

# WIRELESS COMMUNICATION

## # Wireless LAN Overview

UNIT - 2

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A WLAN is a wireless computer network that links two or more devices using wireless communication within a limited area such as home, school, office etc.

This enables users to move around within a local coverage area & still be connected to the network.

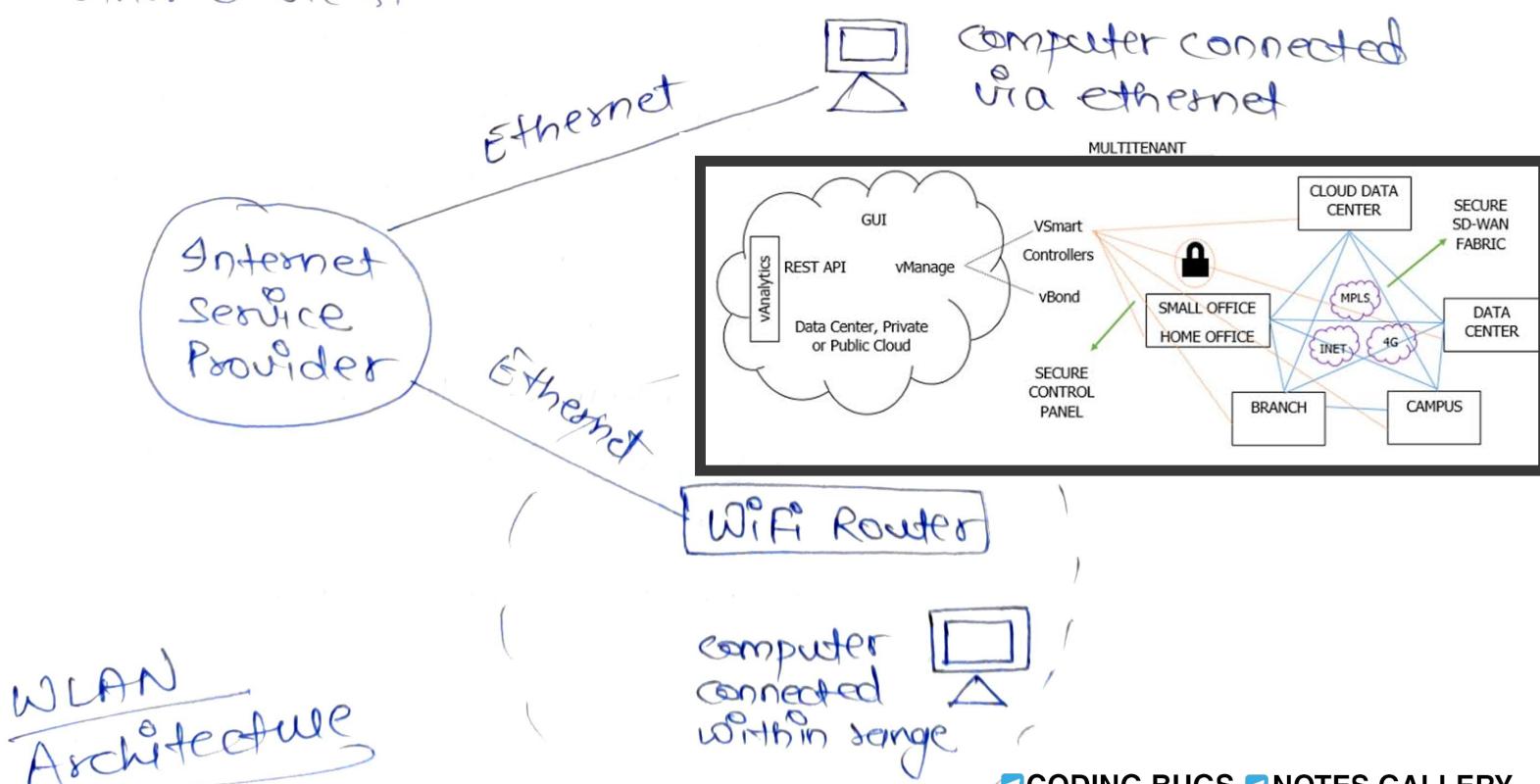
They are also called "Wi-Fi".

### Advantages

- ↳ People can access network whenever they want & aren't limited by length of cable.
- ↳ Setting up of WLAN is done with wireless router.
- ↳ Router can handle more than one connections at same time.

### Disadvantages

- ↳ It uses radio waves, hence, special care is needed for encryption.
- ↳ Reliability issues are there due to interference from other devices.



## # IEEE 802.11

It is the name for series of protocols used for wireless networking. They are called as WLAN, Wireless LAN or WiFi. They allow computers to communicate with each other without using cables.

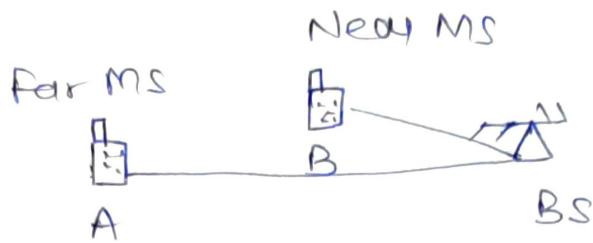
- It was first Wi-Fi standard.
- It was made in 1997.
- It delivers speed of 1-2 Mbps.
- IEEE 802.11 introduced forward error correction.
- It specified 3 physical layer technologies - Differed Infrared frequency hopping spread spectrum, Direct sequence spread spectrum.

## # Motivation for specialized MAC

One of the most commonly used MAC schemes for wired networks is carrier sense multiple access with collision detection (CSMA/CD). In this scheme, a sender senses the medium to see if it is free. If the medium is busy, the sender waits until it is free. If the medium is free, the sender starts transmitting data and continues to listen into the medium. If the sender detects a collision while sending, it stops at once and sends a jamming signal. But this scheme doesn't work well with wireless networks. The problems are:

- Signal strength decreases  $\propto$  square of the distance.
- The sender would apply CS & CD, but the collision happens at the receiver.
- It might be a case that a sender cannot "hear" at the collision, i.e., CD does not work.

## Near Far Problem



A & B both are sending signals with same transmission power. Signal strength decreased proportional to square of distance. Hence, BS is unable to receive A's transmission.

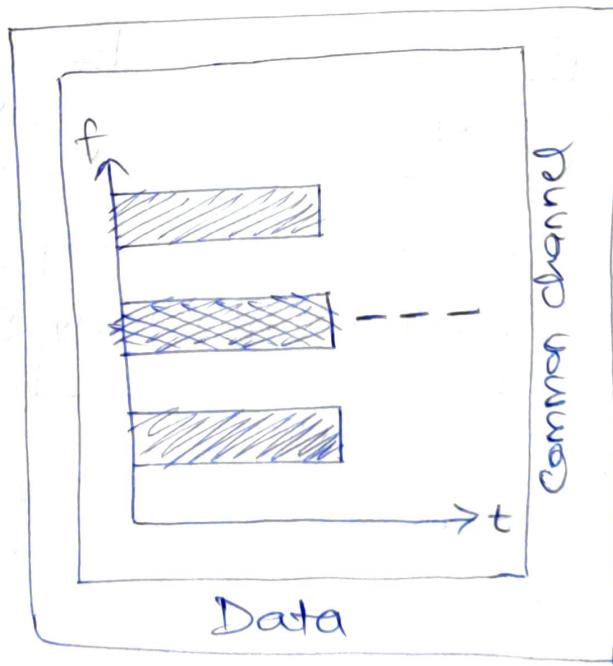
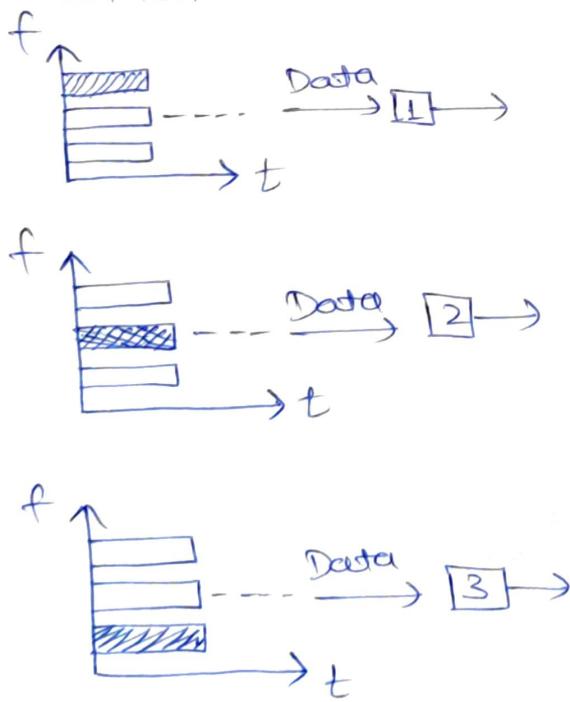
This is the near far problem in CDMA. All signals must arrive at receiver at same strength otherwise the communication quality will be severely degraded.

Precise power control is needed to receive all senders with same strength at the receiver.

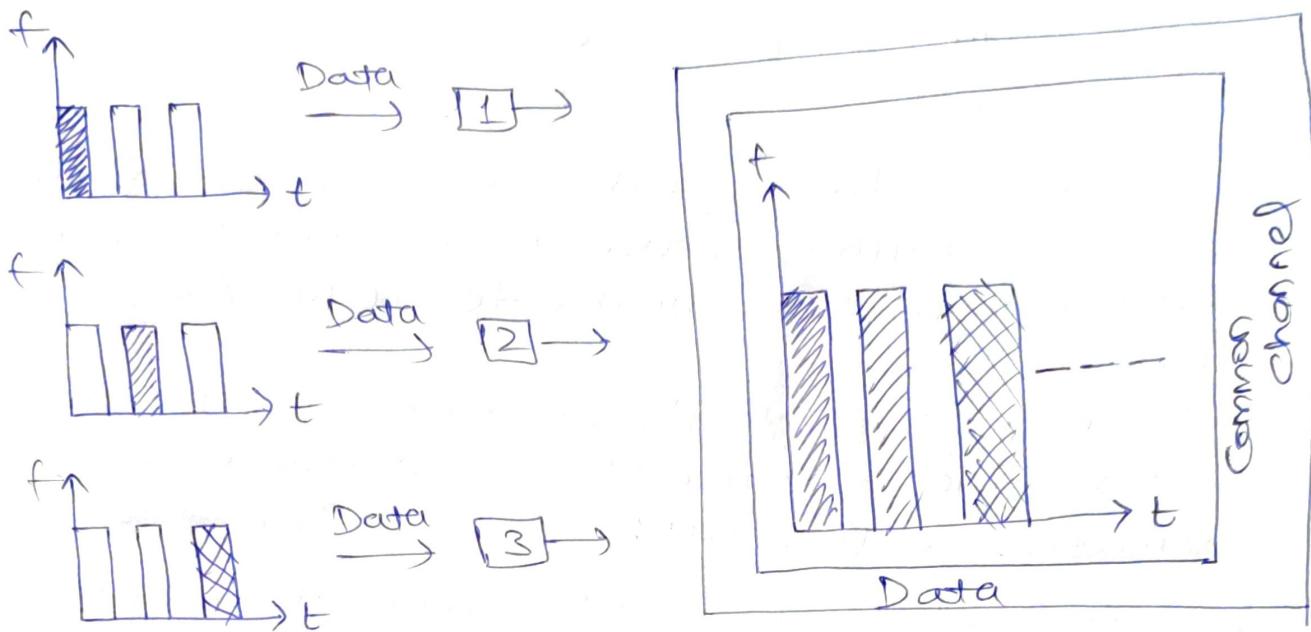
## Multiple Access Techniques

\* FDMA:- FDMA is a type of channelization protocol.

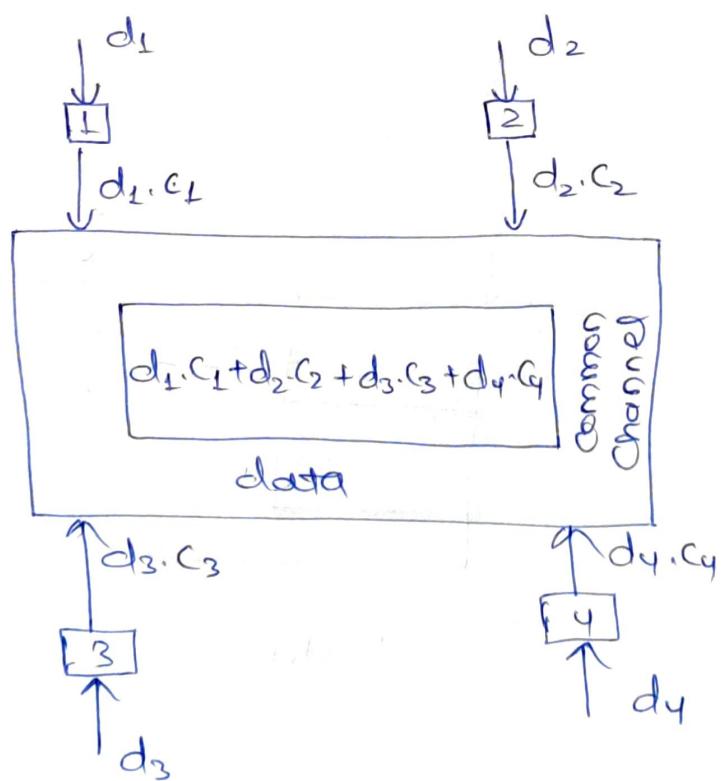
In this, bandwidth is divided into various frequency bands.



\* **TDMA**:- TDMA is the channelization protocol in which bandwidth of channel is divided into various slots on the time basis.



\* **CDMA**:- In CDMA, all the stations can transmit data simultaneously. It allows each station to transmit data over the entire frequency all the time.

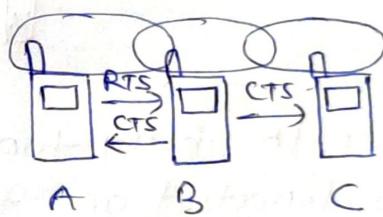


FDMA	TDMA	CDMA
full form	full form	full form
sharing of bandwidth among different stn takes place.	only the sharing of time of satellite transponder takes place	there is sharing of both i.e., bandwidth & time.
no need of any code word.	no need of any code word.	code word is necessary.
synchronization is not required.	synchronization is required.	synchronization is not required.
rate of data is low.	rate of data is medium.	rate of data is high.
little flexible	moderate flexible	highly flexible

## Multiple Access with Collision Avoidance (MACA)

MACA is a simple scheme that solves hidden terminal problem. It uses random access aloha scheme but with dynamic reservation. In this case, A & C both want to send to B and A has already started transmission but it is hidden for C, so, C also starts transmission & hence collision occurs at B. With MACA, A doesn't start transmission at once but sends request to send (RTS) first. B receives RTS that contains name of sender & receiver & length of future transmission. RTS is not heard by C & B triggers acknowledgements called clear to send (CTS). This CTS is heard by C & medium is reserved by A for duration of transmission. Hence C is not allowed to send anything to B for duration indicated in CTS. Hence, collision can't occur at B & hidden terminal problem is solved.

Still collision can occur during sending RTS. Both A & C could send RTS that collide at B. RTS is very small as compared to data transmission, so the probability of collision is much lower. B resolves this by acknowledging only one station at a time.

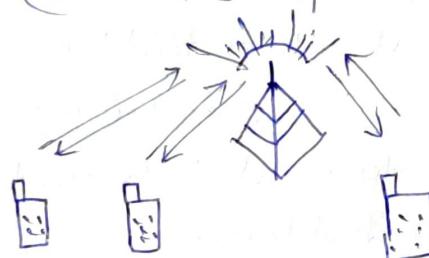


## # Polling Scheme

Polling schemes are used when one station wants to be by others. Polling is strictly centralized scheme with one master & several slave stations. The master can poll slaves according to many schemes: Round Robin (only efficient if traffic pattern are similar over all stations), randomly according to reservation etc. The master can also establish list of students visiting to transmit during contention phase. After this phase, the station polls each station on the list.

## # Inhibit sense Multiple Access

This scheme, which is used for the packet data transmission service cellular Digital Packet Data (CDPD) in the AMPS mobile phone system, is also known as digital sense multiple access (DSMA). Here, the base station only signals a busy medium via a busy tone (called BUSY/IDLE indicator) on the downlink.



After the busy tone stops, accessing the uplink is not coordinated any further. The base station acknowledges successful transmissions; a mobile station detects a collision only via the missing positive acknowledgement. In case of collisions, additional back-offs and retransmission mechanisms are implemented.

## # Spread Spectrum

It is a form of wireless communication in which frequency is transmitted signal is deliberately varied. This results in much greater bandwidth than the signal would have, if its frequency were not varied.

ms of spread spectrum are :-

### Direct Sequence Spread Spectrum (DSSS)

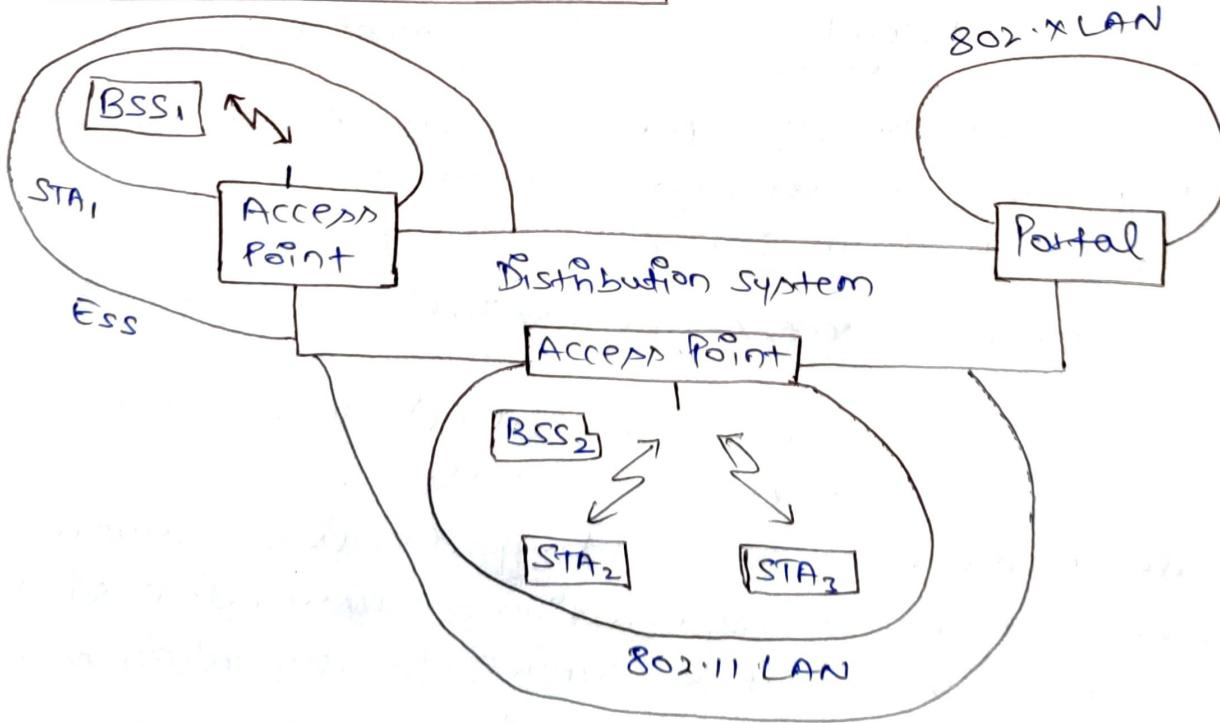
This technique is used to reduce overall signal interference. In this, stream of information to be transmitted is divided into small pieces, each of which is allocated to a frequency channel. A data signal at point of transmission is combined with higher data rate bit sequence (also known as clipping code) that divides data according to spreading ratio.

### \* Frequency hopping spread spectrum (FHSS)

FHSS transmission is the repeated switching of frequencies during media transmission to reduce transmission interference. It is useful for reducing eavesdropping or to obstruct jamming of telecommunication.

In FHSS, the transmitter hops between available narrowband frequency in a pseudo random sequence known to both sender & receiver.

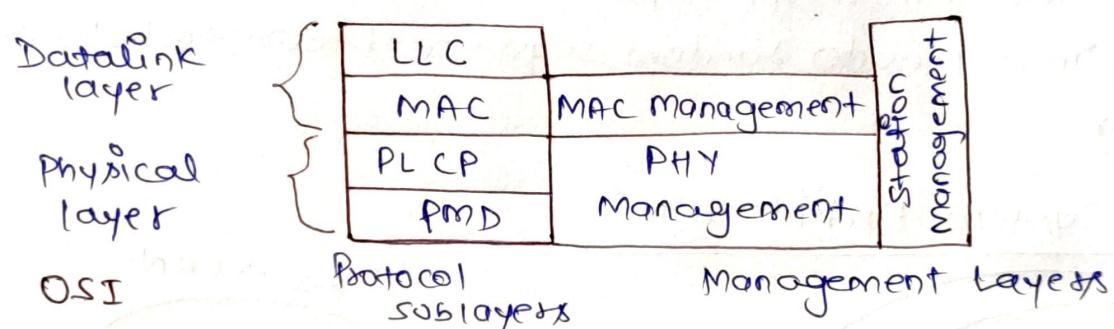
### # LAN System Architecture



## Components of architecture & Wireless Port

- Several nodes called stations (STA<sub>i</sub>) are connected to access points.
- Stations & AP within same radio coverage form Basic service set (BSS<sub>i</sub>)
- BSS<sub>i</sub> & BSS<sub>j</sub> are connected via a distribution system.
- Distribution system connects BSS<sub>i</sub> via AP to form single network & extends wireless coverage area. This network is called Extended Service Set (ESS) & has its own identifier, (ESSID).
- ESSID is the name of network & is used to separate different networks.

## LAN Protocol Architecture



LLC → Logical Link Control; MAC → Media Access Control

PLCP → Physical layer Convergence Protocol

PMD → Physical medium Dependent Sublayer

- MAC handles medium access, fragmentation of user data, encryption.
- PLCP provides carrier sense signal called clear channel Assessment & provides Service Access Point (SAP).
- PMD handles modulation & encoding/decoding of signals.
- MAC management supports association & reassociation of a station to an access point & roaming b/w different access points.
- PHY Management includes channel tuning & maintenance.
- Station Management interacts with both management layers & responsible for additional higher layer functions.

## HiperLAN

High Performance Radio LAN (HiperLAN) is a WLAN standard. It is European alternative for IEEE 802.11 standards. It is defined by European Telecommunications Standards Institute (ETSI). In ETSI, standards are defined by BRAN project.

### Motivation for HiperLAN

- Massive growth in wireless & mobile communication.
- Demand for high internet speed access.
- Emergence of multimedia applications.

### Four different versions

- HIPERLAN/1: Bit rate - 20 mbps, 50m range, frequency Range - 5GHz
- HIPERLAN/2: BR - 50 mbps, FR - 5GHz
- HIPERACCESS: BR - 25mbps, FR - 11 to 66 GHz
- HIPERLINK: BR - 155 mbps, short range point to point technology.

## ② IEEE 802.15

It includes short distance wireless networks used for networking of portable and computing devices such as cell phones, PCs, PDAs, etc.

The original functional requirements for such standards included:-

- Power management :- low current consumption
- Range :- 0-10 metres
- Speed :- 19.2-100 kbps
- Small size :- 0.5 cubic inches without antenna
- Low cost relative to target device
- Also support for a minimum of 16 devices.

The IEEE 802.15 working group proposes two general categories:-

- ↳ TG4 (low rate: data speed of 20 kbps to 250 kbps)
- ↳ TG3 (high rate: data speed of 11Mbps to 55Mbps)

## # Bluetooth User Scenarios

- \* Three-in-one phone : In office, your phone functions as intercom/no telephony (charge); At home, it is used as cordless phone (fixed line charge) on-the-move, it functions as mobile phone (cellular charge).
- \* Headset: Connect your desktop/laptop to printer, scanner, keyboard, mouse.
- \* Cordless Desktop: Connect headset to your PC through bluetooth. Mostly used in cars.
- \* Internet Bridge: Use mobile device or laptop to surf internet by connecting through bluetooth & sharing internet.
- \* File sharing: Share files b/w devices using bluetooth.

## # WPABX

Wireless Private Automatic Branch Exchange.  
These system integrate wireless telephone with a PBX switching system. Wireless PBX telephones communicate through wired base stations to WPBX, switching system. Most WPABX system have automatic switching call transfer that allows wireless handset to transfer their calls to other base stations as they move through their radio coverage area.

WPABX system work force is highly mobile in a relatively small area.

A WPABX radio system allows for voice or data communications on either an analog or digital radio channel.

## IrDA: Infrared Data Association.

+ It is an industry sponsored organization to create international standards for hardware & software used in infrared communication links.

In this radio transmission, a focused ray of light in the infrared frequency spectrum is modulated with information & sent from transmitter to a receiver over relatively short distance.

IR is same technology used to control a TV set with remote control.

Infrared data communication plays an important role in wireless data communication in devices like laptops, PDA, digital cameras, etc other uses include.

- sending document from notebook computer to printer,
- coordinating schedules & telephone books b/w your devices.

④ ZigBee: It is a low cost, low power wireless network standard used to create personal area network.

ZigBee chips are integrated with radios or microcontrollers that have flash memory b/w 60-256 kbps.

ZigBee network layer supports both star & tree networks & mesh networking. It is built on Physical & MAC layer defined in 802.15. ZigBee includes four key components: network layer, application layer, ZigBee Device Objects (ZDO) & manufacturer defined application objects which allows for customisation & favors total integration.

Application include wireless light switcher, traffic management system, home energy monitor, etc.

## ④ RFID :- Radio Frequency Identification.

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It is a form of WC that uses electromagnetic fields to automatically identify an object, animal or person. It also tracks tags attached to objects. The tags contain electronically stored information.

An RFID system consists of 3 components : a scanning antenna & transceiver & transponder. Transponders are known as RFID tags which consists of a microchip, memory & antenna.

RFID system comprise of different functions:

- Reading or Interrogating data in tag,
- filtering data.
- Communicate in the tag with host computer.
- Updating & entering customized data into the tag.

## ⑤ WiMAX :- Worldwide Interoperability for Microwave Access.

- It is a family of WC standards based on Wireless Metro - polish Area Network technology.
- It operates similar to WiFi but at higher speeds & over greater distances & for greater of users.
- It can provide service even in areas that are difficult for wired infrastructure.
- It was initially designed to provide (30-40 mbps) but now, it aims at providing 19 bps for fixed stations.
- It aims at providing about 15 Mbps capacity in a 3km cell coverage area.