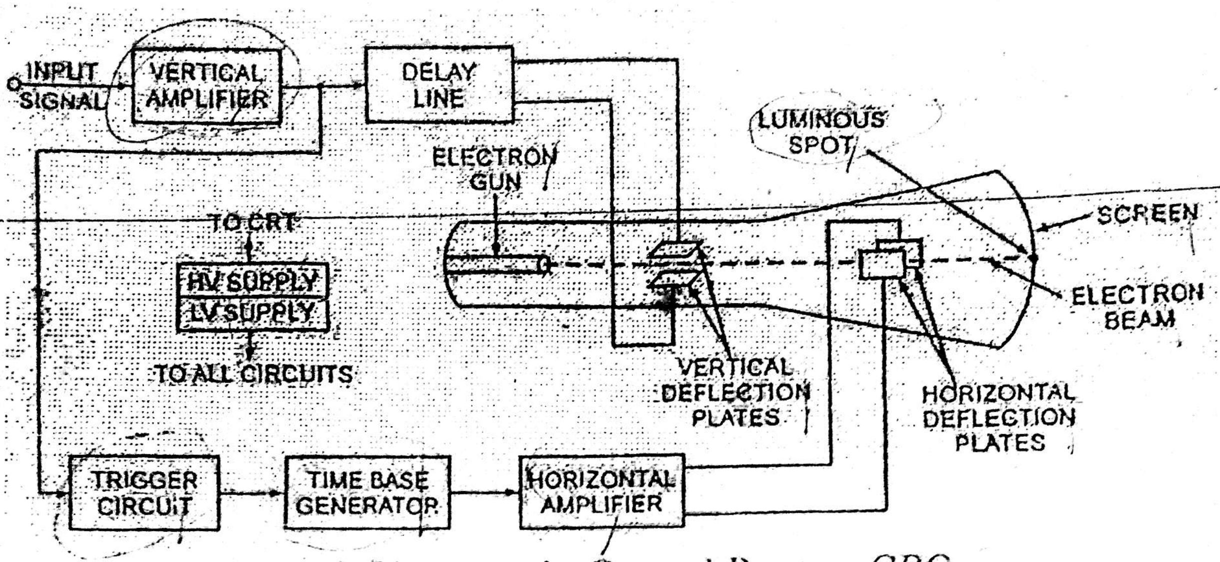
(2012)

5.1. Cathode Ray Oscilloscope:

The cathode ray oscilloscope is an extremely useful and versatile laboratory instrument used for studying wave shapes of alternating currents and voltages as well as for measurement of voltage, current, power and frequency.



Block Diagram of a General Purpose CRO

The instrument employs a **CathodeRayTube** (CRT). which is the heart of the oscilloscope. It generates the electron beam, accelerates the beam to a high velocity, deflects the beam to create the image, and contains a phosphor screen where the electron beam eventually becomes visible. For accomplishing these tasks various electrical signals and voltages are required, which are provided by the power supply circuit of the oscilloscope. Low voltage supply is required for the heater of the electron gun for generation of electron beam and high voltage, of the order of few thousand volts, is required for cathode ray tube to accelerate the beam. Normal voltage supply, say a few hundred volts, is required for other control circuits of the oscilloscope.

Horizontal and vertical deflection plates are fitted between electron gun and screen to deflect the beam according to input signal. Electron beam strikes the screen and creates a visible spot. This spot is deflected on the screen in horizontal direction (X-axis) with constant time dependent rate. This is accomplished by a time base circuit provided in the oscilloscope. The signal to be viewed is supplied to the vertical deflection plates through the vertical amplifier which raises the potential of the input signal to a level that will provide usable deflection vertical on Y-axis. A triggering circuit is provided for synchronizing two types of deflections so that horizontal deflection starts at the same point of the input vertical signal each time it sweeps.

A general purpose oscilloscope consists of the following parts:

1. Cathode ray tube
2. Vertical amplifier
3. Delay line
4. Time base generator
5. Horizontal amplifier
6. Trigger circuit
7. Power supply

Cathode Ray Tube - It is the heart of the oscilloscope. When the electrons emitted by the electron gun strikes the phosphor screen, a visual signal is displayed on the CRT.

Vertical Amplifier - The input signals are amplified by the vertical amplifier. Usually, the vertical amplifier is a wide band amplifier which passes the entire band of frequencies.

Delay Line - As the name suggests, this circuit is used to delay the signal for a period of time in the vertical section of CRT. The input signal is not applied directly to the vertical plates because the part of the signal gets lost, when the delay time is not used. Therefore, the input signal is delayed by a period of time.

Time Base (Sweep) Generator - Time base circuit uses a uni-junction transistor, which is used to produce the sweep. The saw tooth voltage produced by the time base circuit is required to deflect the beam in the horizontal section. The spot is deflected by the saw tooth voltage at a constant time dependent rate.

Horizontal Amplifier - The saw tooth voltage produced by the time base circuit is amplified by the horizontal amplifier before it is applied to horizontal deflection plates.

Trigger Circuit - The signals, which are used to activate the trigger circuit, are converted to trigger pulses for the precision sweep operation whose amplitude is uniform. Hence, input signal and the sweep frequency can be synchronized.

Power supply - The voltages required by CRT, horizontal amplifier, and vertical amplifier

Functioning –

- The cathode ray is a beam of electrons which are emitted by the heated cathode (negative electrode) and accelerated toward the fluorescent screen. The assembly of the cathode, intensity grid, focus grid, and accelerating anode (positive electrode) is called an electron gun
- Its purpose is to generate the electron beam and control its intensity and focus. Between the electron gun and the fluorescent screen are two pair of metal plates - one oriented to provide horizontal deflection of the beam and one pair oriented to give vertical deflection to the beam. These plates are thus referred to as the horizontal and vertical deflection plates
- The combination of these two deflections allows the beam to reach any portion of the fluorescent screen. Wherever the electron beam hits the screen, the phosphor is excited and light is emitted from that point. This conversion of electron energy into light allows us to write with points or lines of light on an otherwise darkened screen
- The linear deflection or sweep of the beam horizontally is accomplished by use of a sweep generator that is incorporated in the oscilloscope circuitry.
- In the most common use of the oscilloscope, the signal to be studied is first amplified and then applied to the vertical (deflection) plates to deflect the beam vertically, and at the same time, a voltage that increases linearly with time is applied to the horizontal (deflection) plates, thus causing the beam to be deflected horizontally at a uniform rate
- The signal applied to the vertical plates is thus displayed on the screen as a function of time. The horizontal axis serves as a uniform time scale.

Applications of CRO

1. Meaurement of voltage – Voltage waveform will be made on the oscilloscope screen. From the screen of the CRO, the voltage can be measured by seeing its amplitude variation on the screen.

2. Measurement of current – Current waveform will be read from the oscilloscope screen in the similar way as told in above point. The peak to peak maximum current value can be measured from the screen

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2. **Measurement of current** – Current waveform will be read from the oscilloscope screen in the similar way as told in above point. The peak to peak, maximum current value can be measured from the screen.

3. **Measurement of frequency** – Frequency measurement in cathode ray oscilloscope can be made with the help of measuring the time period of the signal to be measured.

4. **Measurement of phase** – Phase measurement in CRO can be done by the help of Lissajous pattern figures. Lissajous figures can tell us about the phase difference between two signals. Frequency can also be measured by this pattern figure.

5.2. SDR :(Software Defined Radio)

A radio is any kind of device that wirelessly transmits or receives signals in the radio frequency(RF) part of the electromagnetic spectrum to facilitate the transfer of information. SDR is that it has a generic hardware platform on which software runs to provide functions including modulation and demodulation, filtering (including bandwidth changes), and other functions such as frequency selection and if required frequency hopping.

Software-defined radio (SDR) is a radio communication system where components that have been typically implemented in hardware (e.g. mixers, filters, amplifiers, modulators/demodulators, detectors, etc.) are instead implemented by means of software on a personal computer or embedded system.

Software-defined radio (SDR) is a radio communication technology that is based on software defined wireless communication protocols instead of hardwired implementations. In other words, frequency band, air interface protocol and functionality can be upgraded with software download and update instead of a complete hardware replacement. SDR provides an efficient and secure solution to the problem of building multi-mode, multi-band and multifunctional wireless communication devices.

An SDR is capable of being re-programmed or reconfigured to operate with different waveforms and protocols through dynamic loading of new waveforms and protocols.

Scanned by CamScanner

A basic SDR system may consist of a personal computer equipped with a sound card, or other Analog-to-digital converter, preceded by some form of RF front end. Significant amounts of signal processing are handed over to the general-purpose processor, rather than being done in special-purpose hardware (electronic circuits). Such a design produces a radio which can receive and transmit widely different radio protocols (sometimes referred to as waveforms) based solely on the software used.Software radios have significant utility for the military and cell phone services, both of which must serve a wide variety of changing

Operating principles

The ideal receiver scheme would be to attach an analog-to-digital converter to an antenna. A digital signal processor would read the converter, and then its software would transform the stream of data from the converter to any other form the application requires. An ideal transmitter would be similar. A digital signal processor would generate a stream of numbers. These would be sent to a digital-to-Analog converter connected to a radio antenna.

The ideal scheme is not completely realizable due to the actual limits of the technology. The main problem in both directions is the difficulty of conversion between the digital and the Analog domains at a high enough rate and a high enough accuracy at the same time, and without relying upon physical processes like interference and electromagnetic resonance for assistance.

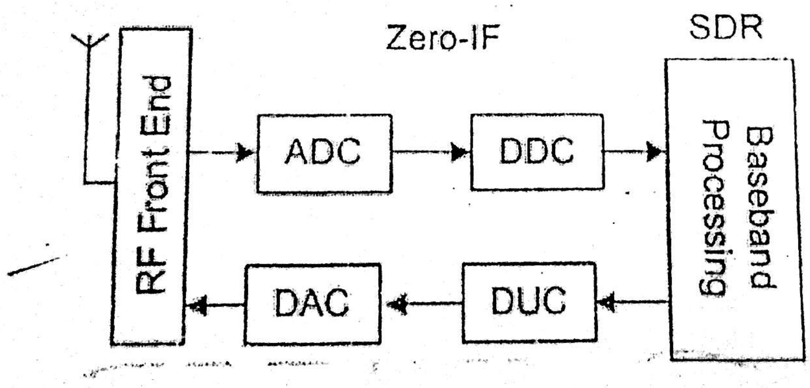

Fig 5.2. Block diagram of SDR

Fig. shows the block diagram of a SDR receiver. At first, the RF tuner converts the Analog signal to IF. Next, the IF signal is passed to the ADC converter .The samples are feed to the following stage's input which is a Digital Down Converter (DDC). The DDC is commonly a monolithic chip and it stands as the key part of the SDR system. It consists of three main components: (1) a digital mixer, (2) a digital local oscillator, and (3)) low-pass filter. The digital mixer and the local oscillator shift the IF digital samples to baseband, while the low

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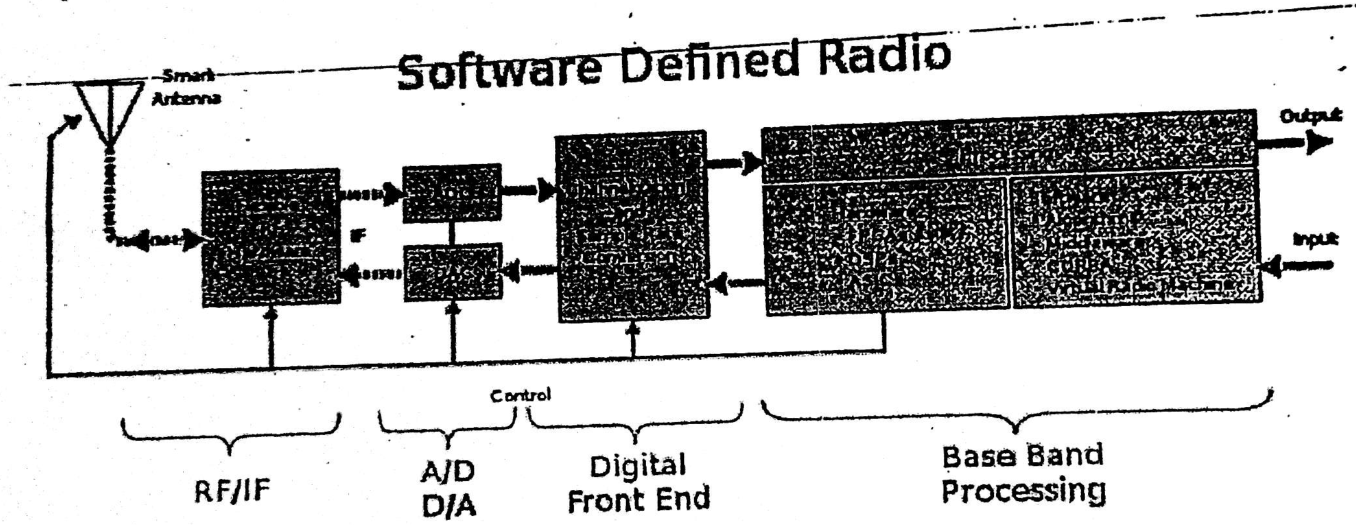
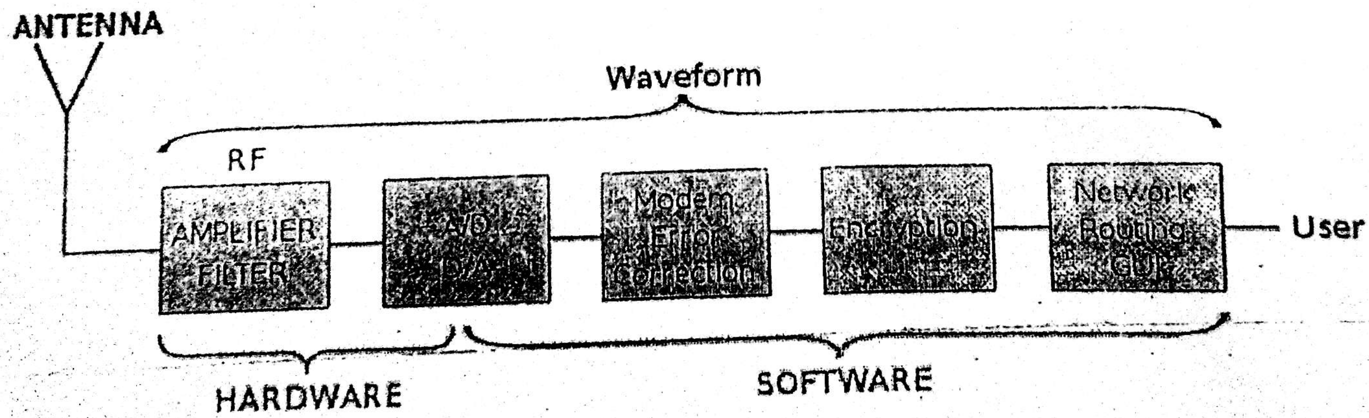
pass filter limits the bandwidth of the final signal. For the implementation of each of its parts, the DDC includes a high number of multipliers, adders and shift registers. Finally, the baseband samples are passed to the Digital Signal Processing (DSP) block, where task such as demodulating and decoding are performed, among others

Although the most common SDR devices are receivers, the technology also includes transmission schemes. SDR transmitters receive a base band signal as an input, typically generated by a DSP step as it is shown in Fig. The first block is a Digital Up Converter (DUC) which transfers the baseband signal to IF. The DAC that follows transform the samples to the Analog domain. Next, the RF converter shifts the signal towards higher frequencies. Finally, the signal is amplified and directed to the antenna.





Receiver architecture

Most receivers use a variable-frequency oscillator, mixer, and filter to tune the desired signal to a common intermediate frequency or baseband, where it is then sampled by the Analog-to-digital converter. However, in some applications it is not necessary to tune the signal to an intermediate frequency and the radio frequency signal is directly sampled by the Analog-to-digital converter (after amplification).

Real Analog-to-digital converters lack the dynamic range to pick up sub-microvolt, nanowatt-power radio signals. Therefore, a low-noise amplifier must precede the conversion step and this device introduces its own problems. For example, if spurious signals are present (which is typical), these compete with the desired signals within the amplifier's dynamic range. They may introduce distortion in the desired signals, or may block them completely. The standard solution is to put band-pass filters between the antenna and the amplifier, but these reduce the radio's flexibility. Real software radios often have two or three Analog channel filters with different bandwidths that are switched in and out.

Software Defined Radio - Benefits:

The benefits of SDR are compelling.

For Radio Equipment Manufacturers and System Integrators, SDR Enables:

• A family of radio "products" to be implemented using a common platform architecture, allowing new products to be more quickly introduced into the market.

• Software to be reused across radio "products", reducing development costs dramatically.

• Over-the-air or other remote reprogramming, allowing "bug fixes" to occur while a radio is in service, thus reducing the time and costs associated with operation and maintenance.

For Radio Service Providers, SDR Enables:

• New features and capabilities to be added to existing infrastructure without requiring major new capital expenditures, allowing service providers to quasi-future proof their networks.

• The use of a common radio platform for multiple markets, significantly reducing logistical support and operating expenditures.

• Remote software downloads, through which capacity can be increased, capability upgrades can be activated and new revenue generating features can be inserted.

For End Users - from business travellers to soldiers on the battlefield, SDR technology aims to:

• Reduce costs in providing end-users with access to ubiquitous wireless communications – enabling them to communicate with whomever they need, whenever they need to and in whatever manner is appropriate.

Examples of SDR adoption illustrating the transition to the mainstream are abundant:

• Thousands of software defined radios have been successfully deployed in defense applications.

• Cellular infrastructure systems are increasingly using programmable processing devices to create "common platform" or "multiband-multiprotocol" base stations supporting multiple cellular infrastructure standards

• Cellular handsets are increasingly utilizing System on Chip (SoC) devices that incorporate programmable "DSP Cores" to support the baseband signal/modem processing

• Satellite "modems" in the commercial and defence markets make pervasive use of programmable processing devices for intermediate frequency and baseband signal processing.

the SDR Forum's market and technology studies have shown that cost effective radio frequency technologies supporting the operation of software defined radios over a broad spectral range have begun to mature, allowing for the first time the use of software defined radio as an enabling technology for dynamic spectrum access systems with cognitive or smart radio functionality. This trend is expected to continue over the next several years, allowing SDR to finally achieve the define division of reducing costs in providing end-users with access to ubiquitous wireless communications – enabling them to communicate with whomever they need, whenever they need to and in whatever manner is appropriate

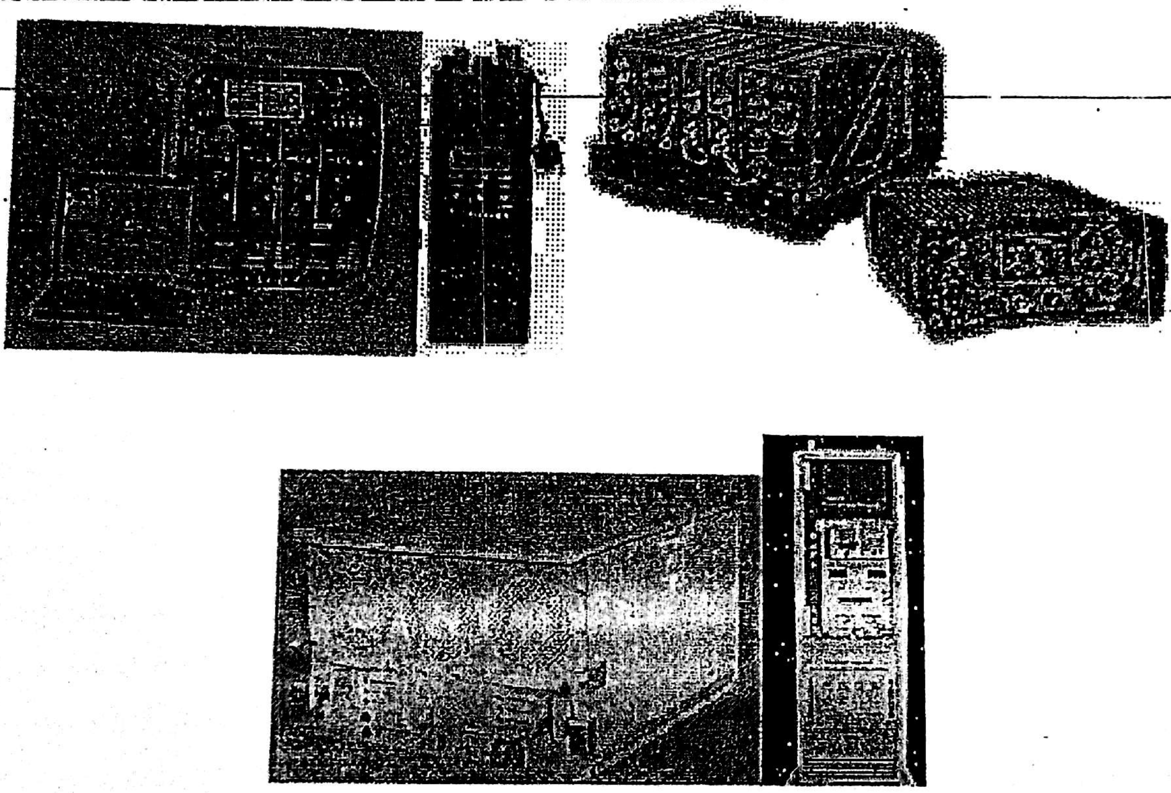


Fig: pictures of SDR

5.3. Smart phones:

5.3.1. Introduction

Smartphones are an extremely popular type of phone used all around the world, offering a wealth of features that make them very useful in the modern age. Despite the emergence of smartphones and their dominance in the market, standard mobile phones have stood the test of time and are still highly popular around the world, especially in developing nations. There are many people who cannot live without smartphones, for both professional and personal reasons. There are still many people, however, that do not need all of the features provided by a smartphone, and are instead better served by a normal mobile. This guide explains the differences between these two important types of mobile phone technology.

Smartphones are much more advanced than standard mobiles, but in reality the purchasing decision all comes down to what the buyer is looking for. Standard mobiles can provide all that is needed, their simplicity and long battery life make them very useful, and they will no-doubt be around for as long as there are reasons to make calls and send text messages. When it comes to staying truly connected from a mobile device in the digital age, however, smartphones cannot be beaten.

With the smartphone boom in today's world, many people today only purchase smart phones. Smartphones started from cellphones, which were advanced to incorporate the technology today and convert them into smartphones. Cell phones were basically a telephony device that allowed users to send/receive calls and text messages. As technology developed, it incorporated additional capabilities such as internet browsers, multimedia text messages, games, applications, etc. This further developed into a mini computer that we now know as a smartphone. A smartphone is a phone has computing capabilities and an operating system powering the device. A normal phone is a phone that supports basic calling features and internet capabilities.

5.3.2 The Differences between Mobiles and Smartphones:

Here are the differences that should be recognised between standard mobiles and smartphones.

Shape and Size

There is huge variation in both shape and size for mobiles and smartphones, though general differences can be described. Mobiles have smaller widths and lengths and are thicker, while smartphones have larger widths and lengths and are thinner. The larger face dimensions of smartphones are a result of the larger screen interface, which ranges from roughly 4 – 6 inches. Most standard mobiles have a much smaller screen than this. Larger smartphones are currently being introduced into the market to compete with tablets and micro tablets. There are also plenty of small, compact smartphones which offer many of the same features as larger smartphones but in a small package.

Design and Durability

Normal mobile phones are synonymous with durability and robustness, and there are many models which are designed specifically to be dustproof or waterproof. This contrasts with smartphones which tend to be less robust, and this is mainly due to the large touch screen.

Having said this, technology is getting better all the time and this may make smartphones much more physically robust in the future. The very first waterproof smartphone was unveiled at the start of 2013, for example.

Battery Life

One of the biggest advantages of basic mobile phones is their long battery life. Power demands are much less and therefore normal mobile phone batteries can keep the phone running for much longer when compared to smartphones. 'Standby time' is the amount of time the battery lasts when the phone is on but not in use. Standby times can be over a month for standard mobiles and a few weeks for smartphones. 'Talk time' is the amount of time the battery lasts when phone calls are being made. Talk times are around 24 hours for standard mobiles and up to 12 hours for smartphones. This means that, generally speaking, mobile phone battery life is roughly twice as long as for smartphones. Furthermore, when a smartphone is used extensively, the screen and processing power requirements quickly drain the battery. This means that, based on extensive use, normal mobile battery life can be much more than twice the amount of smartphone battery life. New technological innovations and improvements are helping to improve smartphone battery life. Some of the latest models are now offering much greater standby times than the times stated above.

Cameras

High resolution cameras are a staple of the modern smartphone. Cameras are still available with many standard mobiles, though smartphone cameras provide much higher resolutions as well as video recording. Smartphone applications make it simple to adjust images and video, and front-facing cameras are now available with many smartphones for video calling.

Operating System

The most popular smartphone operating systems are Android, iOS, BlackBerry and Windows. Operating systems such as iOS are specific to Apple smartphones, while the Android operating system can be found with many different smartphone manufacturers such as HTC and Samsung. Every phone comes with an operating system, but these are very non-descript with normal mobiles and rarely affect the purchasing decision. In contrast, operating systems are a crucially important factor to consider with smartphones because they have a big impact on the smartphone's overall usability, functionality, convenience and number of available features. For example, the new HTC BlinkFeed is a dynamic home screen which combines news feeds and social networking accounts in one central location, and the iOS App Store provides access to countless high quality mobile applications.

Internet Connection

Standard mobiles do not usually come with Internet capabilities, and when they do, things are very limited. Even for standard mobiles with Internet capabilities, the Internet is difficult to use because of the small screen and slower hardware. On the other hand, online connectivity is a pivotal aspect of the modern smartphone and with large screens, high processing power and software compatibility, smartphones can be used to perform almost all of the same internet activities as a computer. Smartphones can connect to the Internet via Wi-Fi, and may also include 3G or 4G technology for internet connection using a network service provider.

5.3.3. Feature of Smart phones.

Any new Smartphone has a gimmick. Whether it's wireless charging, fingerprint scanning or even eye-tracking, there's always an amazing feature you "can't live without." But let's be honest: many of those features you really can live without.

On the other hand, some of the futuristic technology available in next-generation smart phones is really useful. But which features do you need in your toolbox and which are just the icing on the cake? This definitive list ranks 10 useful features your Smartphone needs to have.

1. A long-lasting battery

Your Smartphone could have a shrink-ray or turn lead into gold and it would still be useless without juice. There are ways to boost the battery life of your gadget, but at the end of the day a larger battery is going to last you longer.

The Droid Maxx is the undisputed king of batteries. It will get you close to 48 hours of use. The Galaxy Note 3 has a respectable battery life at 12-16 hours of use, but it's still well behind the Maxx. The iPhone 5S is around 10 hours and the Samsung Galaxy S4 brings up the rear at 9 hours.

2. Warp-speed processing

Speed is still the ultimate prize in the smartphone arms race. You notice when apps lag or when swiping takes an eternity.

The iPhone 5s is the fastest smartphone on the market. Its A7 chip is even light years ahead of blazing fast phones like the Samsung Galaxy S4 or the surprisingly quick Motorola Moto X. But don't despair if your phone feels a little sluggish — there are ways to speed it up.

3. Crystal-clear display

Smartphones are as much about enjoying media as they are about communicating. You watch movies, play games and view photos on your mobile screen and you want the crispest display around.

In this case that award goes to the Samsung Galaxy S4. It has the best resolution and most pixels per inch. The LG G2 and Nokia Lumia 1020 are close behind, but it's Samsung's super AMOLED display technology that sets it ahead.

While the screen on the iPhone 5s and 5c can't match the size or pixel density of their competitors, it's still a solid high-resolution display and many people prefer it for its color accuracy.

4. A great camera

You don't have to be a pro photographer to see the difference between modern phone cameras and the ones on your old flip phone. A great camera is important for more than just great photos. You can use your camera for some surprising other things, like visual search.

Nokia's Lumia 1020 includes an elite ZEISS lens, image stabilization and a whopping 41 megapixels. It's clearly the best camera phone because it's more camera than phone!

The iPhone 5s and the HTC One are also very respectable shooters. Their image sensors have larger pixels, which gives you better color range and excellent low-light images.

5. NFC

Near Field Communications allows your smartphone to transmit data to other phones and tablets in the vicinity. It's really handy for sharing pictures and music. You can even use it to pay at stores and restaurants. Plenty of great Android and Windows phones offer NFC, but not Apple.

6. Multiple windows

You'd never settle for seeing just one window on your computer, why would you on your phone? Samsung Galaxy phones, as well as LG's G2, Optimus and Enact are superb at letting you see multiple apps at once. Other Android phones and the iPhone stick to displaying a single app at a time.

7. Plenty of storage space

Most smartphones come with anywhere between 16 and 32 gigabytes of storage. Extra space is a nice luxury, but these days you'll be saving most of your media in the cloud.

8. Infrared remote control

How cool would it be to control your TV with your Smartphone? You'll never search for the remote again. Phones like the HTC One and Samsung Galaxy S4 include Infrared transmitters as well as apps to help you control your TV. Of course, there are third-party infrared add-ons for the iPhone and other Android phones.

9. Fingerprint sensor

Apple's most gabbed-about feature on the new 5s was definitely the fingerprint sensor. It's not really any more secure than traditional lock screen passcodes. But it does save you time. The HTC One Max Android phone also has one, but few other phones do at this time.

10. Wireless charging

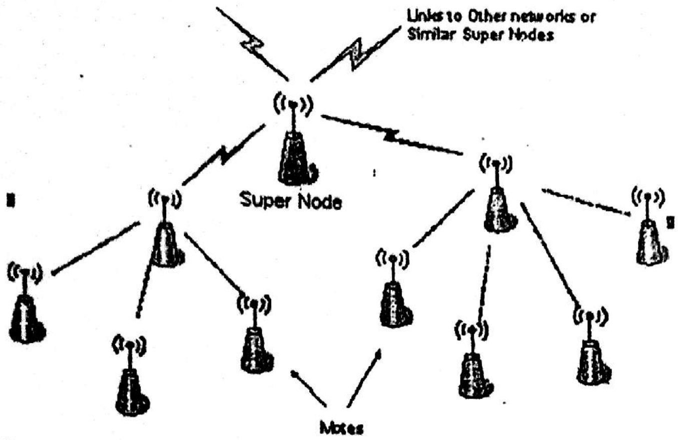
This is a handy feature for those of you who don't want to plug in your phone. Just set it down and it's charging. And don't worry, wireless charging is perfectly safe.

Note: This is for reference only. you can update with day to day.

5.4. WIRELESS SENSOR NETWORK (WSN):

A wireless sensor network (WSN) is a wireless network consisting of spatially distributed autonomous devices using sensors to monitor physical or environmental conditions. A WSN system incorporates a gateway that provides wireless connectivity back to the wired world and distributed nodes. WSNs measure environmental conditions like temperature, sound, pollution levels, humidity, wind speed and direction, pressure, etc.

WSNs were initially designed to facilitate military operations but its application has since been extended to health, traffic, and many other consumer and industrial areas. A WSN consists of anywhere from a few hundreds to thousands of sensor nodes or motes that communicate with each other and pass data along from one to another.



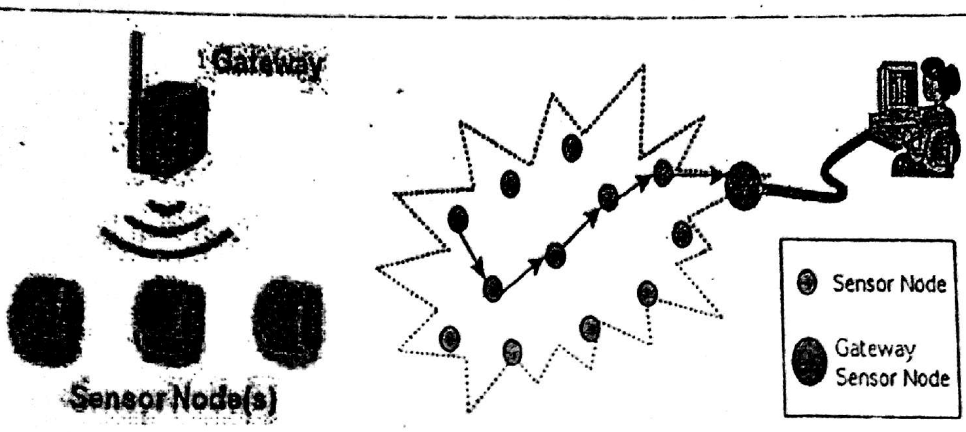


Figure : WSN Components, Gateway, and Distributed Nodes

The sensor node equipment includes a radio transceiver along with an antenna, a microcontroller, an interfacing electronic circuit, and an energy source, usually a battery as shown in below figure. The size of the sensor nodes can also range from the size of a shoe box to as small as the size of a grain of dust. As such, their prices also vary from a few pennies to hundreds of dollars depending on the functionality parameters of a sensor like energy consumption, computational speed rate, bandwidth, and memory.

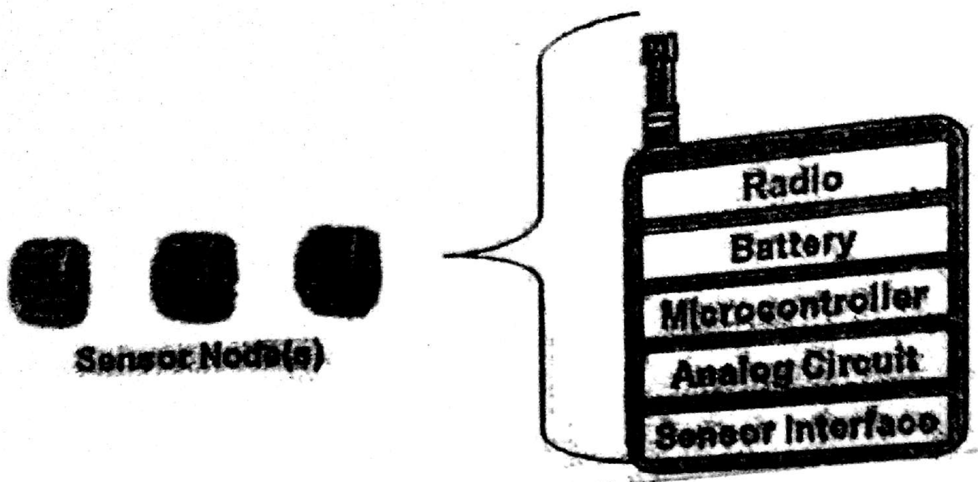
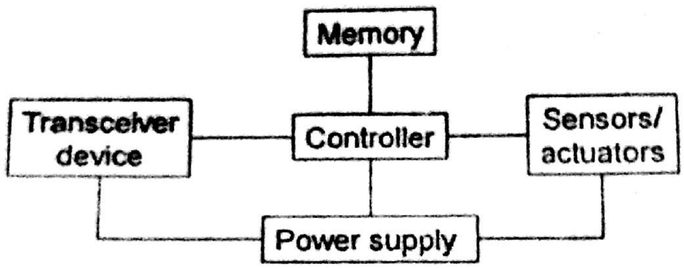
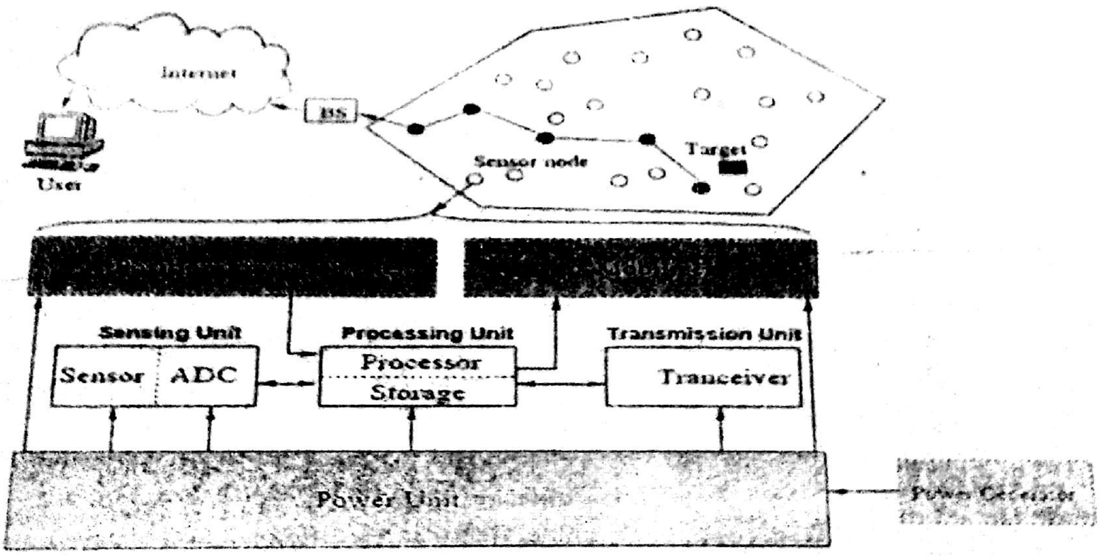


Figure. WSN Sensor Node Components





5.4.1 CHARACTERISTICS

1. Self – Organization
2. Concurrency processing

4. Restricted energy resources
5. Tiny
6. Small radio range

54.2 Applications of wireless sensor network

1. Area monitoring
2. Health care monitoring
3. Air pollution monitoring
4. Forest fire detection
5. Landslide detection
6. Water quality monitoring
7. Natural disaster prevention
8. Industrial monitoring

5.4.3 ADVANTAGES OF A WSN

1. Avoids a lot of wiring
2. Can accommodate new devices at any time
3. Flexible to go through physical partitions
4. It can be accessed through a centralized monitor
5. Infrastructure

5.44 DISADVANTAGES OF WSN

1. Easy for hackers to hack a network
2. Comparatively low speed of communication
3. Gets distracted by various elements
4. Costly at large
5. Life of nodes Energy life

5.5. BLUETOOTH

Bluetooth is a wireless technology used to transfer data between different electronic devices. Bluetooth is a telecommunications industry specification that describes how mobile phones, computers, and personal digital assistants (PDAs) can be easily interconnected using a short-range wireless connection. Using this technology, users of cellular phones, pagers, and personal digital assistants can buy a three-in-one phone that can double as a portable phone at home or in the office, get quickly synchronized with information in a desktop or notebook computer, initiate the sending or receiving of a fax, initiate a print-out, and, in general, have all mobile and fixed computer devices be totally coordinated. The distance of data transmission is small (10-100m) in comparison to other modes of wireless communication. Bluetooth operates between 2.4 and 2.485 GHz in license free globally available radio band. Bluetooth based networks have maximum data transfer rates of up to 1Mbps

Bluetooth Physical System

The Bluetooth system consists of a radio unit, a link control unit and a support unit for link management and host terminal interface functions.

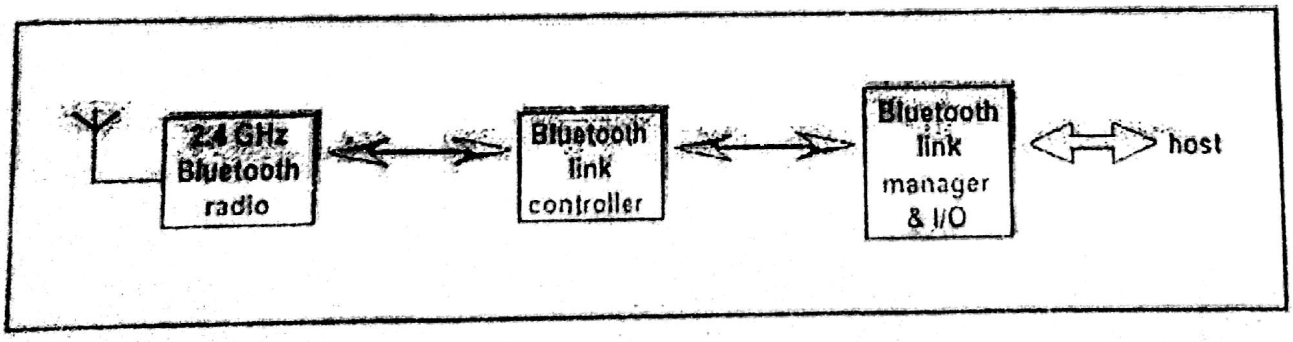


Fig: Block diagram of Bluetooth

Bluetooth protocol is not much encouraged for long duration applications due to power consumption limitations. Hence, for small gadgets which run on battery or limited power source, a new wireless data transfer protocol was needed which should manage working with low power consumption. To fulfil these requirements, a protocol named Zigbee was introduced.

Zigbee is a wireless technology designed for low power consumption batteries allowing batteries to essentially last forever. It makes possible completely networked homes where all devices are able communicate and controlled by a single unit.

Types of Bluetooth Devices:

1. Head Set
2. In-Car Bluetooth System
3. Bluetooth Equipped Printer
4. Bluetooth Equipped Web Cam
5. Bluetooth GPS System
6. Bluetooth Key Board

~~5.5.1. Importance of Bluetooth:~~

- These have replaced cables for transferring Information from one Electronic Device to another one.
- These have decreased Strain like carrying phones while talking, making hands free to do another work.
- This is cheaply available.
- Its Mobility is also very Important as it doesn't need any power outlet or Internet connection or any other items

5.5.2. Disadvantages of Bluetooth:

1. Data sent between two Bluetooth devices is very slow compared with Wi-Fi transfer Rate.
2. Low range.
3. Security is Biggest Disadvantage as transfer takes place through radio waves and a hacker can easily hack it.
4. Battery usage is also a problem, it will make device out of power before it would have if Bluetooth was not powered on.

Distinguish btw bluetooth and zigbee.

Aisl

5.6. ZIGBEE

Bluetooth protocol is not much encouraged for long duration applications due to power consumption limitations. Hence, for small gadgets which run on battery or limited power source, a new wireless data transfer protocol was needed which should manage working with low power consumption. To fulfil these requirements, a protocol named Zigbee was introduced.

Zigbee is a wireless technology designed for low power consumption batteries allowing batteries to essentially last forever. It makes possible completely networked homes where all devices are able communicate and controlled by a single unit.Zigbee is also a Technological Standard Created for Control and Sensor Networks and Operates in Personal Area Networks (PAN's) and device-to-device networks. Operates in unlicensed region of frequency ISM 2.4 GHz Global Band at the data rate of 250kbps, 868 MHz European Band at 20kbps and 915 MHz North American Band at 40kbps.

Zigbee uses Direct Spread Spectrum technique. In Frequency hopping, the carrier signal is made to vary in terms of frequencies while in direct spread spectrum; the original signal is mixed and extracted from a pseudo random code at transmitter and receiver, respectively.inZigbee, data transfer rates are up to 250Kbps.

Benefits of ZigBee

- **Reliable and robust** and uses multi-hop mesh networking to eliminate single points of failure and expand the reach of networks.
- Low-power allowing battery-operated devices such as door and widow sensors to operate for seven years. With the Green Power feature, you don't need any batteries!
- Secure and uses a variety of security mechanisms such as encryption, device and network keys and frame counters.
- Global and is built on 2.4 GHz which is available for unlicensed use anywhere around the world. This means a product developer can sell the same product anywhere on the planet.
- Interoperable and standardizes network and application layers. Everything from joining a network to device operations like on and off are defined so devices from different vendors can work together seamlessly.

ZigBee is widely used in a variety of markets including:

Smart Homes: ZigBee affordably connects the widest range of devices to improve comfort, security and convenience for consumers. It is the technology of choice for world-leading service providers, installers and retailers who deliver home automation, security and energy management applications to the home.

Connected Lighting: ZigBee is used in residential and commercial lighting applications and allows users to gain control over LEDs, light bulbs, fixtures, remote controls and switches. Users can change lighting remotely to reflect ambiance, task or season, all while managing energy use and making their homes greener.

Utility Industry: ZigBee Smart Energy is the world's leading standard for interoperable products that monitor, control, inform, and automate the delivery and use of energy and water. It is deployed in tens of millions of smart meters around the world helps create greener homes by giving consumers the information and automation needed to easily reduce their consumption and save money. If you're interested in Metering applications please see our special section on ZigBee smart Energy. This technology offers Energy companies an easy route to create home wireless networks that can communicate and control other smart appliances in the home such as thermostats.

5.6.1. Characteristics of Zigbee:

- Low cost
- simple implementation
- Reliable data transfer
- Low power consumption
- Short-Range operations
- Low data rate
- Adequate security

5.6.2. Applications of Zigbee:

1. Road map products-tracking
2. Consumer electronics
3. Personal and healthcare
4. Commercial and residential control
5. Home networking
6. Industrial control and management.
7.

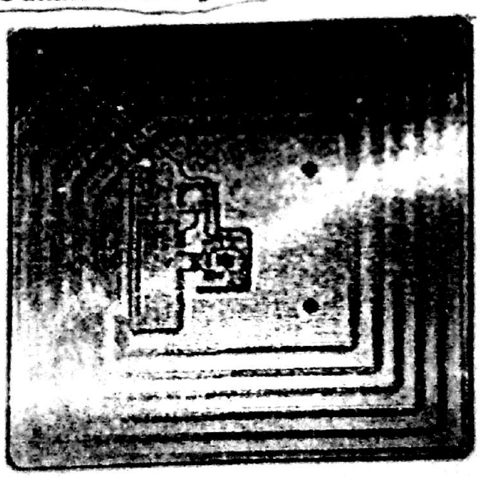
5.7. RFID

RADIO FREQUENCY IDENTIFICATION (RFID): RFID or Radio Frequency Identification (RFID) technology is a wireless technology that allows for automated data collection and a unique identification of objects. RFID systems are composed of RFID tags attached to the objects, readers that can read the tags from a distance, and application software. Every RFID enabled object has its own unique identification number (ID). Tags can be classified into three main groups based on power supply namely, passive, semi-passive and active

5.7.1Basic RFID System:

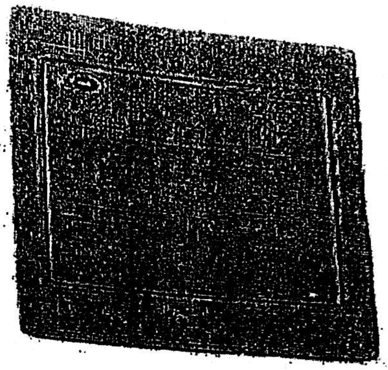
Three Main Components of a RFID Systemare:

1. **RFID tag:** It consists of a silicon microchip attached to a small antenna and mounted on a substrate and encapsulated in different materials like plastic or glass veil and with an adhesive on the back side to be attached to objects.



RFID Tag

2. **Reader:** It consists of a scanner with antennas to transmit and receive signals and is responsible for communication with the tag and receives the information from the tag.



An RFID Reader

3. **Processor or a Controller:** It can be a host computer with a Microprocessor or a microcontroller which receives the reader input and process the data.

- Purpose of Radio frequency Identification and Detection system is to facilitate data transmission through the portable device known as tag that is read with the help of RFID reader; and process it as per the needs of an application. Information transmitted with the help of tag offers location or identification along with other specifics of product tagged – purchase date, color, and price. Typical RFID tag includes microchip with radio antenna, mounted on substrate.

- The RFID tags are configured to respond and receive signals from an RFID transceiver. This allows tags to be read from a distance, unlike other forms of authentication technology. The RFID system has gained wide acceptance in businesses, and is gradually replacing the barcode system.

5.7.2.RFID Working

In a basic RFID system, tags are attached to all items that are to be tracked. The tag chip contains memory which stores the product's Electronic Product Code (EPC) and other variable information so that it can be read and tracked by RFID readers anywhere.

Basic RFID consists of a transponder (tag), a RFID interrogator (reader) with an antenna and data processing unit (host computer). The typical block diagram of RFID system is shown in below Fig.Antenna emits the radio signals to activate tag and to read as well as write information to it. Reader emits the radio waves, ranging from one to 100 inches, on the basis of used radio frequency and power output. While passing through electronic magnetic zone, RFID tag detects activation signals of readers. Powered by its internal battery or by the reader signals, the tag sends radio waves back to the reader. Reader receives these waves and identifies the frequency to generate a unique ID.Reader then decodes data encoded in integrated circuit of tags and transmits it to the computers for use.

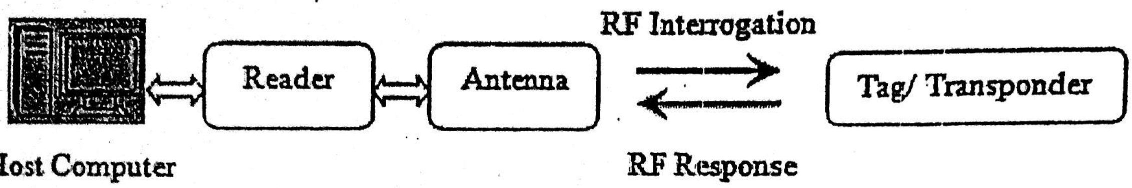


Figure: 5.7.1

An RFID reader is a network connected device (fixed or mobile) with an antenna that sends power as well as data and commands to the tags. The RFID reader acts like an access point for RFID tagged items so that the tags' data can be made available to business applications.

5.7.3. Types of RFID Systems:

RFID systems are divided into two categories based on

(i) The frequency band within which they operate: low frequency, high frequency, and ultra-high frequency

(ii) Battery power: passive, active and semi passive type.

(i). Signal Frequency Band:

If an RFID system operates at a lower frequency, it has a shorter read range and slower data read rate, but increased capabilities for reading near or on metal or liquid surfaces. If a system operates at a higher frequency, it generally has faster data transfer rates and longer read ranges than lower frequency systems, but more sensitivity to radio wave interference caused by liquids and metals in the environment.

a) Low frequency RFID tags:

LF tags typical operating frequency of 125 KHz to 134.2 KHz. This frequency band provides a short read range of 10 cm, and has slower read speed than the higher frequencies, but is not very sensitive to radio wave interference.LF tags used for low cost, suitable for close, low transmission rate, the smaller amount of data applications, such as access control, time and attendance, e-billing, e-wallet, parking fees management. Lower low-frequency tags operating frequency can penetrate water, organic tissue and timber, its appearance can be made into earrings style, collar type, style pills or injectable for cattle, pigs, pigeons and other animals identified.

b) High-frequency RFID tags:

Common operating frequency of the high frequency tag is 13.56MHz. The HF band ranges from 3 to 30 MHz. Most HF RFID systems operate at 13.56 MHz with read ranges between 10 cm to 1 m. HF systems experience moderate sensitivity to interference. HF RFID is commonly used for electronic identification, electronic tickets, payment, and data transfer applications.

c) Ultra High Frequency RFID tags:

The UHF frequency band covers the range from 300 MHz to 3 GHz..

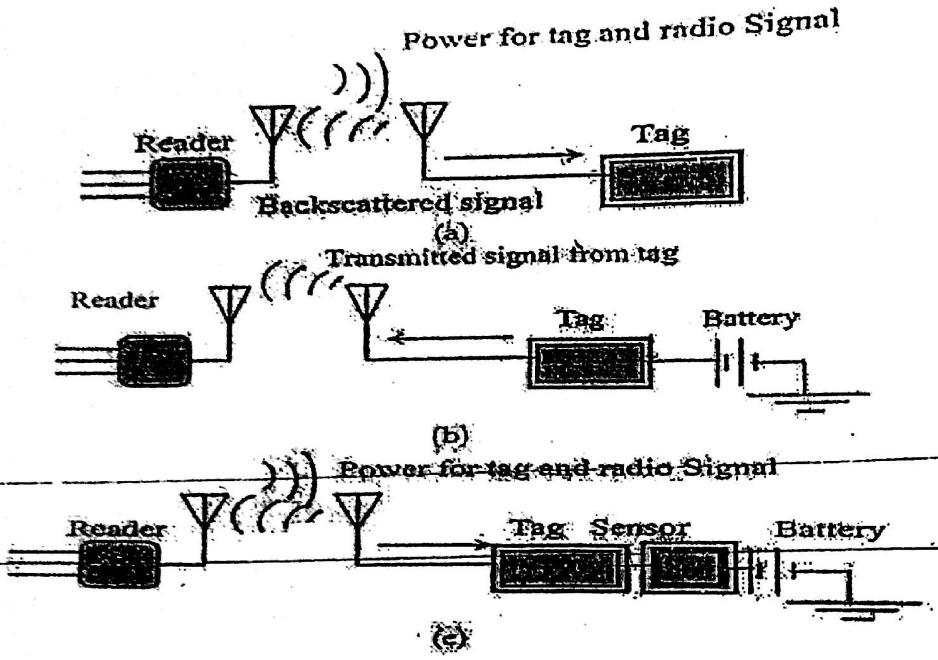
UHF RFID is used in a wide variety of applications, ranging from retail inventory management, to pharmaceutical anti-counterfeiting, to wireless device configuration

(ii). Battery Power:

a) Passive RFID system: These are systems where the tag gets power through the transfer of power from a reader antenna to the tag antenna. They are used for short range transmission.Here we are mostly concerned with the passive RFID system as it is most widely used in regular applications like in retail market organizations. The lower price point per tag makes employing passive RFID systems economical for many industries shown in below figure (a).

b) Active RFID system: These are systems where the tag has its own power source like any external power supply unit or a battery. The only constraint being the life time of the power devices. These systems can be used for larger distances and to track high value goods like vehicles. Active tags provide a much longer read range than passive tags, but they are also much more expensive shown in below figure (b).

c) Semi-passive tags:- These tags, sometimes known as battery-assisted passive tags, shown in below figure have a battery, like active tags, but still use the reader's power to transmit a message back to the RFID reader using a technique known as backscatter. These tags thus have the read reliability of an active tag but the read range of a passive tag. They also have a longer shelf life than a tag that is fully active shown in below figure (c).

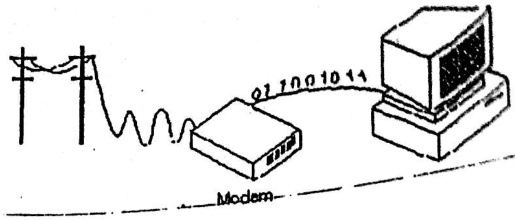


5.7.4.A brief listing of RFID applications that find use on a daily basis is:

- Warehouse Management Systems
- Retail Inventory Management
- Toll Roads
- Automatic Payment Transactions
- High Value Asset Tracking and Management
- Public Transportation
- Automotive Industry
- Livestock Ranching
- Healthcare and Hospitals
- Pharmaceutical Management Systems
- Military
- Marine Terminal Operation
- Manufacturing
- Anti-counterfeit

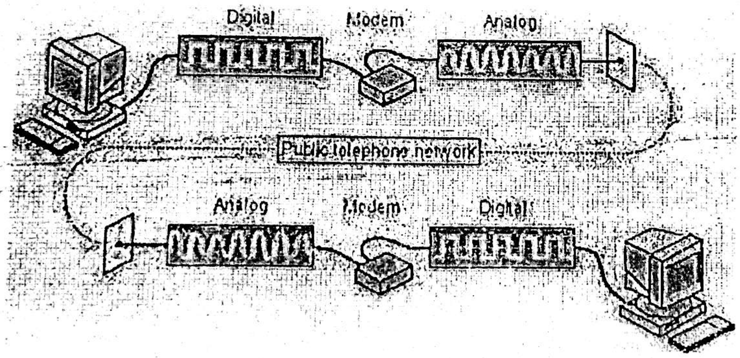
5.8. MODEM

A MO(dulator) DEM(odulator) is a device that translates an Analog signal to digital and back. We use them to take patters of zeros and ones and turn them in to Analog electrical signals so they can be sent along a wire, and then translated back to zeros and ones on the other end.

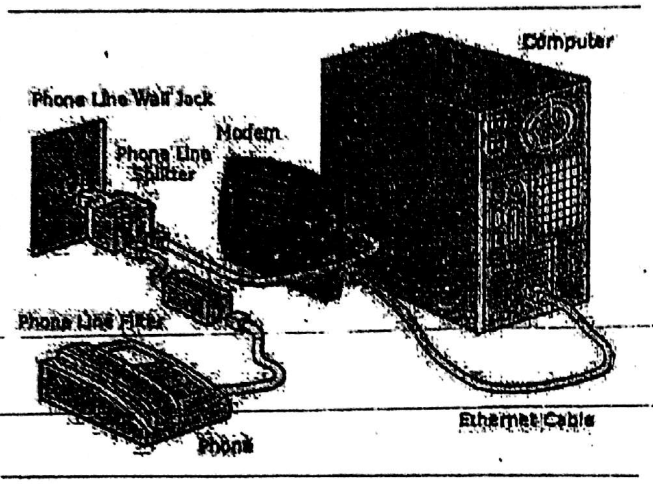


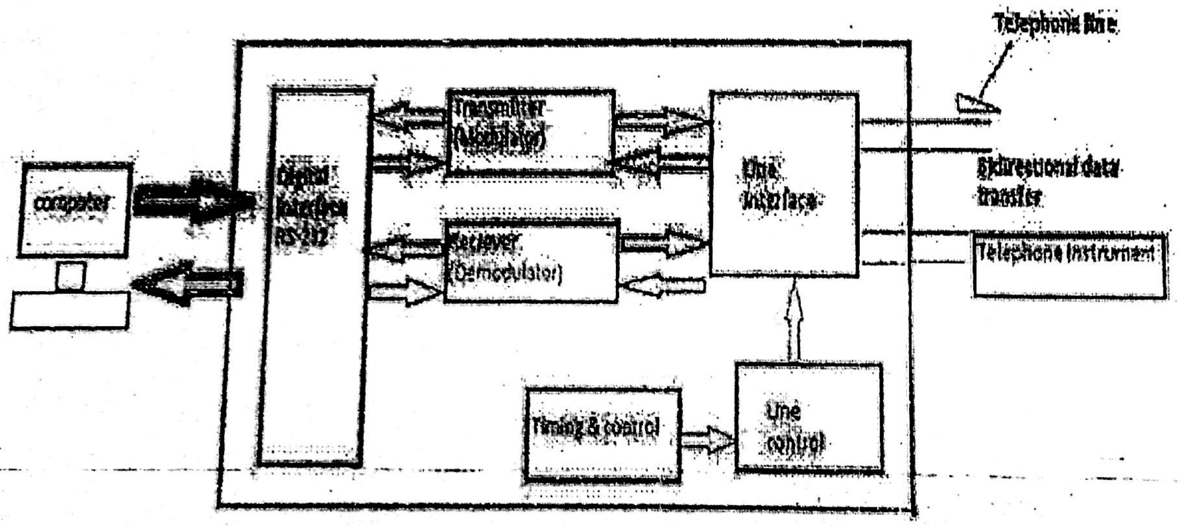
The normal digital signal cannot be put directly on the telephone line. The role of modem is to convert the Analog signal to digital signal and digital signal to Analog signal. A modem contains a modulator as well as a demodulator. Modulator will convert digital signal to Analog signal and Demodulator will convert the Analog signal to digital signal

Modem (Modulator-Demodulator) is a communication device that converts binary signal into Analog signals for transmission over telephone lines and converts these Analog signals back into binary form at the receiving end. Conversion to Analog signal is known as modulation. Conversion back to binary signal is known as demodulation.



At the source, modulation techniques are used to convert digital data (0's and 1's) into Analog form for transmission across the channel. At the destination, the received Analog signal is converted to digital data via demodulation. This is a simplified explanation of how a modem works, and there are other issues that require attention, such as channel impairments, encryption, error detection/correction, data compression, modulation, handshake negotiation, and echo cancellation.





FUNCTIONAL BLOCK OF MODEM