ITS 323 Introduction to Data Communication

Assignment #1

ZigBee / Bluetooth / Wireless / Wimax

To

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ZigBee

ZigBee Standard is developed and maintain by The ZigBee Alliance companies. Zigbee is one type of Communication Protocols. It's use low power and based on IEEE 802.15.4-2003 standard for wireless home area networks (WHANs), like consumer electronics electronic with short-range radio. ZigBee technology is intended for simpler and cheap than other WPANs ex. Bluetooth. Radio-Frequencies applications which require a low data rate, long battery life and secure networking are use ZigBee.

Protocol Architecture

Layered Stack   –   has divided into 2 parts, which are Network Layer and Application Layer.

Zigbee Specification

Application Layer

Application Object

Zigbee Device object

Security Service

Application Support Layer

Network Layer

IEEE 802.15.4

Medium Access Control
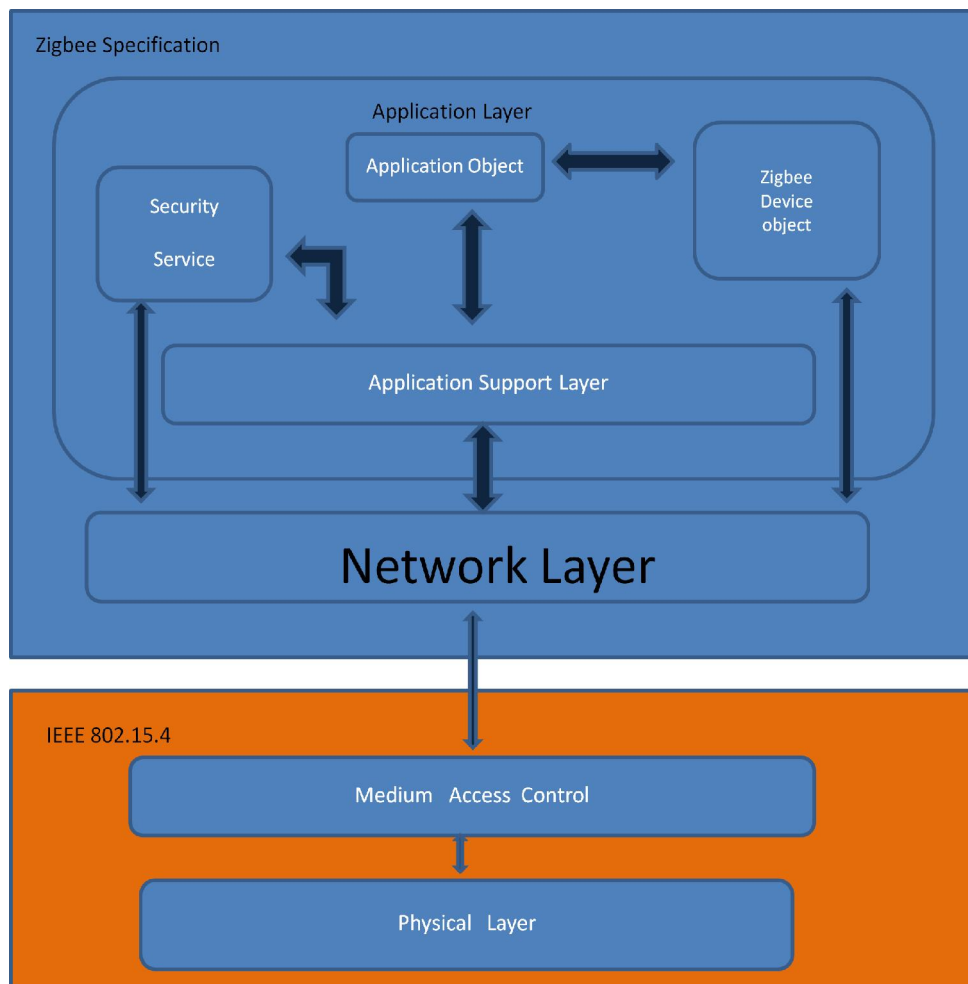
Physical Layer

Network layer is mainly use for enable the correct use of the MAC sublayer and provide a suitable interface for use by the next upper layer.

Application layer is highest level of layer. It's has an Interface to interact with ZigBee user.

Physical Layer is the place where ZigBee was build on.

 Protocols - Zigbee's protocol is build on recent algorithmic research to construct a low-speed ad-hoc network of nodes automatically. ZigBee is support both of beacon enable and non-beacon enable.

On March 3,2009 RF4CE consortium has agreed with ZigBee Alliance to work together and produce some electrical product. ZigBee RF4CE is designed for wide range radio and use in remote control. It's help the remote control more realibility and flexibility
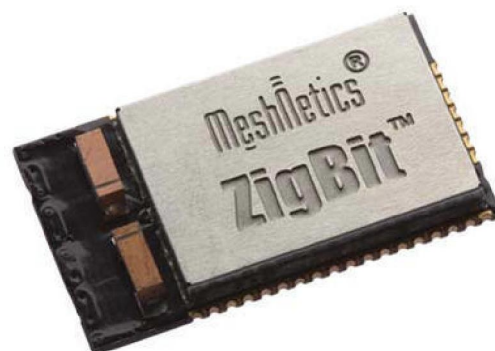
Zigbee lower layer is implemented by IEEE 802.15.4 standard. The access control is based on IEEE 802.15.4

Data Transmission

ZigBee radios use direct – sequence spread spectrum. World Wide frequency is 2.4 GHz and have 16 channels. Over the air ,the data rate is 250 kbits/channel in 2.4 GHz band, for 915 MHz band the data rate is 40 kbits/channel and 20 kbits/channel for 868 MHz band. ZigBee require 5 MHz for Band width.

Transmission Media

Transmission range is about 10-75 meters and for ZigBee pro range is about 1500 meters for. Transmit power is 0 dBm. Received threshold is -85 dBm. Zigbee antennas is in a shape of chip. Sometimes it may come with a stick antennas

Signal Encoding Technic

ZigBee is implement with IEEE802.15.4 in lower layer. Higher Layer was controlled by ZigBee Alliance. The data will send to the end device which is connected with the router. End device can also be RFD and FFD. End device can only receive and transmit the data. Router is in the middle stage. It received the data or signal from server and send them to the end device.

Error

ZigBee use ACK frame. Ideal of ACK frame make the ZigBee system cannot detect the error, Because the algorithm of ACK frame is prove that there is no error.

Application

ZigBee is ideal for some low power consumption device. ZigBee require 3 type of device ZigBee coordinator (ZC) which is the center of system and use for store some network info, ZigBee router (ZR) is use for passing the data. ZigBee end device is contain just only important functionality to contact with their parent node like coordinator or router. Today ZigBee is apply to use with many thing ex. Home entertainment and control, mobile service, home work control, Air conditioner etc.
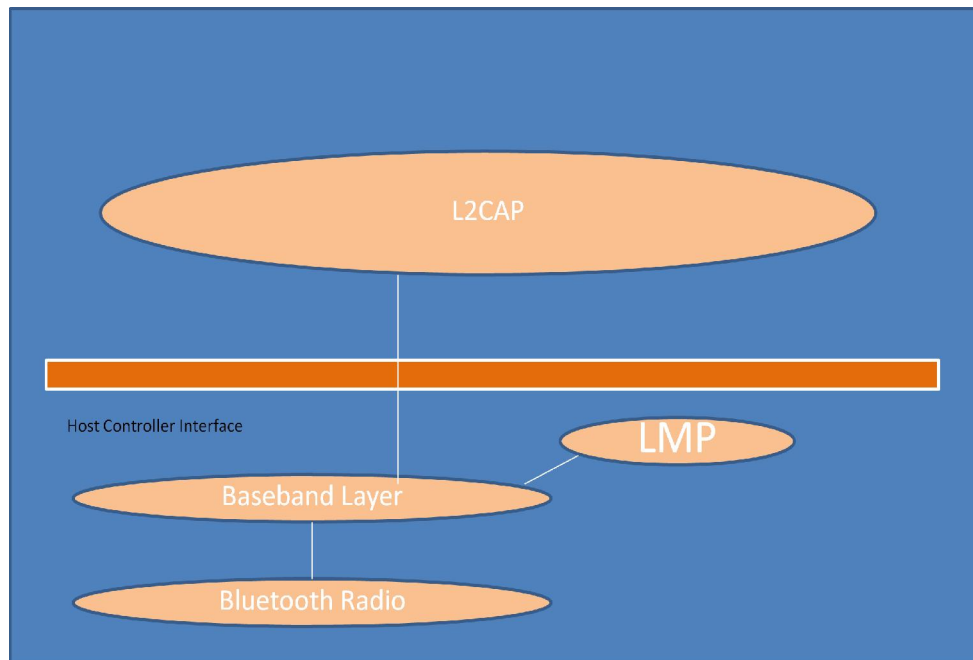
Usage

In Thailand Zigbee is very unpopular, any usage information is very hard to find.

Bluetooth

Bluetooth is a wireless technology that designed for short range exchanging data. It can connect several devices for reduce the synchronization problem. Today Bluetooth is managed by the Bluetooth Special interest Group.

Protocol Architecture

Bluetooth is developed on IEEE 802.15.1 and the version can be change like IEEE802.15.1-2002 is use on Bluetooth v1.1. Bluetooth is always base on Radio Layer and operated on 2.4 GHZ band. Bluetooth can divided into 3 power class Power Class 1 – long rang devices (100m), Power Class 2 – normal or standard range devices (10m)and Power Class 3 – short (10cm)-range operation. Next layer is Baseband layer which is the physical layer. Baseband layer is working on control work. Baseband layer is managed the routines creating a connection. Not only managing task also controls address, power saving , flow control and synchronization among Bluetooth device. Link Manager Protocol is use for carries out link setup, authentication. It discovered other LM and communicate them via LMP. Host Controller Interface is use for allow the command line to access the LMP and Baseband layer. HCI is consist of three parts HCI firmware use to control Bluetooth hardware, HCI driver is use for Bluetooth device, Host Controller Transport Layer is use for connect driver to firmware. Over the HCI has L2CAP which provides data service to the upper host protocol. L2CAP let the application an higher-level protocol to send and receive data. L2CAP is stand for control segmentation and reassembly task. RFCOMM is over L2CAP it help the upper layer protocol think that they connect to RS232 and let the application to need not to know about BLUETOOTH. Service Discovery Protocol (SDP) is use to detect which service available and determine the characteristic of service

Data Transmission

Bluetooth use Frequency hopping spread spectrum (FHSS) technology. This technique make Bluetooth more reliable. The frequency of Bluetooth range is between 2.402 -2.480 GHz. The bandwidth is about 24 kHz and Data rate is about 1 Mbps.

Transmission Media

Bluetooth can divide into 3 class,

Class 3 has range about 1 meter design for low range and it power consumption is 0 dBm.

Class 2 has range about 10 meters this class is commonly use in mobile phone, PC device. The power consumption of class 2 is 4 dBm.

Class 1 has range about 100 meters – 300 meters not widely use in everyday life. The power consumption of class 1 is 20 dBm.

An antennas for Bluetooth can be in many shape. Sometime it build with mobile phone or laptop, sometimes made like a thumb drive with USB port or have an stick antennas build with it.

Error

Bluetooth use 1/3 FEC, 2/3 FEC, ARQ to detect and correct the error. FEC(Forward Error Correcton) is the system that detect and correct the error. When FEC detect the error it let the receiver to correct the error without ask the sender.

Signal Encoding Technique

Bluetooth will received analog data and encoded them to digital. There are 2 ways to encode the data.

- Pulse Code Modulation (PCM) will redraw the input data in graph and compare them to find error.
- Continuous Variable Slope Modulation (CVSD) will compare the data to the average, if higher it will return 1 to the air interface. If it lower it will return 0 or -1.

Application

Now a day, Bluetooth is developed in to new state from the past where Bluetooth can only use for hand free. Now Bluetooth is widely use in many device ex. Networking device in PC, use in game controller

Usage

In Thailand, Bluetooth is widely use in many situation. In phone many people love to use the Bluetooth hand free while they drive. Use it in file sharing among group of friend. Or use to connect to the PC for networking.

Wireless Lan

Today, wireless lan is very popular around the world due to increasing of laptop user. In many business wireless lan is introduced like in coffee shop is introduce free wireless access to the customer.

Protocol Architecture
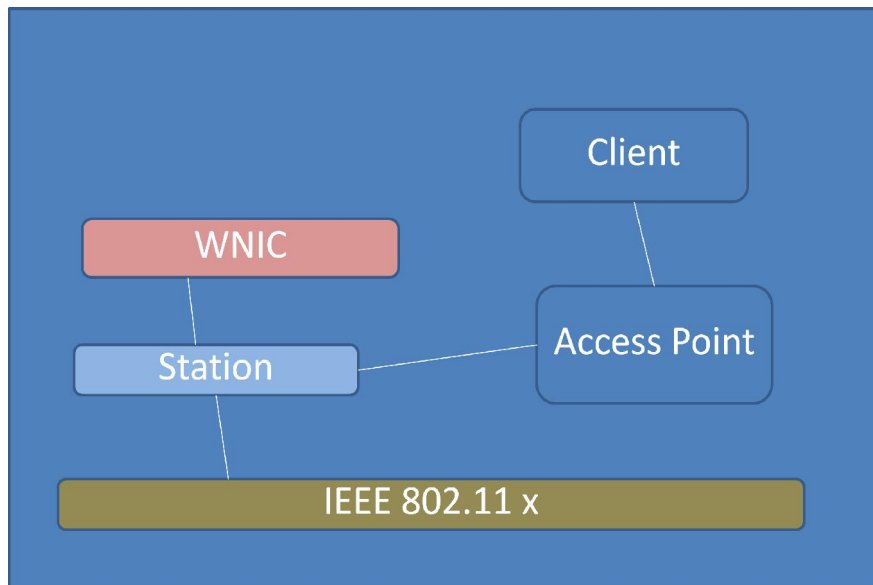
Wireless Lan is based on IEEE 802.11 standard. First layer of wireless lan is Station, it is refer to a component that connect to wireless medium. All stations are equipped with Wireless network interface card (WNIC). Station has divided into 2 parts Access Point, and clients. AP transmit and receive radio frequency for wireless enabled device to communicate with. Client is a station like laptop, work station, Mobile device. Second layer is Basic service set, it is a set of station that can communicate with each other. There are 2 types of BSS independent BSS(IBSS) and infrastructure BSS. BSSID is an ID of BSS which is a MAC Address of AP. IBSS has no access point so it cannot connect to any BSS. Infrastructure is connect with other BSS through access point. If we have a set of connected BSSes, we call Extended Service Set. ESS are connected by distribution system. Every ESS has ID call SSID which contain 32 byte maximum character string. Distribution System is an Access Point for ESS. It use for increase the coverage area of network.

Data Transmissions

Wireless Lan is distributed on typically-spread spectrum or OFMD radio. Over IEEE 802.11a frequencies is 5 GHz. Over IEEE802.11 g is 2.4 GHz. IEEE 802.11 support bandwidth up to 54 Mbps. The data rate is up to version of IEEE 802.11 that you use. On IEEE 802.11n the data rate is over 100 Mbps

Transmissions Media

The area net work of wireless lan is up to your place in an indoor place the range is between 20 – 70 m up to your device. For an outdoor range is about 100 m – 5km up to your device, too. Maximum transmit power is about 100 mW. For Receive threshold is about 20 – 100 mW but for some good has about 400mW. An antennas of a wireless lan has divide in to 2 kind, first is router which is a box that contain chip and system inside come with an antennas. Second is a receiver sometimes build with laptop or mobile phone but sometime is a plug-in device that put on main board of PC or sometime look like a thumb drive.

Signal Encoding

In wireless Transmission the signal is sent over the air. The wireless transmission is using the Decoding Moderator to encode and decode the data. When sent the data the moderator is use for transform analog data to digital signal. At the receive station the decoder will transform the digital signal back to analog data.

Error

Error in transmission occur in one frequency, the signal will be re-broadcast on a different frequency in the next hop.

Application

Wireless lan is widely use around the world. You can connect with the network every where that have an access point. Wireless is apply in many work like in Mobile Workforce that make better in communication of Business and make better product. Apply in Education, Wireless lan help student to access the source of knowledge easier and faster. Not only this, Wireless lan is great for public access area that allow person to connect with network easier.

Usage

In Thailand wireless lan is very popular, you can access to it in many place. From coffee shop to the greatest hotel, most of them have an access point for a customer to use it. Even, when you study in SIIT class you can get access to SIIT network, too. That make you can working or surfing internet as you need. It same as other country that wireless is in trend. In many big Country in the world they have free internet access on wireless lan for there people.

WiMax

WiMax is a telecommunication protocol which work with fixed and fully mobile internet access. The name was create by WiMax Forum. Wimax is described as "Alternative way to access a wireless broadband as use cable".

Protocol Architecture
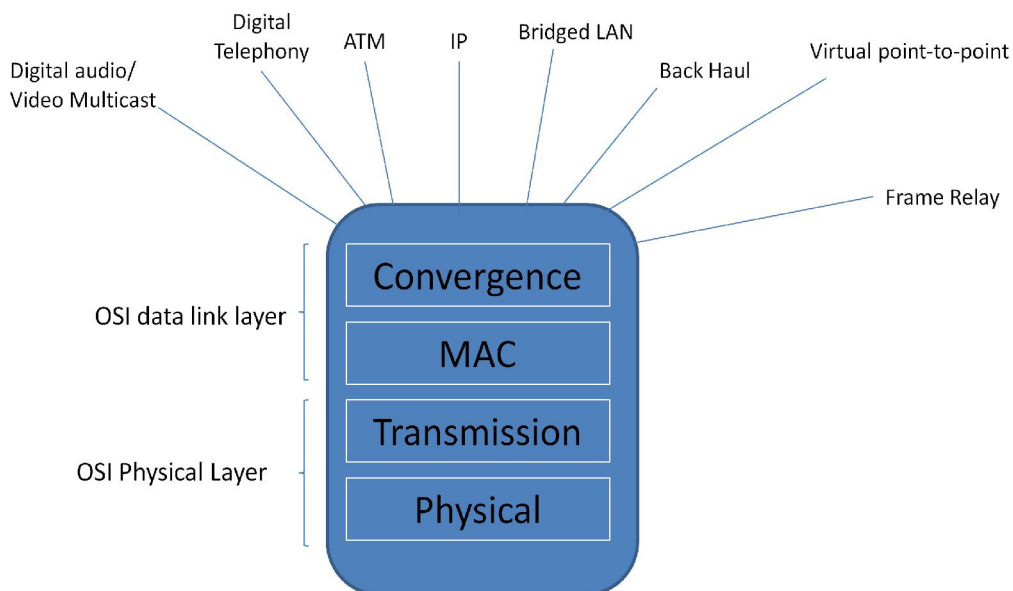
WiMax is based on IEEE 802.16 Standard. It divided into 3 layers, Physical and transmission layer functions is use for encoding and decoding of signals. Use as reception in Bit transmission. Second is Medium access control layer functions, On transmission it use for assemble data into a frame with address and error detection fields. On reception it use for disassemble frame, and perform address recognition and error detection. Govern access to the wireless transmission medium. Third is Convergence layer functions it use for cover PDU framing of upper layers into native 802.16 MAC/PHY frames, Group upper layer's addresses into 802.16 addresses, Translate upper layer QoS parameters into native 802.16 MAC format, Adapt time dependencies of upper layer traffic into equivalent MAC service.

WiMax has 3 layers of protocol that work different. Convergence Sublayer is control higher layer protocol. Common part sublayer is use for channel access, connection Establishment and Maintenance. Security sublayer use for securing, authentication, secure key exchange, encryption.

In WiMax there are 3 kinds of standard that use

- IEEE 802.16

  Air interface on 10-66 GHz licensed bands

  Light-of-sigh (LOS) transmission, point-to-point delivery

- IEEE 802.16a

  Operations on 2-11 GHz licensed/non-licensed bands

  Non-Light-of-sigh (NLOS) transmission, point-to-multipoint delivery

- IEEE 802.16e

  Operation on 2-6 GHz licensed bands

  Support mobility

Data Transmission

There is no licensed spectrum for WiMax but WiMax Forum has set it for 3 profile 2.3, 2.5, 3.5 GHz to drive WiMax and decrease cost. Wimax has frequency range about 10 – 66 GHz and 2-11GHz. The Data rate is about 120 MB/s and Bandwidth is 70 Mbps.

Transmission Media

WiMax is cover 31 miles range. Transmit Power is +43 dBm for base station but for mobile station Transmit power is about +23 dBm. An antennas of WiMax is look like a Square dish or Circle dish for base station. For mobile station it up to your device, it may have a stick antennas or not have, Or it may built-in with your device.

Signal Encoding Technique

WiMax is transmitted from Base Station to other mobile station, from greater to lower form and from higher amount of coding to lower bit-rate.

Error

WiMax has an error correction feature that ensures a robust RF link while maximizing the number of bits/sesivecond for each subscriber unit.

Applications

According to wider bandwidth of WiMax make it portable for mobile broadband across the city or countries. Use instead of cable for DSL broadband service. Use in data and telecommunication service. Use Broadband internet connectivity.

Usage

In Thailand WiMax is not popular as Wi-Fi because of the price of device and the network. In Thailand 3g device is expensive and the area of 3g is very small. If you want to use 3g you may have to go to Hua-Hin or Siam Paragon. In the case of learning WiMax is introduce to use in long distance service for a student who faraway from source, the problem is how can they get a device to access.

Compare The Technology

Zigbee VS. Bluetooth

Zigbee and Bluetooth are standing in the short range signal role. There are many different of both of them. Although they are a short range technology but they are applied in different task. Zigbee is design to use in a short radio range or in remote control. Bluetooth is use in signal or data transfer on mobile or any other device. In some short project zigbee is used to control the project, like when you sit on the chair the light will up and when you leave the light will shut. Cost of zigbee is not high but it not widely use. Zigbee is not widely use because it not suitable for typical user. For, Bluetooth it has more side in multimedia you can use it for sharing file, use on Bluetooth headphone. Although Bluetooth and Zigbee is in the same price rate but Bluetooth is more useful than zigbee, so it make Bluetooth more popular.

Wireless VS. WiMax

Wireless Ian and WiMax is long distance communication. They both use to communicate in the long distance. The different of them is situation in using. Wireless Lan is often use in building or home use or internet access. In an Organization Wireless Lan is not only use for internet access, it can use in file sharing or database access. WiMax is not nearly our every day life but in nearly future it may popular than this it up to network area and price. In Thailand, Wireless is our everyday life, because we use it almost everyday. In many of shop have a free wireless internet to support their customer. You can access to the network almost everywhere in BKK. For WiMax, as I say that the price of the WiMax device is hard to catch for everybody and the network area is very small. From this make WiMax is unpopular in our country.

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