ITS323 ASSIGNMENT 1

By

Group 24

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Section	Hemchart	Natthawuth	Thosaporn
Zigbee	90	-	10
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ZigBee

ZigBee is a wireless technology for replace the cables connecting which used sensors to connect point by point until reach the destinations.

1) **Protocol Architectures**

Standards

The ZigBee standard operates on the IEEE 802.15.4. ZigBee is for communication with low speed, low power, low cost and can manage by itself.

ZigBee'slayer supports three networking are

- star networks are common and provide for very long battery life operation.

- Mesh, or peer-to-peer, networks set up high levels of reliable by providing more than one path through the network.
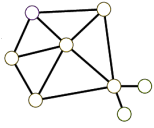
- Cluster-tree networks set up a hybrid star/mesh topology that combines the benefits of both for high levels of reliability and support for battery-powered nodes.

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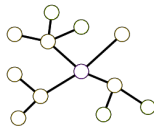
Layer stack protocol

ZigBee is designed only for Application layer and network layer

But use MAC layer and Physical following IEEE.802.15.4.

- <u>Application layer</u>   In this layer , there is ZigBee Device Object(ZDO) to manage and
control. This layer also create frame of application layer for sent and receive data.

- <u>Network layer</u> In this layer , Routing data from source to destination which may or may not in the same network.

There are 2 kind of types of ZigBee application

1) Physical device has 2 types

- definition of reduced function device (RFD)
- Limited to star topology

- Cannot become network coordinator

- Capable of being a coordinator

- Can talk to any other device (FFD/RFD)

- line powered

- full function device (FFD).
    - Can function in any topology

    - Capable of being Network coordinator

    - Talks only to network coordinator (FFD)

    - Simple implementation – min RAM and ROM.

    - battered powered

2) Logical device has 3 type

- The ZigBee Coordinator set up a network, manages network nodes, and stores network node information.
- The ZigBee Router manage the path in the network by routing messages between paired nodes.
- The ZigBee End Device is user node in the network and can be an RFD or FFD.

2) Data Transmission

ZigBee have Carrier Sense Multiple Access with Collision Avoidance (CSMA - CA) which is many signal channel access to avoid collision. IEEE.802.15.4 is perform in Physical layer , There are 3 channel

2.4-2.4835 GHz bit rate 250 kb/s ,16 channel

868-870 MHz bit rate 20 kb/s ,1 channel

902-928 MHz bit rate 40 kb/s , 10 channel

The frequency of 2.4-2.4835 is used around the world(including Thailand).

Zigbee is very used extensively in Thailand and other counter because Zigbee is very low cost and the size of ZigBee is very small and use very low power.

application. The approximate cost of the Bluetooth is 100-2000 baht in Thailand

Bluetooth

Bluetooth wireless technology is a short-range private communications system for replace the cables connecting.

The key features of Bluetooth wireless technology are

- robustness
- low power
- low cost

Protocol Architectures

Standard

The evolution of Bluethooth began from Ericsson company and IBM company in standard of IEEE 8021.15.

Bluethooth 's radio channel is shared by a group of devices that are synchronized to a clock and frequency hopping pattern.One device will be the synchronization center and is

called   the master.All other devices are the slaves. A group of devices synchronized in form of piconet.
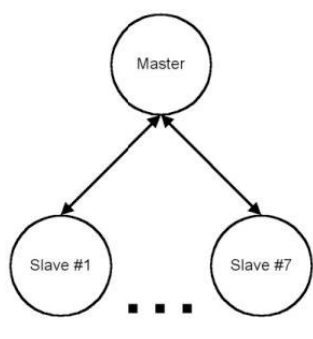
Bluetooth Protocol
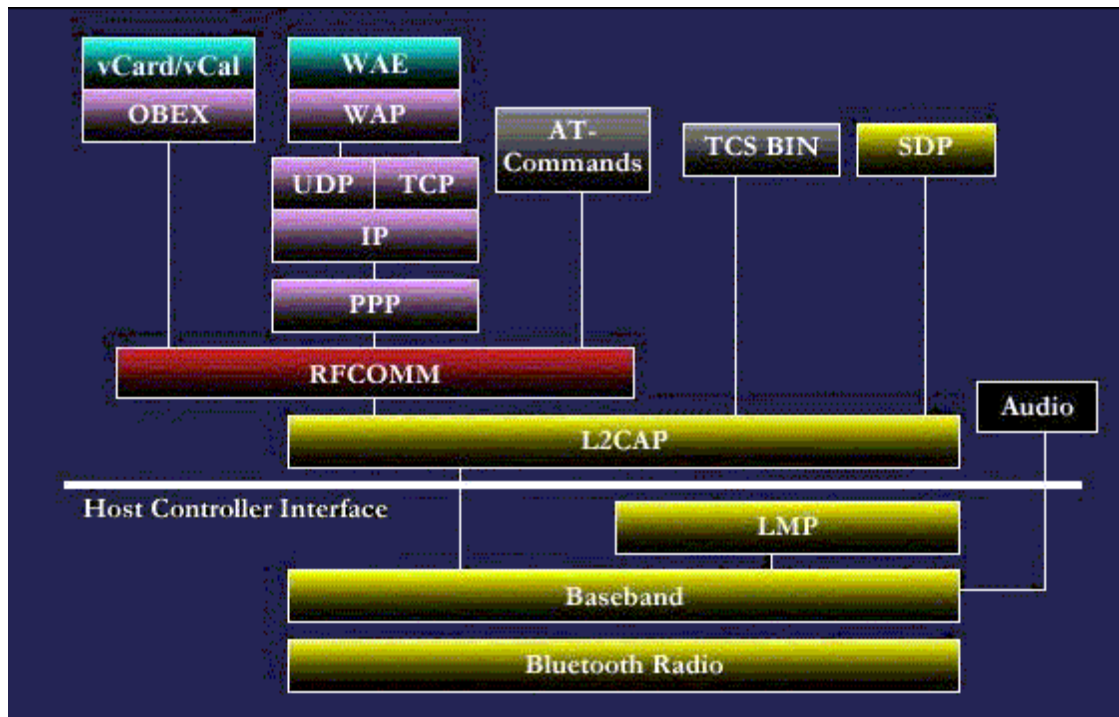
• **Bluetooth Core Protocols**

- Base band and Link Control both are the connection device in Bluetooth.In this layer act to find the signal which is in the same hopping pattern.

- Audio is directly connect to Base band which is for sent-recrive data in term of sound.

- Link Manager Protocol (LMP) act as connecter and manager.

- Logical Link Control and Adaptation Protocol (L2CAP) act as

To add and correct the data into the packet.

- Service Discovery Protocol (SDP) act as discover the other bluethooth device.

- **Cable Replacement Protocol**

RFCOMM copy the data which come from L2CAP to the signal in use of application.

- **Telephony Protocol**

Telephony Control Protocol-Binary (TCS-BIN) manage data and convert into sound.

- **Adopted Protocols**

- OBEX (Object Exchange) is a protocol use for sent the packets

- TCP/UIP/IP use when Bluethooth is connect to device over internet TCP/IP/PPP and for WAP will be UDP/IP/PPP

Data Transmission

Bluethooth is in frequency of 2.4 GHz

There are 3 class of Bluetooth

- Class 1 is in the range of 100 m but use power about 100 mW which is about haft of WiFi 802.11 that use power abote 250 mW

- Class 2 is in the range of 10 m but use power about 2.5 mW .This class is very popular because use less power.

- Class 3 is in the range of 10 cm - 1 m
but use power about 1 mW even this class use the less power but the range is too close.

Signal Encoding Techniques

Bluethooth use **Bluetooth Audio Signal Processor (BTASP)** to encoding the signal . The Bluetooth Audio Signal Processor (BTASP) is a sys Bluetooth supports voice links compressed with log-PCM (A-law or µ-law) or CVSD. A voice link is duplex and the data rate is fixed at 64 kbit/s.

The Bluetooth clock and the signal sample clock are not synchronous and may be error occur. so, it has to synchronize data to/from a signal with the Bluetooth clock.

The BTASP support all signals which needed audio links using all the defined compression/decompression standards. The BTASP will support Bluetooth/signal synchronization.
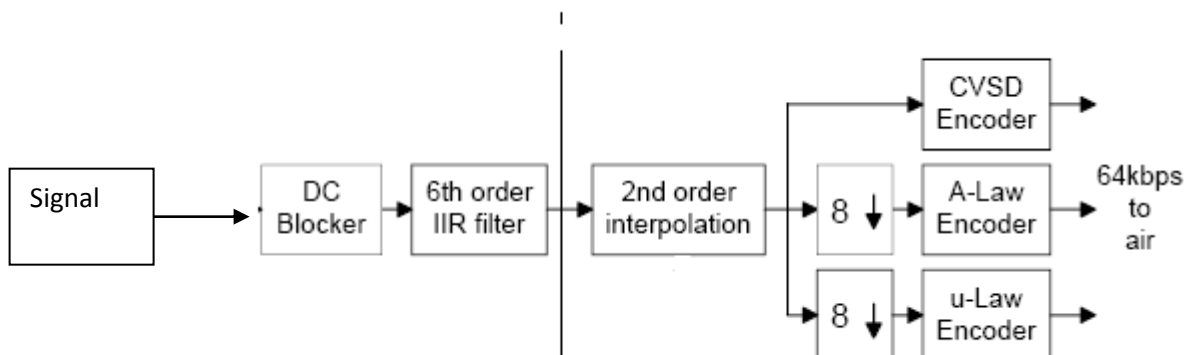

The DC blocker will remove any potential DC-offset from the signal. The IIR filter will limit the signal follow the Bluetooth requirements and the interpolator will synchronize data to/from a signal with the Bluetooth clock
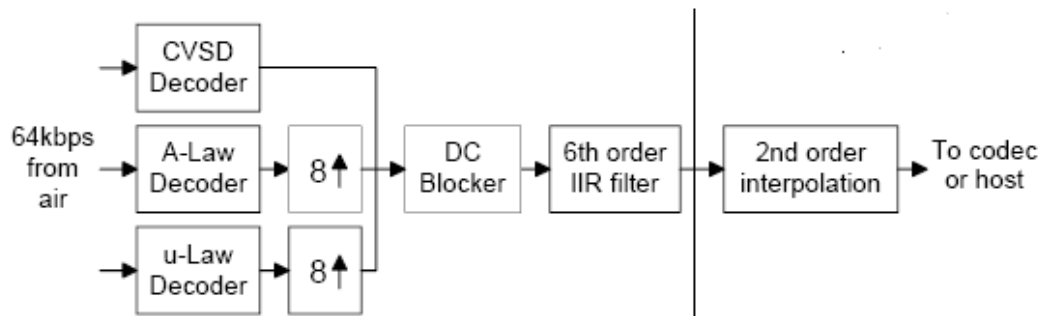
For the application receiver The DC blocker will remove any potential DC-offset from the signal. The IIR filter will limit the signal follow the application requirements and the interpolator will synchronize data to/from a signal with the application clock

Conclusion

Bluetooth is designed to allow low bandwidth wireless connections to become so simple to use into your daily life. A simple example of a Bluetooth application is updating the phone directory of your mobile phone.

Cubicle #1   Cubicle #2
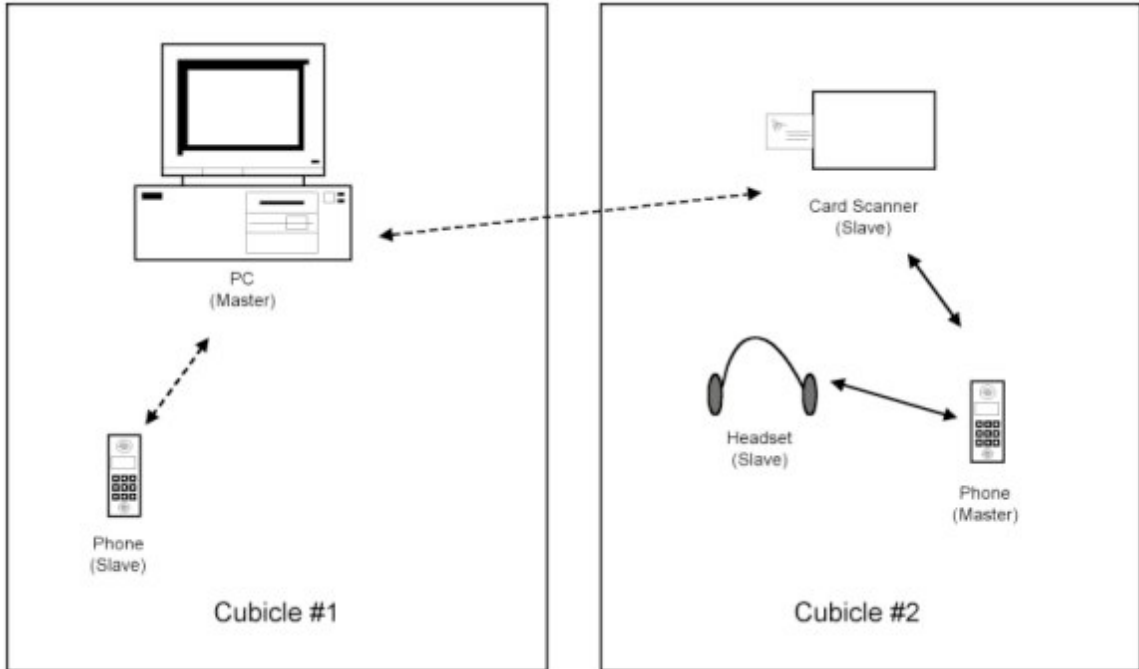
Bluetooth is very used extensively in Thailand and other counter because Bluetooth is low cost

and from the key feature that low power so it is very easy to adopt Bluetooth to many communicating application. The approximate cost of the Bluetooth is 1000-3000 baht in Thailand

WLAN

IEEE 802.11 Protocol Architecture
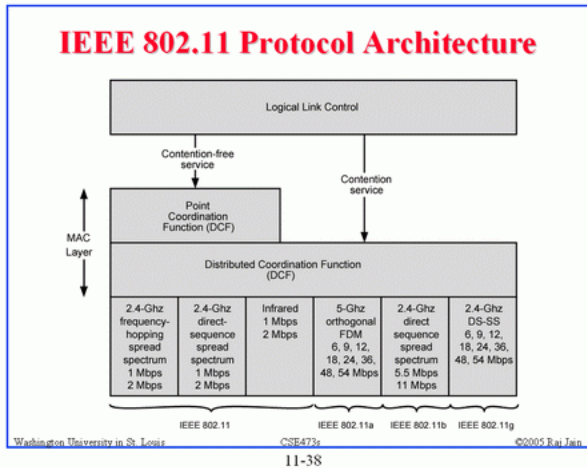
WLAN

WLAN or referred as Wi-Fi. WLAN is based on a networking system that connect the local network using the radio frequency which contain both wired and wireless which cooperate through the access point. It has a standard protocol of IEEE 802.11. It use the frequency band of 2.4, 3.6 and 5 GHz. But the public standard there are use is the 2.4 GHz.

These standard is according to the organization called the institute of electrical and electronics engineering or IEEE. Which is a non profit professional organization that has an advancement on the technology and electricity devices. This organization has around 150 countries as their member there for the standard that come from the committee of this is usually a national standard.

Protocol	Bandwidth (MHz)	Frequency (GHz)	Data Rate(Mb/s)	Indoor Distance	Outdoor Distance
802.11	20	2.4	1,2	20m	100m
802.11a	20	5	6,9,12,18,24,36,48,54	35m	120m
802.11a (2007)	20	3.7	6,9,12,18,24,36,48,54	-	5km
802.11b	20	2.4	1,2,5.5,11	38m	140m
802.11g	20	2.4	1,2,6,9,12,18,24,36,48,54	38m	140m
802.11n	20	2.4	7.2,14.4,21.7,28.9,43.3,57.8,65,72.2	70m	250m
802.11n	40	5	15,30,45,60,60,120,135,150	70m	250m

There are many standard protocols as you can see from above. But for Thailand we use only 2 standard protocols are 802.11b and 802.11g. As same as in the united states that these two standards can be use without the license. The data rate will differ on each of the standard. The environment make the different in the distance as if it is the local area maybe a building or a small office you can look forward the distraction or signal deduction from the object in between the signal transmitter and the receiver. But on the other hand the signal can go longer in a wide open area. WLAN has the system like an antenna that has the transmitter and the receiver. But in the case of WLAN it use the access point or WAP that use relay the data between the wireless device and the wired device network. With the use of WAP the network is shared and the tcp/ip data rates drop to 20 to 25 Mbits/s.

The frequency on the WLAN is depending on it channel which has 14 various channel occur. But each channel is offer due to each countries regulation and also due to the expected services that is involved. So these mean that even there are all the frequency that available in a single area it may not be possible to use all of them. That is because if use the channel frequency that is overlapping than it may cost the signal to degrade.

The example of the use of the channel is like the US that use only 1,6 and 11.

Channel Number	Lower Frequency MHz	Center Frequency MHz	Upper Frequency MHz
1	2.401	2.412	2.423
2	2.404	2.417	2.428
3	2.411	2.422	2.433
4	2.416	2.427	2.438
5	2.421	2.432	2.443
6	2.426	2.437	2.448
7	2.431	2.442	2.453
8	2.436	2.447	2.458
9	2.441	2.452	2.463
10	2.451	2.457	2.468
11	2.451	2.462	2.473
12	2.456	2.467	2.478
13	2.461	2.472	2.483
14	2.473	2.484	2.495

Mostly channel 1st to 13th it is available in all the countries but the 14th channel is only use in Japan as 802.11b.

The power consumption on the device is consider into 5 states ; off, sleep, listen, receive and transmit state. The off and sleep states always take place in the same level as the lowest one but anyway the power consumption does not take this state into a count so make it 0 even if the sleeping state is consuming the power as 40mW. But the other three state is to be count. Refer to the design from Atheros company the transmit state take the power around 2W , the listen state take 0.8W and the receiving state is 0.9W.

WLAN is using the multiplexing system called OFDM or the orthogonal frequency division multiplexing. This work as a digital multi-carrier modulation method. It use a orthogonal carrier to carried the data.Which also work as a audio data encoding as same as the way it work for the compact disc. This method simplifies the design of the transmitter and the receiver. It also maintain the error checking called the forwarding error correction. Which is a predetermined algorithm.

The access point or the router takes the lowest cost around 2000 baht but the price may get to more than 10000 baht. For most of the user that use laptop mostly there will be no excessive cost on it but for some there needs an extra adapter to connect to access points which may cost at least 500 baht more for a USB WLAN or PCI adapter.

WIMAX

WIMAX stands for Worldwide Interoperability for Microwave Access which is the new wireless broadband with the maximum speed. There are two types of WIMAX which are fixed and mobile models.

Protocol architectures

Standard of WIMAX is certified by IEEE standing for InstituteofElectricalandElectronicsEngineers.At present, there are three standards of WIMAX which are IEEE 802.16, IEEE 802.16a, IEEE 802.16e.

1. IEEE 802.16 is the standard that has the working radius at 1.6-4.8 kilometers, and its frequency is 10-66 GHz. IEEE 802.16 works only Line of Sight (LoS)

2. IEEE 802.16a is an amended standard from IEEE 802.16 that has the working radius at 48 kilometers, and its frequency is 2-11GHz. EEE 802.16a works as Non Line of Sight (NLoS). Moreover, its maximum speed to send and receive data is 75 megabit per second.

3. IEEE 802.16e or mobile WIMAX standard is the standard that has the working radius at 1.6-4.8 kilometers. IEEE 802.16e is designed for the movable device like PDAs and laptops. In addition, the mobile WIMAX can work while they are being moved.

Standard	Network	Max speed	Distance	Frequency
IEE 802.16d	WMAN	Up to 75mbps	6.4-10 km	Sub 11GHz
IEE 802.16e	mobile WMAN	Up to 30mbps	1.6-5 km	2-6 GHz

Layer stacks

There are two layers

1.Physical layer

The IEEE 802.16 specified a physical layer operating in the10 to 66 GHz range. In 2004 it is updated to 2 to 11 GHz. In 2005, it uses scalable orthogonal frequency-division multiple process (SOFDMA) to fixed OFDM.. Early version bring multiple antenna support through MIMO

2.MAC (data link) layer

The WIMAX data link layer uses a scheduling algorithm. It is divided into 2 sublayers

1. Convergence Sublayer (CS)
CS accepts higher layer PDU from the higher layer. It classifies and maps the MSDUs into appropriate CIDS(Connection Identifier).It delivers CS PDUs to the appropriate MAC SAP and receives PDU from the PEER entity.

2. Medium Access Control Common Part Sublayer (MAC CPS)
Three main functions of the CPS are

-bandwidth allocation

-connection establishment

-maintenance of the connection between the two sides

Security sublayer is the layer in CPS responsible for authentication, secure key exchange, encryption, and integrity control across the BWA system.
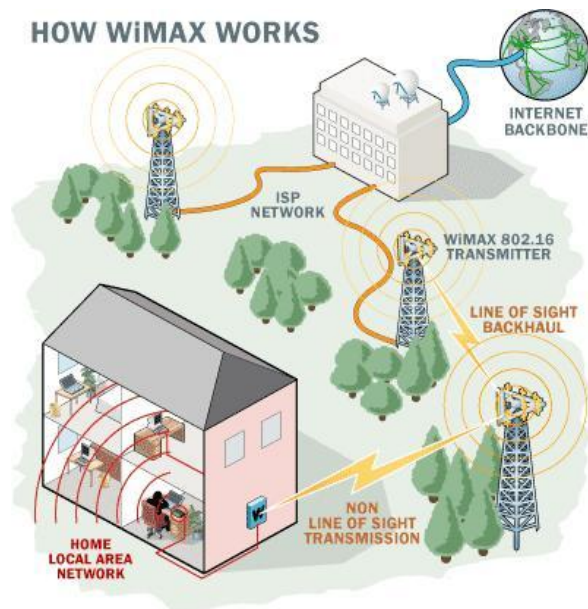
Wimax antennas

There are two parts of WIMAX system which are a WIMAX tower and a WIMAX receiver.

A WIMAX tower works like a mobile phone tower. One WIMAX tower can cover about 3,000 square miles or 8,000 square kilometers.

A WIMAX receiver, there are two types of antenna or a receiver which are a tiny box and a PCMCIA card or they can be built in the device.

By using a high-bandwidth, wired connection like a T3 line the WIMAX tower station can directly connect to the Internet.

Moreover, one WiMAX tower can connect to another WIMAX tower, and this is can be called a backhaul by using microwave link and a line- of - sight.

Types of WIMAX antennas

1. Omni directional antenna is the Point-to-Multipoint antennas. This type of antenna has semi round circle above the ground from its center. It works well with the receivers that is not too far away from the antenna. It has working radius not more than 100 meters from the center of the antenna. Working of the signal will be sent independently.

2. Sector antennas is the point-to-point antennas. It works as line- of-sight. The signal is strength and send very far. However, if the receiver is out of the working radius, the signal cannot reach at all.

3. Penal antennas sends the specific signal to another antennas [point-to-point]. The signal can be sent both indoor and outdoor, but the weather must be considered and there must not has the obstacles.

APPLICATION

WIMAX can send signals about 30 miles or 50 kilometers which means WIMAX can cover areas ten times more than 3G network handset for fixed models and 3 to 10 miles or 5 to15 kelometers for mobile models. The best range is about 10 miles if far more than that it will be too crowed network problem. Moreover, the transmitting data of WIMAX is 70 Mbps per second which is faster than 3G network handset 30 times. WIMAX can send signals from one point to many points, in other words, point-to-multipoints. Users can surf the internet everywhere they want by using mobile WIMAX. It is none line of sight technology which means there is no effects if there are obstacles such as buildings walls or trees. It is suitable for faraway areas like rural areas that the cables cannot reach, and it is also suitable for expanding the network in cities that already exist because it is cheaper and more convenient. If you want to receive the WIMAX's wave, you must have the receiver for the WIMAX. It is used instead of wired network for a typical users. The requires device are Wimax base stations, Wimax receiver,Wimax antenna, and Wimax backhaul.

COST

WIMAX is less expensive than broadband DSL Internet and 3G data plans. It is cheaper than broadband DSL Internet because the users do not have to place the wires around the places that we want to cover. and WIMAX is cheaper than 3G plans because the users of 3G plans have limited to transfer and receive the data though their package, but the WIMAX is unlimited. cost of WiMAX USB Modem is about $50 or 1700 Baht.

USAGE

WIMAX is now not be used inThailand because the first project of WIMAX in Thailand will be launched in

phuget, however, nowadays there is just a plan. For other countries that use WIMAX, Australia in the Metropolitan area of Adelaide, South Australia and in the Coorong, Yorke Peninsula, and Riverlands areas of South Australia Canada, Finland, Japan

ERROR

WIMAX has error detection in itself in order to decrease

the system Signal to Noise Ratio (SNR) obligations. In addition, in order to identify and correct the mistakes to improve throughput

Convolutional Encoding, Strong Reed Solomon FEC, and interleaving algorithms are used. These techniques help to reclaim the debase frames which might miss because of the weakness of the frequency selective or the explosion of the errors. Moreover,

Automatic Repeat Request is used to delete the error.

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