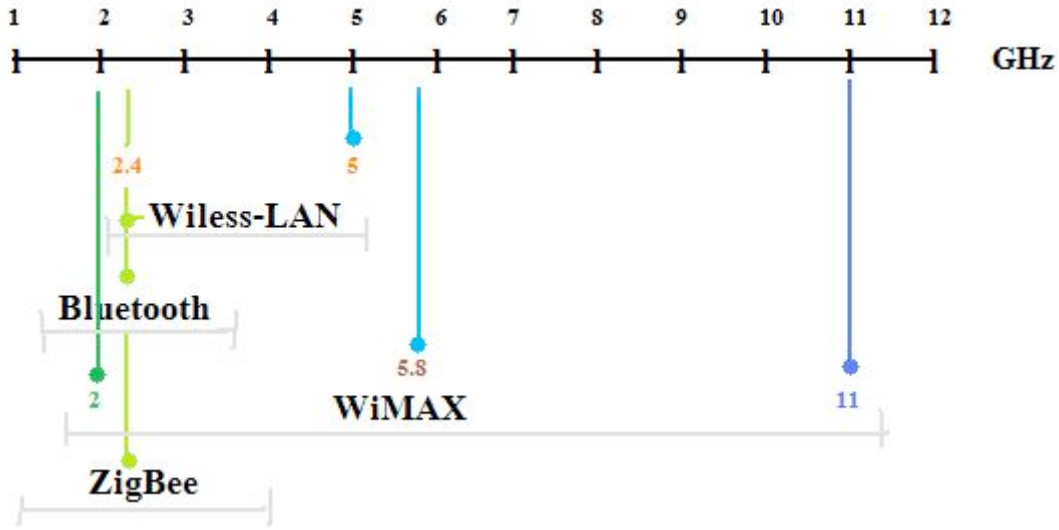


Now, We will focus on frequency. The frequency of 2.4 GHz has the advantage that it is less noise which increase the quality whereas using a frequency of 11 GHz (now in the real world the frequency of WiMax is less than less 11GHz)

is better for long distance(you can see next table). For example in rural area we may use WiMax technology that can communicate in the long distance but increase the level of noise.

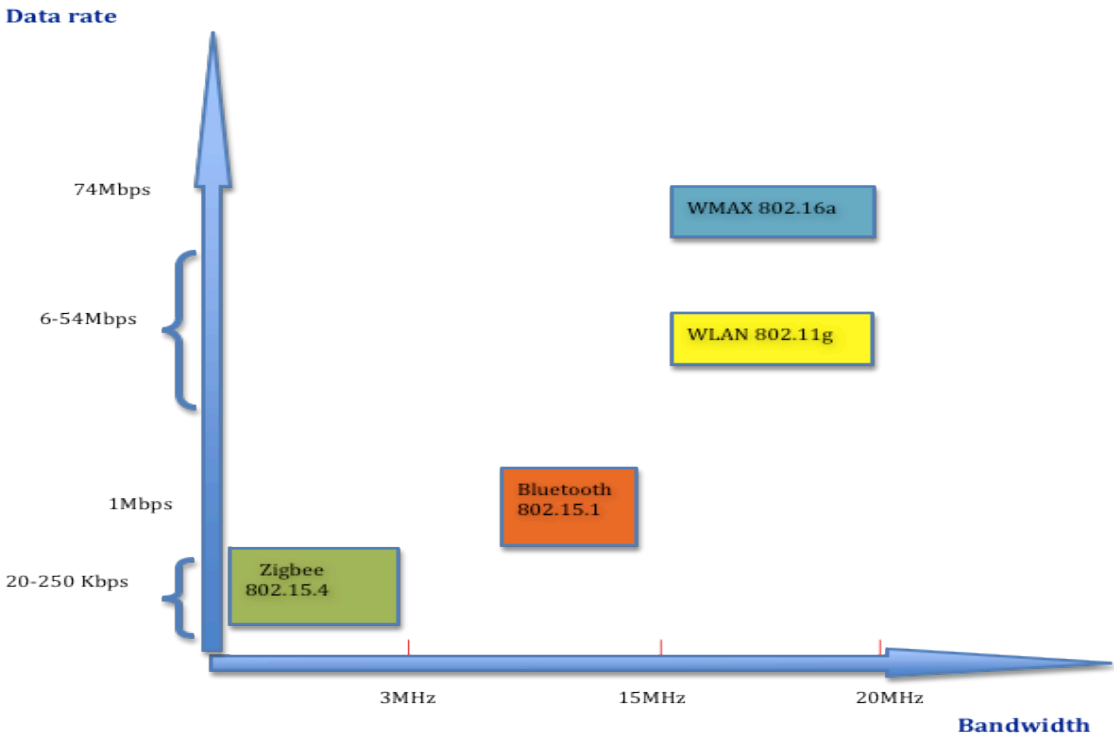
For this table We will compare with the transmission power of ZigBee is less than WiMax. If you would like to communicate in long distance. It requires high power. WiMax is the one of highest transmission power. About the Bluetooth and wireless lan you may be confuse with the rate of the transmission power. Why Bluetooth more transmission power than wireless? Because of each technology depend on version and device. For example if you use the Wireless LAN "Cisco Aironet 802.11g Wireless CardBus Adapter" It will have lower transmission power than Bluetooth class1

Spectrum allocation



Transmission Media

	ZigBee	Bluetooth	Wireless LAN	WiMax
Transmission power	0dBm(0.5mW)	Class1 20dBm(100mW) Class2 4 dBm(6.5 mW) Class3 0 dBm(1mW)	10-13 dBm	Base station +43dBm Mobile station +23 dBm
Receive sensitive	- 85	-70 dBm	- 71dBm	-80 dBm
Distance	50 m	Class1 100 m Class2 10 m Class 3 1 m	27 m	48 km



From this graph, you can see the efficiency of each technologies. In different technology, you can choose for specific task. For example Bluetooth we use on the mobile to send the small data and it is half duplex direction.

For WiMAX

Use the IEEE 802.16 Standards for classify.

- IEEE 802.16: Is the air interface is on 10-66 GHz licensed bands, that is Light-of-sigh (LOS) transmission and delivery is point-to-point.
- IEEE 802.16a : The operations is on 2-11 GHz licensed and non-licensed bands, that is Non-Light-of-sigh (NLOS) transmission and delivery is point-to-multipoint.
- IEEE 802.16e : The operation is on 2-6 GHz licensed bands. The goal of this type is for support mobility

Data Transmission

	ZigBee	**Bluetooth**	**Wireless LAN**	**WiMax**
Frequency	2.4 GHz	2.4Ghz	2.4 GHz	2-11 GHz
Bandwidth	3 MHz	15 MHz	20 MHz	20 MHz
Data rate	250Kbps	1 Mbps	6-54 Mbps	75Mbps

From the table. We will focus on the bandwidth First, The bandwidth of ZigBee and Wireless LAN are different. So you can see if it has more bandwidth. Also it will more data rate. If we want to send the large data, it means we need more bandwidth for good quality and fast to send the data.

Standard

WiMax	Bluetooth	ZigBee	WireLess LAN
IEEE 802.16	IEEE 802.15	IEEE 802.15.4	IEEE 802.11

Standard organization

Is the company, that take care about the standard and develop the knowledge of computer. IEEE stand for Institute of Electrical and Electronic Engineers.

Remark

For Wireless LANs

We have **IEEE 802.11** is a set of standard. It has many protocols i.e. 802.11 legacy, 802.11a, 802.11b, 802.11g, 802.11-2007, 802.11n.

The table of Data Transmission. We use the IEEE 802.11g in comparison.

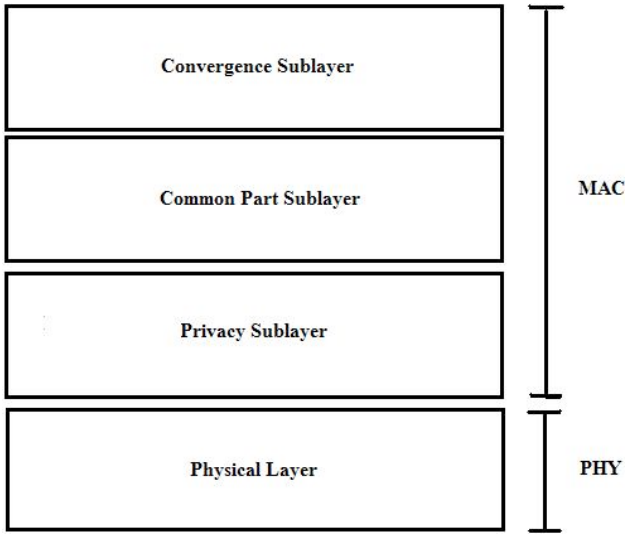
The table below shows example of another protocol of IEEE802.11.

Technologies: Wi-Fi

Networks: WLAN

Standard	Speed	Distance	Frequency
IEEE802.11a	Max 54 Mbps	100M	5GHz
IEEE 802.11b	Max11 Mbps	100M	2.4GHz
IEEE 802.11g	Max 54Mbps	100M	2.4GHz

WiMax layer



Physical layer functions:

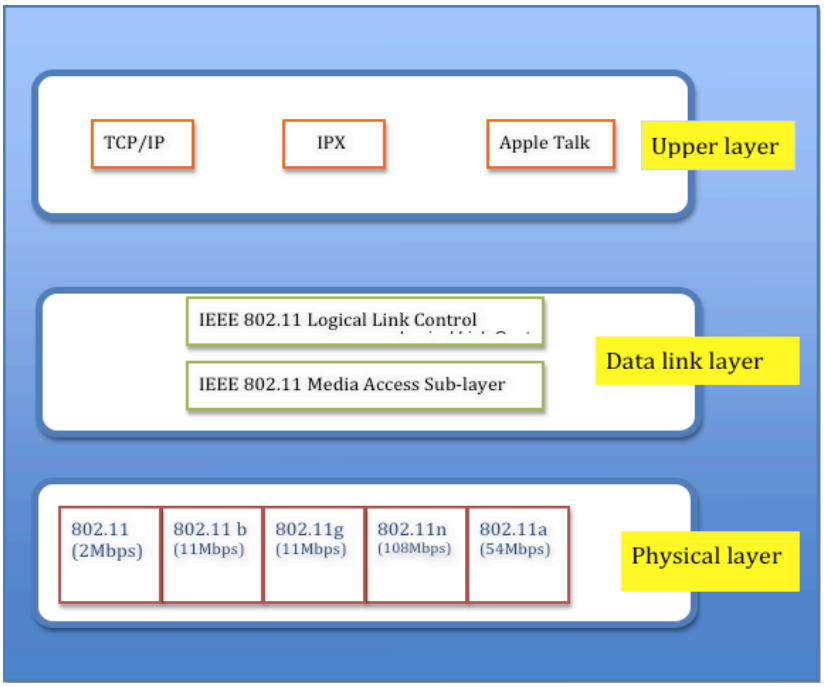
WiMAX PHY layer specification has been standardized keeping in view the 10-66 GHz Line-of-sight (LOS) and 2-11 GHz Non-line-of-sight (NLOS) bands. In the 10-66 GHz band. Due to the point to multipoint architecture of WiMAX systems, the base station transmits a Time - division multiplexing(TDM) signal. Support has been provided both for Time Division Duplex (TDD) and Frequency Division Duplex (FDD).

Medium access control layer functions:

The IEEE 802.16 MAC layer is responsible to provide a medium independent interface to the 802.16 PHY layer. Two types of service specific convergence sublayers are defined by 802.16 MAC. The ATM convergence sublayer is defined for ATM services and the packet convergence sublayers are defined by 802.16 MAC. The ATM convergence sublayer is defined for ATM services and the packet convergence sublayer is defined for mapping packet based services like IPv4, IPv6, Ethernet etc. The 802.16 MAC is connection oriented. Each subscriber station has a 48-bit MAC address. However, this MAC address merely serves as the equipment identifier as the connections are referenced with the 16-bit connection identifier (CID).

The Bluetooth layers are different from Internet protocol. From the picture radio layer is like the physical layer of Internet. The distance of transmission is about 10 m. About baseband layer is like the MAX sub layer of LAN by using TDMA. This technical is the communicate between master and slave. Bluetooth use form of TDD-TDMA (time-division duplexing TDMA) that is the half duplex communication so if you use this technology. You cannot send and receive data at the same time. The L2Cap is use for multiplexing, segmentation, group management and quality of service.

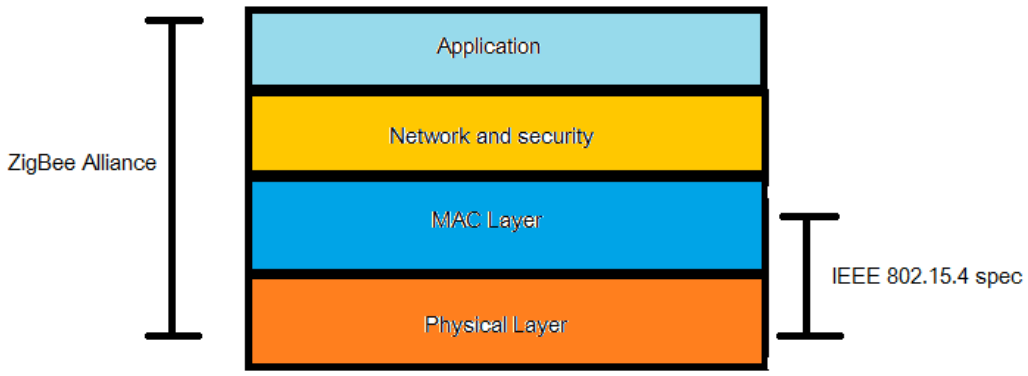
Wireless LAN



This picture. It shows the layer of WLAN. Which has three main layers Upper layer, Data link layer and Physical layer. The Upper layer contains three-part TCP/IP, IPX and Apple talk. The Data link layer contain to part Logical link control and Media Access Sub-layer. The Physical layer is the last layer contain Data transmit type Ex.802.11b, 802.11gthat make WLAN different speed and range of transmission.

Protocol Architecture

ZigBee



This picture, it shows the all the layers of ZigBee. Which contain four layers. There are Application, Network and security, MAC Layer and Physical Layer.

For the IEEE802.15.4, It has only two layers. There are MAC Layer and Physical Layer.

Bluetooth layer

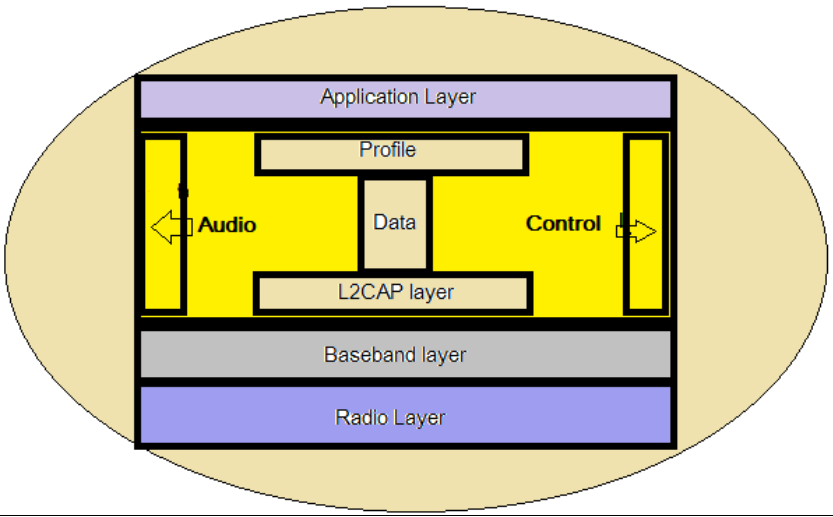


Table of participation

Section	Niracha	Krisit	Manussawee
1.Wifi	60	20	20
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Introduction to Data Communications

(ITS 323)

Assignment 1: Wireless technologies

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