

### **3G Introduction**

- The Third Generation (3G) wireless systems offer services and thereby reduce the distinction between the range of services of wire line and wireless.
- The main reason for the evolution of 3G was due to the limited capacity of the 2G networks.
- 2G networks were built for voice calls and slow data transmission. But these services were unable to satisfy the requirements of present wireless revolution.
- International Telecommunication Union (ITU) has defined the demand for 3G in the International Mobile Telecommunication (IMT)-2000 standards to facilitate growth, increase bandwidth, support diverse applications.

## **Features of 3G**

- It provides cost efficient high quality, wireless multimedia applications and enhanced wireless communications.
- It supports greater voice and data capacity and high data transmission at low cost.
- 3G mobiles can operate on 2G and 3G technologies.
- It offers greater security features than 2G. It supports network access security, network domain security, user domain security, application security.
- It supports video calls and video conferences. It provides support from localized service like accessing traffic and high end services like weather updates. We can listen to music, watch videos online and can download huge files with in less time.

## **Advantages of 3G**

All the functions in a normal 2G mobile devices can be performed in 3G at a higher speed.

It provides faster connectivity, faster internet access and music with improved quality.

## **Applications of 3G**

- 1) The 3G mobile can be used as a modem for computer which can access internet and can download games and songs at high speed.
- 2) It provides high quality voice calls and video calls.
- 3) It provides weather updates, news headlines and TV broadcasting in mobile phone.
- 4) It provides high speed internet facility for many applications. It can provide data transmission speed up to 2Mbits /sec.
- 5) It provides multimedia services such as sharing of digital photos and movies. It provides location based services and real time multi player gaming.
- 6) It supports virtual banking and online selling.
- 7) It supports teleconferencing.

## **Drawbacks**

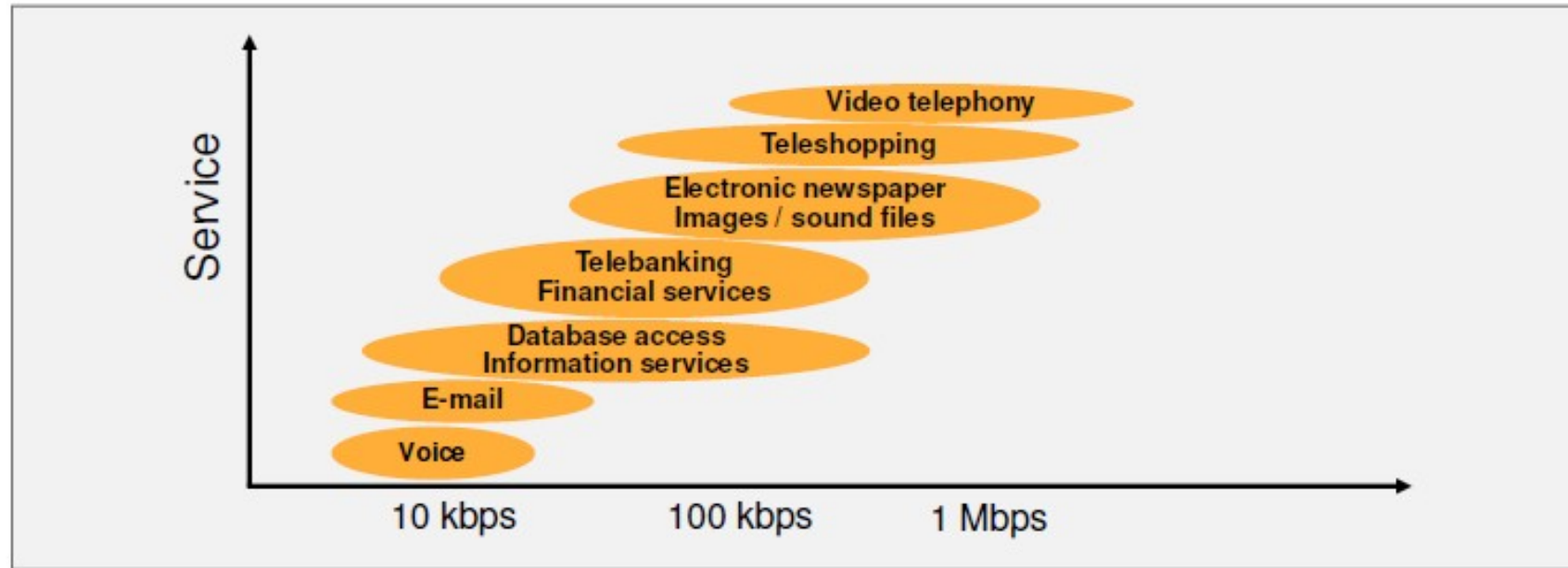
There are few drawbacks:

Upgrading the base station and cellular infrastructure to 3G incurs very high costs.

- 1) Service provider has to pay high amount for 3G licensing and agreements.
- 2) Problem with the availability of handsets and few regions and their costs.
- 3) High power consumption.

# Evolution For 3G Standards

1. HSCSD
2. GPRS
3. EDGE for GSM and IS 136
4. IS 95 B for 2.5G CDMA
5. IMT 2000



## **EDGE for GPRS and IS 136**

- EDGE which stands for Enhanced Data rates for GSM for Global Evolution is more advanced upgrade to the GSM standard and requires additional hardware and software at existing base stations.
- EDGE allows nine air interface formats, known as Multiple Modulation and Coding Schemes with varying degree of error control protection.
- Rapid feedback between the base station and subscriber unit then restores the provision acceptable air interface state.
- This adaptive capability to select the best air interface is called incremental redundancy whereby packets are transmitted first with maximum error protection and maximum data rate throughput and then subsequent packets are transmitted until the link has an unacceptable delay.
- When EDGE uses 8 PSK modulations without any error protection and all 8 timeslots of a radio channel dedicated to single user, a raw peak throughput data rate of 547.2 kbps can be provided.

## IS 95B in CDMA

- The interim data solution of CDMA is called IS-95B.
- IS-95B is already being deployed worldwide, and provides high speed packet and circuit switched data access on a common CDMA radio channel by dedicating multiple orthogonal user channels (Walsh functions) for specific users and specific purposes.
- The CDMA solution, IS-95B supports medium data rate (MDR) service by allowing a dedicated user to command up to 8 different user Walsh codes simultaneously and in parallel for an instantaneous throughput of 115.2 kbps per user ( $8 \times 14.4$  kbps).
- IS-95B also specifies hard hand-off procedures that allow subscriber units to record different radio channels in the network without instructions from the switch so that the subscriber units can rapidly tune to different base stations to maintain link quality.



# IMT 2000

IMT-2000 refers to IMT-2000 (Mining the 3rd Generation (3G) Mobile Telecommunication). It embraces the project of unifying mobile communication systems with the objectives of providing high-speed data transmission and multimedia services on mobile networks.

- Background:** IMT-2000 was the standard that was created by the International Telecommunication Union (ITU) and was meant to be a breakthrough from the capabilities of the 2G system GSM and to be the universal unified standard for mobile communications. It served to create data transfer at a higher rate of speed and supported multimedia services.

- Multiple Standards:** IMT-2000 includes several different guidelines developed by different institutions, each with its unique specifications. Such as CDMA2000, WCDMA (UMTS), and TD-SCDMA. That norm is different for every standard and the process of its implementation.

•**Data Transmission:** The end vision of IMT-2000 was to offer fast data transfer on mobiles. In addition to creating the advancements in data rates necessary to support services ranging from video calling to mobile internet to multimedia streaming, it did a lot of research as well.

•**Interoperability:**

•IMT-2000 ensured interoperability between different carriers and manufacturers.

•Roaming across networks became smoother due to standardized protocols.

•**Evolution:**

- IMT-2000 represented the transition from 2G (second-generation) to 3G (third-generation) mobile systems.
- It marked the era of high-speed data transmission and paved the way for innovations in mobile communication.

**Transition to 4G (LTE) and Beyond:**

- IMT-2000 laid the groundwork for subsequent generations, including 4G (LTE) and 5G.
- LTE (Long-Term Evolution) improved data rates, spectral efficiency, and overall network performance.

## **Features**

IMT-2000 (International Mobile Telecommunications-2000) is a global standard for third generation (3G) wireless communications. It has several aspects that relate to evolution, including:

- Flexibility**

IMT-2000 is designed to be flexible and allow for the evolution of systems and migration of users.

- Open architecture**

IMT-2000 has an open architecture that allows for the easy introduction of new technologies and applications.

- Compatibility**

IMT-2000 is compatible with fixed telecommunications networks and other radio access systems.

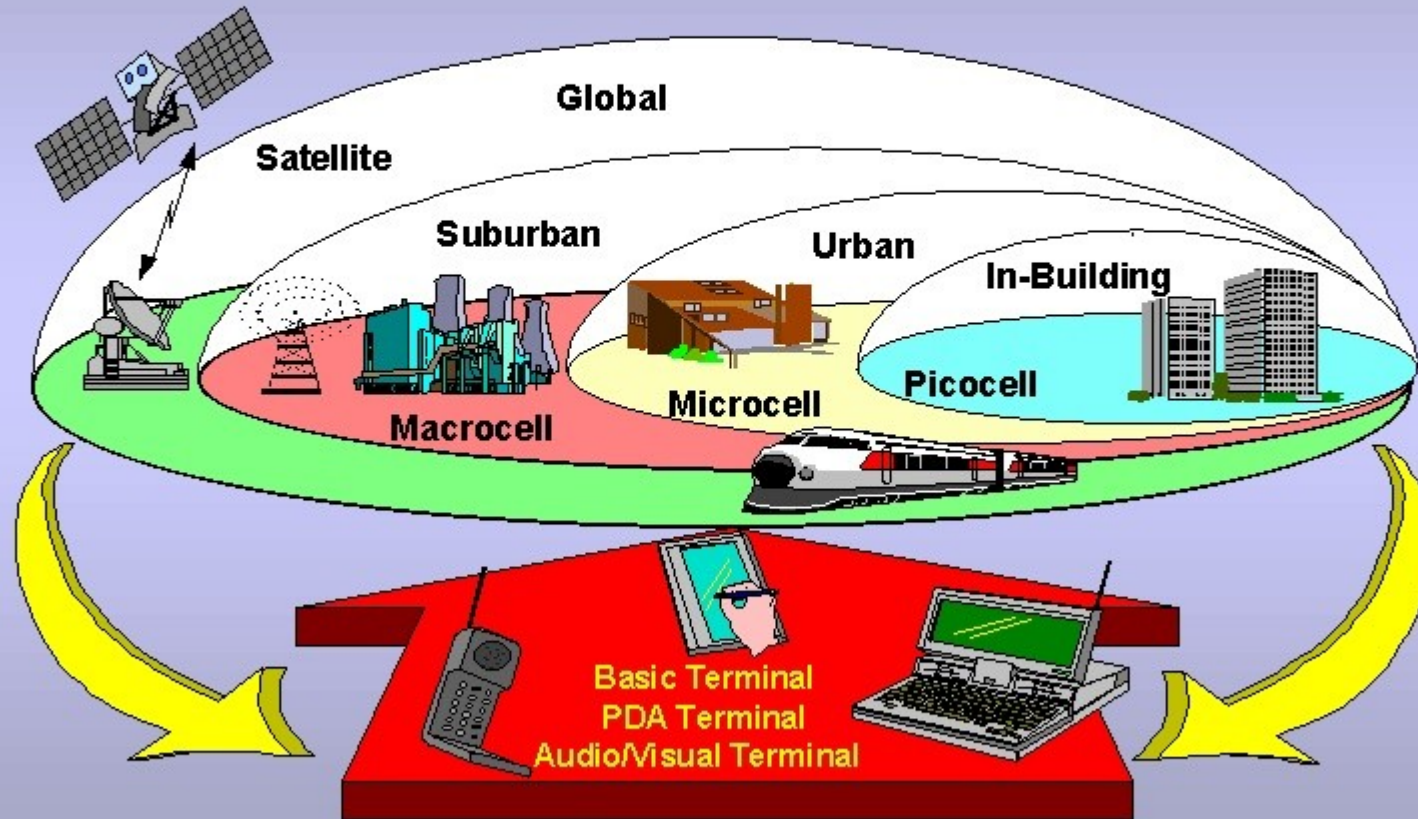
- Interworking**

IMT-2000 can interwork with pre-IMT-2000 systems.

- Modular architecture**

IMT-2000 has a flexible modular architecture that allows for the introduction and evolution of new capabilities.

# *IMT-2000: flexible, multifunctional*



## • Vision of IMT 2000

- Worldwide usage,  
integration of satellite and terrestrial systems to provide global coverage;
- Used for all radio environments,  
(LAN, cordless, cellular, satellite);
- Wide range of telecommunications services,  
(voice, data, multimedia, internet);
- Support both packet-switched (PS) and circuit-switched (CS) data transmission;
- Offer high data rates up to 2 Mbps,
  - 144 kbps for high mobility,
  - 384 kbps with restricted mobility and,
  - 2 Mbps in an indoor office environment;
- Offer high spectrum efficiency;
  - Global roaming.
  - Enhanced Security and Performance.
  - Increased spectrum efficiency.

## Family members

For the terrestrial mobile network, there are six family members identified as being IMT-2000 compatible:

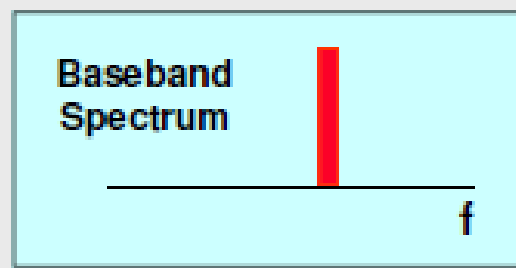
- IMT Direct Spread (IMT-DS; also known as UMTS/UTRA-FDD);
- IMT Multicarrier (IMT-MC; also known as CDMA2000);
- IMT Time Code (IMT-TC; also known as UMTS/UTRA-TDD, “narrowband TDD”);
- IMT Single Carrier (IMT-SC; also known as UWC-136 or EDGE);
- IMT Frequency Time (IMT-FT; also known as DECT (Digital Enhanced Cordless Telecommunications)).
- IMT OFDMA TDD WMAN (also known as mobile WiMAX)

## **Frequency bands**

The frequency bands 1885-2025 MHz and 2110-2200 MHz were identified for IMT-2000 by the ITU in 1992.

Terrestrial IMT-2000 networks will operate in the following bands:

- 1920 - 1980 MHz paired with 2110 - 2170 MHz,
- FDD with mobile stations transmitting in the lower sub-band.
- 1885 - 1920 MHz and 2010 - 2025 MHz.



Base band  
signal

Digital Signal (Bits)



Multiplier

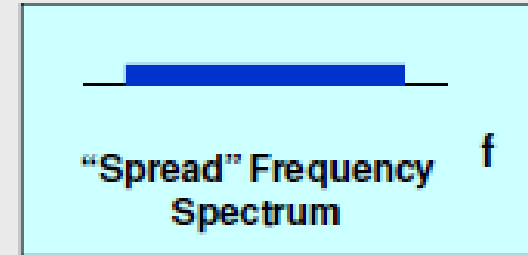
X

RF  
Modulator

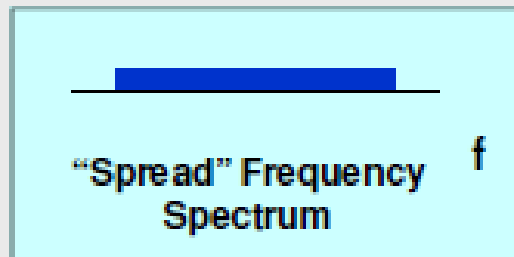


Code  
Generator

Code Bits (Chips)



Transmitter



RF  
Demodulator

Multiplier

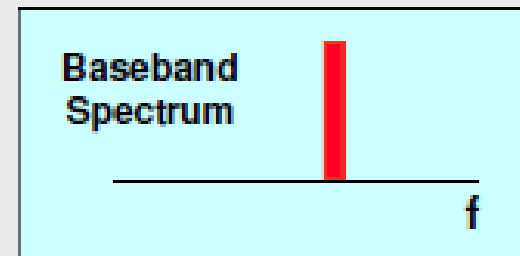
X

LP  
Filter

Despread  
Signal

Code  
Generator

Code Bits (Chips)



Receiver





# WI MAX

## Worldwide Interoperability for Microwave Access (WiMAX)

- The WiMAX Forum is an industry body formed to promote the IEEE 802.16 standard and perform interoperability testing.
- The WiMAX Forum has adopted certain profiles based on the 802.16 standards for interoperability testing and “WiMAX certification”.
- These operate in the 2.5GHz, 3.5GHz and 5.8GHz frequency bands.
- Which is a very effective means of transferring data when carriers of width of 5MHz or greater can be used.

## **WiMax Forum**

- WiMAX Forum is a non-profit corporation that was formed in April 2001 by equipment and component suppliers to help to promote and certify the compatibility and interoperability of Broadband Wireless Access (BWA) equipment.
- As of May 2004, there are over 100 members of WiMAX Forum. WiMAX's members, which include
- Airspan, Alcatel, Alvarion, Fujitsu, Intel, OFDM Forum, Proxim, Siemens, account for over 75 percent of sales in the 2 to 11 GHz BWA market.
- The WiMAX Forum (the Forum) is a coalition of wireless and computer industry companies that has endorsed and is aggressively marketing the WiMAX standard. A principal purpose of the organization is to promote and certify compatibility and interoperability of devices based on the various 802.16 specifications and to develop such devices for the global marketplace.

## **Advantages of WiMAX**

- Wide Coverage Area:** WiMAX can cover an area of up to 50 kilometers, making it suitable for providing broadband access in rural and underserved areas.
- High Data Rates:** WiMAX can provide data rates of up to 75 Mbps, which is higher than many other wireless technologies.
- Scalability:** WiMAX can be easily scaled to support a large number of users and devices.
- Interoperability:** WiMAX is based on an international standard, which allows for interoperability between different vendors' equipment.
- Cost-effective:** WiMAX is a cost-effective solution for providing broadband access in areas where it is not economically feasible to deploy wired infrastructure.

## **Disadvantages of WiMAX**

- Limited Mobility:** WiMAX is designed for fixed or nomadic (semi-fixed) use, less for mobile use.
- Interference:** WiMAX operates in the same frequency range as other wireless technologies, which can lead to interference.
- Security Concerns:** WiMAX uses a shared spectrum, which can make it vulnerable to security threats such as eavesdropping and jamming.
- Limited device availability:** WiMAX devices are not as widely available as devices for other wireless technologies, such as WiFi.
- Limited penetration:** WiMAX signals may have trouble penetrating through walls, buildings and other obstacles.

## **Applications of WiMax**

- Broadband Internet Access:** WiMAX is used to provide high-speed internet access in rural and underserved areas where traditional wired broadband is not available.
- Wireless Backhaul:** WiMAX is used to provide a wireless link between a cellular base station and the core network, eliminating the need for a wired connection.
- Mobile Broadband:** WiMAX is used to provide mobile broadband services, allowing users to access high-speed internet on the go.
- Public Safety:** WiMAX is used to provide wireless connectivity for public safety networks, allowing emergency responders to communicate and share information in real-time.
- Smart Grid:** WiMAX is used to provide wireless connectivity for smart grid systems, allowing utilities to remotely monitor and control the power grid.
- Telemedicine:** WiMAX is used to provide wireless connectivity for telemedicine systems, allowing healthcare professionals to remotely diagnose and treat patients.
- VoIP (Voice over Internet Protocol) :** WiMAX is also used to provide a wireless link for Voice over IP (VoIP) phone services, allowing users to make phone calls over the internet.
- Video Surveillance:** WiMAX is used to provide wireless connectivity for video surveillance systems, allowing security personnel to monitor and record video footage remotely.

### 802.16-2004

Fixed Applications  
10-66GHz Single Carrier,  
LOS, Licensed  
2-11GHz OFDM, Non-  
LOS, Licensed &  
Unlicensed

WiMAX  
Profiles &  
Certification  
Testing  
OFDM  
3.5 GHz  
5.8 GHz

Fixed WiMAX/802.16-2004-Compliant  
Deployments for  
Broadband Wireless  
Fixed and/or Nomadic Services

### 802.16e

Fixed & Mobile Applications  
< 6 GHz SOFDMA,  
Non-LOS, Licensed

WiMAX  
Profiles &  
Certification  
Testing  
2.3 GHz  
2.5 GHz  
3.5 GHz

Mobile WiMAX/802.16e-Compliant  
Deployments for  
Mobile Services

Release-1  
Profiles

Other Mobile WiMAX Profiles:  
Frequency bands, Channel BWs,  
FDD, etc. (based on markets and  
opportunities)

2004

2005

2006

2007

2008/9

**Phase I (2004 - 2005): *Fixed Location, Private Line Services, Hot Spot Back-Haul.***

Using the initial 802.16 standard as its cornerstone, Phase I of WiMAX deployment has already begun with the provision of traditional dedicated-line services to carriers and enterprises. Companies such as Towerstream Wireless are offering wireless Internet access to more than 600 customers in six major markets, including New York, Boston and Chicago.<sup>14</sup> Phase I also will include such operations as aggregating public Wi-Fi hot spots to a central, high-capacity internet connection.

**Phase II (2005 - 2006): *Broadband Wireless Access/Wireless DSL.***

Phase II of the rollout will entail the first mass-market application of WiMAX technology. With the backing of computer industry heavyweights such as Intel Corporation and Dell, this phase will involve the delivery of low-cost, user installable premises equipment that will not have to be pointed at a base station. In conjunction with the equipment rollout, the Forum anticipates that the number of wireless internet service providers (WISPs) utilizing WiMAX compatible technology will increase exponentially.



**Phase III (2007): *Mobile/Nomadic Users.***

Phase III of the rollout will focus on the development of a mobile-broadband market. In this final phase, laptops and other mobile computing devices will be fully integrated with WiMAX chips and antennas, allowing mobile workers to send and receive high-bandwidth files such as schematics, videos, and multimedia presentations in real time over a wireless broadband connection. The WiMAX Forum anticipates that the technology will be deployed for the offering of other products and services, as well.

**1) A WiMAX Base Station:** Base station consists of indoor electronics and a WiMAX tower. Typically, a base station can cover up to 10 km radius (Theoretically, a base station can cover up to 50 kilo meter radius or 30 miles, however practical considerations limit it to about 10 km or 6 miles). Any wireless node within the coverage area would be able to access the Internet.

**2) A WiMAX receiver** - The receiver and antenna could be a stand-alone box or a PC card that sits in your laptop or computer. Access to WiMAX base station is similar to accessing a Wireless Access Point in a WiFi network, but the coverage is more.

## Difference between WiFi and WiMax

S. No.\	Parameters	WiFi	WiMax
1.	Defined	<u>WiFi</u> is defined under IEEE 802.11x standards where x stands for various WiFi versions.	<u>WiMAX</u> is defined under IEEE 802.16y standards where y stands for various WiMAX versions.
2.	Type of Network	WiFi is for LAN (Local Area Network) applications.	WiMAX is for <u>MAN</u> (Metropolitan Area Network) applications.
3.	Guarantee	WiFi does not guarantee any Quality of Service ( <u>QoS</u> ).	WiMAX guarantees Quality of Service (QoS).
4.	Distance	The WiFi network range is around 100 meters.	WiMAX network can reach about 50-90 km.
5.	Connection oriented	WiFi uses the conflict-based <u>CSMA/CA</u> protocol which is not connection-oriented.	WiMAX networks operate on a connection-oriented <u>MAC</u> .
6.	Range	WiFi is short-range technology.	WiMAX is long-range technology.

<b>S. No.</b>	<b>Parameters</b>	<b>WiFi</b>	<b>WiMax</b>
7.	Transmit	WiFi connection can transmit up to 54 Mbps.	WiMAX connection can transmit up to 75 Mbps.
8.	Signal	WiFi access points transmit signals to the receiving device.	A signal will be sent from the WiMAX base station or tower station to the WiMAX receiver.
9.	Cost	It is inexpensive compared to WiMAX technology.	It is expensive because of high installation cost.
10.	Usage	WiFi is utilized for domestic use and short-distance connections.	WiMAX supports a broader interoperable network.

## **MIMO (Multiple-Input Multiple-Output)**

- MIMO stands for Multiple-Input Multiple-Output.
- It is a wireless communication technology that utilizes multiple antennas at both the transmitting and receiving ends to improve the performance and capacity of wireless networks.

### **MIMO Working**

In a MIMO system, multiple independent data streams are transmitted simultaneously over the same frequency channel using multiple antennas.

At the receiver end, the signals from the multiple antennas are combined and processed to extract the original data streams.

This process is known as spatial multiplexing.

## types of MIMO Systems

- Single-User MIMO (SU-MIMO):** In SU-MIMO, the multiple antennas are used to create a dedicated high-throughput link between a single transmitter and a single receiver.
- Multi-User MIMO (MU-MIMO):** MU-MIMO allows a single base station or access point to communicate with multiple users simultaneously, improving overall network capacity and efficiency.

## **Benefits of MIMO Technology**

One of the key benefits of MIMO is its ability to mitigate fading and interference in wireless channels.

**Increased Data Throughput:** By transmitting multiple data streams simultaneously, MIMO can significantly increase the overall data throughput and spectral efficiency of a wireless system.

•**Improved Signal Quality:** MIMO leverages multipath propagation to enhance signal quality, reducing the effects of fading and interference.

•**Extended Range:** The spatial diversity provided by MIMO helps to extend the range of wireless communications by improving the signal-to-noise ratio (SNR) at the receiver.

•**Enhanced Reliability:** The redundancy introduced by multiple signal paths in MIMO systems improves the overall reliability and robustness of wireless connections.

•**Increased Capacity:** MU-MIMO enables efficient spectrum utilization, allowing multiple users to share the same frequency channel, thereby increasing the overall network capacity.

## **MIMO in Modern Wireless Standards**

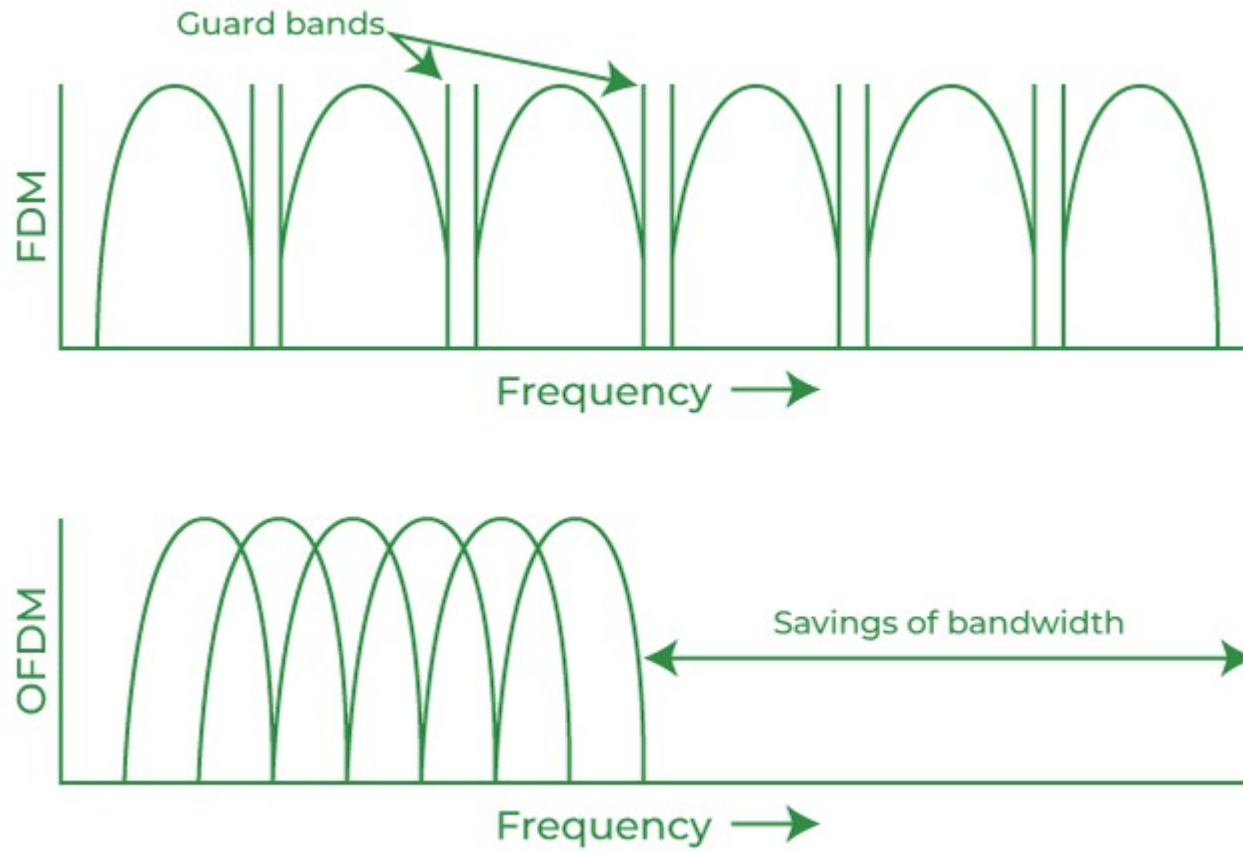
MIMO technology has been widely adopted in various wireless communication standards such as Wi-Fi (802.11n/ac/ax), 4G LTE Advanced, and 5G NR (New Radio).

**Wi-Fi:** MIMO is widely used in Wi-Fi standards, such as 802.11n, 802.11ac, and 802.11ax (Wi-Fi 6), to achieve higher data rates and improved coverage.

- LTE and LTE-Advanced:** MIMO is a key enabler for higher data rates and increased spectral efficiency in LTE and LTE-Advanced cellular networks.

- 5G NR:** 5G New Radio (NR) heavily relies on advanced MIMO techniques, including Massive MIMO and beamforming, to deliver ultra-high data rates, low latency, and improved network capacity.

## OFDM



**Delay Problem**  
**ISI Error**  
**Frequency waste**  
**Poor Efficiency**



<b>S.N O</b>	<b>FDM</b>	<b>OFDM</b>
<b>1.</b>	<b>FDM stands for Frequency Division Multiplexing.</b>	<b>OFDM stands for Orthogonal Frequency Division Multiplexing.</b>
<b>2.</b>	<b>In FDM, Guard band is required.</b>	<b>While in OFDM, Guard band is not compulsory.</b>
<b>3.</b>	<b>The spectral efficiency of FDM is low.</b>	<b>While the spectral efficiency of OFDM is high.</b>
<b>4.</b>	<b>The effect of interference in FDM is face down.</b>	<b>The effect of interference in OFDM is trivial.</b>
<b>5.</b>	<b>There is no relationship exist between the carriers in FDM.</b>	<b>There is exist the relationship between the carriers in OFDM.</b>
<b>6.</b>	<b>FDM supports low data rate.</b>	<b>While OFDM gives higher data rate.</b>
<b>7.</b>	<b>Applications of FDM are in radio and satellite communication.</b>	<b>Applications of OFDM are in LTE technologies and broadband internet.</b>

## UNIT 5

### ***“Mobile Data Services & Short Range Network”***

- 1. Mobile Messaging & Types**
- 2. The Wireless Web**
- 3. Wireless Application Protocol**
- 4. Web (Site) Design**
- 5. Short-range Wireless Network/ Communication Technology**
- 6. Wireless LAN Architecture:**
- 7. Cordless Telephony**
- 8. Irda (Infrared Data Association)**
- 9. Bluetooth – Smart Phones**
- 10. Future Phones**
- 11. Mobile Operating System (OS)**

## **Mobile messaging & Types**

Mobile messaging has revolutionized how people communicate with each other and businesses.

### **1. Short message service (SMS)**

SMS is one of the most common forms of mobile messaging. SMS, a short message service, is a standard text message sent using a cellular signal.

SMS is limited to 160 characters per message and is strictly text-based.

### **2. Multimedia messaging service**

multimedia messaging service, is sent over a cellular signal like SMS, but it has key differences. In particular, Multimedia messaging is a text message accompanied by a media file, like a photo, video, or link.

Multimedia messaging allows users to send messages with more than 160 characters and can be more engaging than a text-only message.

### **3. Instant messaging (via the internet)**

Unlike SMS and MMS, instant messaging uses the internet to send and receive messages. Examples of instant messaging applications are WhatsApp, Facebook Messenger, KakaoTalk, Kik, and Line.

#### **4. Push notifications**

Push notifications are clickable pop-up messages from an application. Often, a user must enable them before apps can send them. Once enabled, companies can send essential announcements to users. It's important to note that push notifications don't appear in the app but are sent to the home or lock screen of a mobile phone.

#### **5. In-app messages**

In-app messages, as the name suggests, are messages users only receive when actively using a mobile application. These messages help keep users engaged, feel rewarded, or push them to convert. For example, when users enter the app, companies can share a welcome message to alert them about new deals or things happening with the brand.

#### **6. Rich Communication Services (RCS)**

RCS is a messaging as a platform technology developed by Google. It is considered an alternative to traditional text messaging. The idea is that with RCS technology, consumers can get an app-like messaging experience through their phone's native messaging system.

## The Wireless Web

The wireless web represents the combination of two innovative technologies— wireless communications and the Internet.

The wireless web (a Broadband service) works by transmitting Internet data via RF, or Radio Frequency.

### Wireless brings three new dimensions to the web:

- 1)localization:** (the ability to geographically locate wireless devices using the global positioning system (GPS)) - users can enter their street location on a PDA and receive information about nearby shops, restaurants, or clubs, sorted by distance and with walking directions)
- 2)personalization:** (wireless network providers already track user identity for billing purposes),
- 3)immediacy:** (Wireless has ability to immediately deliver or push information (like e-mail header alerts, full-text e-mail, paging, and file downloads to users) when they need.

Some **advantages of wireless networks** include:

- **Mobility-** Stay connected while moving around, and access documents, apps etc.
- **Flexibility-**Wireless networks support a wide range of devices.
- **Ease of installation at low cost**
- **Scalability-**Wireless networks are easy to scale.
- **WLANs** enables computing to happen anywhere, even when carrying high data loads and advanced web...

### **Wireless Application Opportunities**

Wireless opens up opportunities for business-to-consumer (B2C), business-to-business (B2B), and business-to-employee (B2E) enterprise integration.

**1.Business-to-consumer (B2C) interaction.** Companies reach out directly to consumers.

**2.Business-to-business (B2B) commerce.** It opens connections to suppliers and partners (movement and management of physical goods). Wireless has been used for supply chain management (SCM) and enterprise resource planning (ERP).

**3.Business-to-employee (B2E) interaction.** It introduced efficiencies into an organization by making corporate data available to mobile workers. Mobile professionals can access e-mail attachments and documents from cell phones, pagers, PDAs, and notebook PCs.

**4. Restaurants:** Locating nearby restaurants is a natural fit for wireless' ability to provide localized services.

**5. Food Delivery:** Home food delivery is growing as an Internet-based service and is moving to wireless.

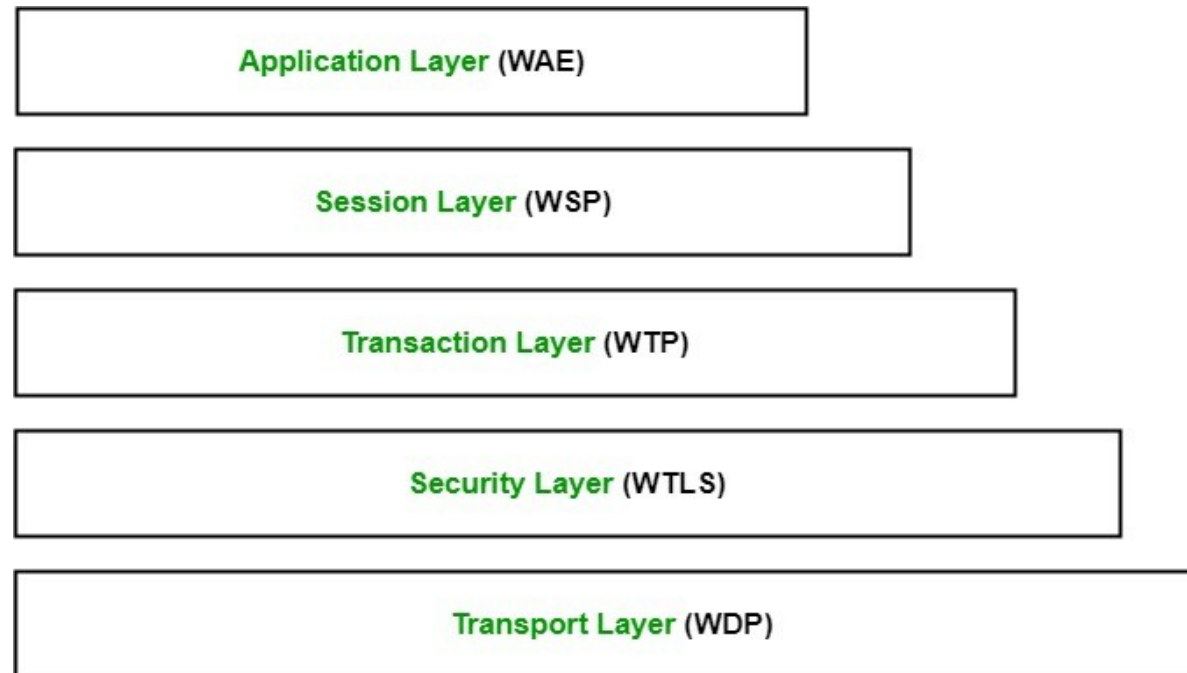
## Wireless Application Protocol

The Wireless Application Protocol (WAP) is a set of communication protocols and an application programming model based on the World Wide Web (WWW).

Its hierarchical structure is quite similar to the TCP/IP protocol stack design.

### **What is Wireless Application Protocol (WAP)?**

Wireless Application Protocol (WAP) is a specification for a set of communication protocols to standardize the way wireless devices, such as mobile phones and radio transceivers, can be used for internet access, including email, the web, newsgroups and instant messaging.



### **1.Application Layer:**

- This layer contains the Wireless Application Environment (WAE).
- It contains mobile device specifications and content development programming languages like WML.
- It is intended for the development and execution of portable application and services WAE consists of two different user agents located on client side.

### **2.Session Layer:** This layer contains Wireless Session Protocol (WSP).

- It provides fast connection suspension and reconnection. Contains the following components –
- **Connection Oriented Session Services**
- **Connectionless Session Services**
- **Session services** – These functionalities help to set up a connection between a client and server using primitive messages.

### **3.Transaction Layer:**

- This layer contains Wireless Transaction Protocol (WTP).
- It runs on top of UDP (User Datagram Protocol) and is a part of TCP/IP and offers transaction support for requests & responses to servers.

### **4.Security Layer:**

- This layer contains Wireless Transport Layer Security (WTLS).
- It is based on **SSL (Secure Socket Layer)**. It provides services that ensure privacy, server authentication, client authentication and data integrity.

### **5.Transport Layer:**

- This layer contains Wireless Datagram Protocol.
- It presents consistent data format to higher layers of WAP protocol stack.
- It manages privacy, authentication and data integrity through public key cryptography.



### **Advantages of Wireless Application Protocol**

- Rapidly evolving technology. Made broad internet access possible with mobile device.
- Improved access speeds through data compression and helped reduce the number of timeouts and connection failures.
- Totally free of cost.
- Can be used over multiple platforms.
- Neither it nor network standards are affected.
- Higher controlling possibilities are offered.
- It follows a model that is similar to the Internet.
- You can send and receive real-time data with WAP.
- WAP is supported by the majority of current mobile phones and devices.

### **Disadvantages of Wireless Application Protocol**

- Slow connection speed is slow and less number of connections
- WAP provides a small User interface (UI).
- Mobile browsers lacked the capabilities of modern browsers.

## **WEB (SITE) DESIGN**

**Web design** encompasses many different skills and disciplines in the production and maintenance of websites.

### **THE IMPORTANT ELEMENTS TO BE REMEMBERED BEFORE A WEBSITE DESIGN**

- 1 Navigation-**
- 2 Visual Design**
- 3 Content**
- 4 Web Friendly**
- 5 Interaction**
- 6 Information Accessibility**
- 7 Intuitiveness**
- 8 Branding**
- 9 Turnaround Time**
- 10 Conversion**

## **How to design a website — step-by-step tutorial**

Your website serves as the online representation of your business. A thoughtful, user-friendly website engages your audience and guides them towards your desired goal. Here are the steps for designing a website:

### **1. Define your website's purpose**

Let's look at the purpose of a few different kinds of websites:

- **Online stores,**
- **Portfolio sites**
- **Business websites**
- **Event pages**
- **Blogs**

### **2. Choose a platform**

.When selecting a platform to build your site here are a few features you should look for:

- **Quick site creation**
- **Responsive web design.**
- **Project workflows**
- **Content insights.**
- **Pricing options.**
- **Versatility**

**3.Pick a layout**

**4.Create and gather content**

**5.Design the website elements**

- **Site architecture**
- **Navigation menu.**
- **Colors**
- **Fonts.**
- **Header and footer.**
- **Motion.**

**6.Add pages**

- **Homepage.**
- **About.**
- **Contact.**
- **Product page.**
- **Blog**
- **FAQ**

**7.Optimize the experience**

**8.Test your website**

## **Short-range wireless network/ communication technology**

### **1.Wi-Fi technology**

- IEEE 802.11.
- Over higher range.
- High data speed 54 Mb/s.
- WPA secure access.
- Large video, audio, graphic, picture.
- Point to Multipoint Communication.
- Connected to Network.
- In theory, with [WiFi technology](#), the user is located in a certain area around the access point, but if blocked by a wall, the effective transmission distance inside the building will be less than outdoors.

### **2.Bluetooth technology**

- IEEE 802.15.1.
- PIN Mode encryption.
- This is an open global specification for wireless data and voice communications.
- The Bluetooth module transmission band is the world-wide 2.4GHz ISM band.
- It provides a transmission rate of 1-3 Mbps and a transmission distance of 10m.
- Low power consumption.
- Point to Multipoint Communication.
- Mobile devices.
- Video, audio, graphic, picture.

### **3.ZigBee technology**

- IEEE 802.15.4.
- Very Low Power Consumption.
- 10-100 mtr range of operation.
- Low data Rate 250 kb/ps.
- AES Encryption method.
- Small Data Packets.
- Point to Multipoint Communication.
- Sensor Network.

### **4. IrDA technology**

- IEEE 1073.3.3-2004
- Uses Infrared light for communication.
- Low error
- Point to Point Communications
- Upto 4 mbps data speed.
- IrDA technology is a technology that uses infrared rays for point-to-point communication and is the first technology to realize wireless personal area networks (PAN).
- At present, its software and hardware technology are very mature, supporting IrDA on small mobile devices such as mobile phones, laptops, printers and other products.

**Advantages:** No need to apply for use rights, low-cost infrared communication, small size, low power consumption, convenient connection, simple and easy to use required for mobile communications, small infrared radiation angle, and high transmission security.

## **5.NFC- Near Field Communications**

- Short-range wireless communication technology standards such as RFID (contactless radio frequency identification) promoted by Philips, Nokia and Sony.
- Data rate Max ~424 kbps.
- Two way communication is possible.
- Unlike RFID, NFC uses two-way identification and connection.
- The operation is within the frequency range of 13.56MHz and the distance is 20cm.
- NFC was originally just a combination of remote control identification and network technology, but now it has gradually developed into a wireless connection technology.

## **6.Radio frequency identification**

- IEEE 1451.7-2010.
- Provide a service over a range of 30 mtr.
- Data rate varies according to frequency.
- One way communications.
- Radio Frequency Identification (RFID) is mainly used to identify, locate, track and manage inventory.
- A nearby reader sends a high-power RF signal to power the passive tag and then reads the data stored in the tag's memory.
- RFID tags are flat, cheap, small and can be attached to anything that needs to be identified or monitored. RFID adopts the ISM frequency of 13.56 MHz, but other frequencies are also used, including 125 kHz, 134.5 kHz, and frequencies in the 902-928-MHz range.

### **IrDA (Infrared Data Association) - definition**

- It is a standard for transmitting data using an infrared port, from one IR device to another.
- Transfer speeds are roughly the same as traditional parallel ports.
- It uses a beam of infrared light to transmit information and so requires direct line of sight and operates only at close range.
- IRDA defines the protocol standard for short range exchange of data over infra-red, for applications like that of PAN
- One can connect to internet from laptop via mobile using IrDA (PC link software is used)
- IR was superseded by Bluetooth, which has the advantage of operating at longer distances (around 30 feet) and being omnidirectional.
- Many home devices such as TVs and DVD players still use IR remote controls.
- IrDA devices require no FCC (Federal Communications Commission) certification, and you can use them on board airlines during flight.



<b>IrDA</b>	<b>Bluetooth</b>
Infrared light as communication media.	Radio frequency of 2.4 GHz is used as communication.
It has max data rates is 4Mb per second.	It has max data rates is 1-3Mb per second.
Infrared only works between two devices at a time.	Bluetooth can work with as many as mobile device.
The open loop control system is more sensitive to noise.	The close loop control system is less sensitive to noise.
Its communication range is up to at least 1m.	Its communication range up to 100m.
IrDA has strong security.	Bluetooth has less security.
It has point to point connection with narrow angle of 30 degree.	It has multipoint connection with Omni-directional.
IrDA is useful in LAN (Local Area Network) technology.	Bluetooth is useful in personal area network .
Communication is blocked by obstacles that block light as infrared light is used in line of sight.	Communication is not blocked by obstacles that block light as radio waves are used.
It has poor accuracy.	It has better accuracy.

### **Applications of IRDA:**

- a. Wireless Data Transfer:** IRDA enables the wireless transfer of data between devices, allowing users to exchange files, documents, and multimedia seamlessly.
- b. Remote Control Systems:** IRDA is widely used in remote control systems, such as TV remotes, air conditioning remotes, and home automation devices.
- c. Printing and Scanning:** IRDA is utilized in wireless printing and scanning applications.
- d. Mobile Payments:** Some smartphones and devices equipped with IRDA can perform mobile payments by securely exchanging transaction data with point-of-sale (POS) terminals.
- e. Healthcare and Wearable:** In the healthcare industry, IRDA is used for communication between medical devices, such as blood glucose meters and insulin pumps.

## **Understanding Bluetooth Technology**

Bluetooth technology allows devices to communicate with each other without cables or wires.

Bluetooth relies on short-range radio frequency, and any device that incorporates the technology can communicate as long as it is within the required distance.

### **What are some security concerns?**

- Depending upon how it is configured, Bluetooth technology can be fairly secure.
- You can take advantage of its use of key authentication and encryption or just personal identification numbers (PINs)
- On discovery of Bluetooth device, unsolicited message/ accessing or corrupting your data ("bluesnarfing") can be possible.
- Also, viruses or other malicious code can take advantage of Bluetooth technology to infect other devices. Results- data may be corrupted, compromised, stolen, or lost.

### **How can you protect yourself?**

- Disable Bluetooth when you are not using it.
- Use Bluetooth in "hidden" mode. When Bluetooth is enabled, make sure it is "hidden," not "discoverable."
- Be careful where you use Bluetooth. Be aware of your environment when pairing devices
- Evaluate your security settings. Examine your settings, particularly the security settings, and select options that meet your needs without putting you at increased risk.
- Take advantage of security options like authentication and encryption offered by your Bluetooth.

## Architecture of Bluetooth

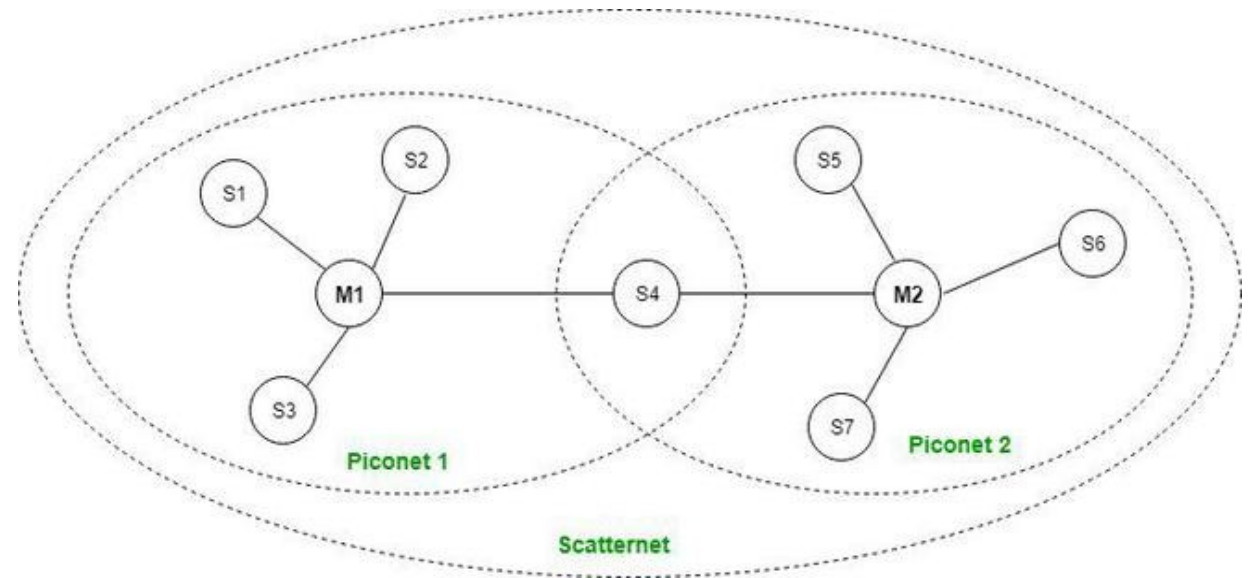
The architecture of Bluetooth defines two types of networks:

### Piconet

- Piconet is a type of Bluetooth network that contains one primary node called the master node and seven active secondary nodes called slave nodes.
- Thus, we can say that there is a total of 8 active nodes which are present at a distance of 10 meters.
- The communication between the primary and secondary nodes can be one-to-one or one-to-many.
- Possible communication is only between the master and slave; Slave-slave communication is not possible.

### Scatternet

- It is formed by using various piconets.
- A slave that is present in one piconet can act as master or we can say primary in another piconet.
- This kind of node can receive a message from a master in one piconet and deliver the message to its slave in the other piconet where it is acting as a master.



### **Advantages**

- It is a low-cost and easy-to-use device.
- It can also penetrate through walls.
- It creates an Ad-hoc connection immediately without any wires.
- It is used for voice and data transfer.

### **Disadvantages**

- It can be hacked and hence, less secure.
- It has a slow data transfer rate of 3 Mbps.

Bluetooth communication does not support routing

## **FUTURE PHONES**

### **New Features Likely to come up in near future smartphones**

#### **1. Photonic Crystal Displays**

Research and development is now pointing to photonic crystals, adapt too well to varying light conditions.

Instead of giving off bright light like LCD or OLED displays, a photonic crystal display features nanostructures that adapt and modify themselves according to the amount of ambient light in a given environment.

#### **2. Nano-Tech Batteries**

In 2015, a Israeli tech company Store Dot revealed a customized Samsung Galaxy S5 with a nano-technology-utilizing battery that could charge from 0 to 100 percent in less than a minute.

#### **3. Liquid Buttons**

Tactus Technology had developed a keyboard that uses special micro fluidics technology which drives small amounts of liquid into invisible pockets that rest over the typing pad on a smartphone.

When the user brings up the touchscreen keyboard, the pockets instantly fill with liquid which has the effect of physically raising the buttons.

#### **4. Headphone Surround Sound**

With a 7.1 mobile audio solution for smartphones that promises to faithfully recreate the sound of specific listening environments using even the simplest pair of headphones.

#### **5. Biometric Authentication**

Qualcomm has developed a new type of ultrasonic fingerprint scanner using a piezoelectric layer that creates ultrasound. In addition to mapping your finger, the scanner features greatly increased resolution, which is also an enhanced security benefit.

#### **6. Virtual Reality**

The new 4K displays that will be rolled out on new smartphones, are ideal for VR applications. Once inserted into a head-mounted device, the phone itself will act as the VR headset's display and 4K resolution will be instrumental in providing an immersive, non-pixelated experience.

## **7. Graphene**

Since its development for practical application in 2004, graphene has been praised as “wonder material”. It’s thin, lightweight, flexible, transparent and over 200 times stronger than steel. It’s also one of the best materials for conducting electricity, which makes it ideal for use in electronic devices.

## **8. No SIM Cards**

Apple and Samsung are making strides to rid the world of the physical presence of SIM cards by replacing them with an electronic version.

By having a programmable SIM integrated into your phone, you’ll essentially be able to switch between networks without having to request a new SIM card. It will be quite handy for anyone travelling or living abroad who wants to get set up with a local number.

## **9. Pressure-Sensitive Screens**

The Force Touch on the Apple Watch has demonstrated that companies already have the ability to manufacture screens that are capable of sensing pressure. Controls that can distinguish between a light tap from a firm press will give users even more ways to manipulate their phones



### **11. Innovative Medical Apps**

Recently, scientists developed an app called Athelas which makes use of a lens attachment to track malaria and cancerous cells as they move through a patient's blood. This innovation has prompted scientists to look for other ways that smartphones could be used to track highly infectious diseases, such as Ebola, to gain a better understanding of how they move and spread.

### **12. Smart Cameras**

In 2015, Qualcomm demoed a camera that showed it was capable of identify the objects it was looking at. The system works by comparing real world objects to a huge reference database stored on the device. Best of all, it's possible to train the software to understand ever more things. This technology could have enormous potential and enable cameras to do all sorts of clever and useful things relating to the real world environment.

## Mobile operating system (OS)

A mobile operating system (OS) is the software that runs on mobile devices such as smartphones, tablets, and smartwatches. It manages the hardware and software resources of the device and provides a platform for running applications.

They are responsible for managing the input and output of data from the device, allocating memory for running applications, and providing a platform for running different programs.

The mobile OS is responsible for controlling and managing various functions and features of the mobile device, such as making phone calls, sending text messages, accessing the internet, and running applications. It enables the user to interact with a device through a graphical user interface (GUI).

There are several mobile operating systems available, with the most popular ones being:

**1.Android:** Developed by Google, Android is the most widely used mobile operating system globally.

**2.iOS:** Developed by Apple, iOS is the operating system that runs exclusively on Apple devices, such as iPhones, iPads, and iPods.

**3.Windows Mobile or Window phone:** Developed by Microsoft, Windows Mobile is a mobile operating system that runs on smartphones, tablets and other mobile devices.

**4.BlackBerry OS:** Developed by BlackBerry, this mobile operating system was widely used in the past. that runs on Samsung smartphones & smartwatches and other devices.

**6.KaiOS** - An emerging mobile operating system that powers feature phones and low-cost smartphones.

### Important Terminologies:

**Android Open Source Project:** The purpose of the project is to develop the open source android platform for mobile devices.

**jailbreak:** the removal of restrictions placed on a mobile operating system to give the user greater control over the mobile device.

**near-field communication:** a method by which two devices can communicate wirelessly when in close proximity to one another.

**real-time operating system:** an operating system that is designed to respond to input within a set amount of time without delays caused by buffering or other processing backlogs

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## **Cordless Telephone**

- Cordless Telephone Systems are duplex communication systems that use radio to connect a portable handset to a dedicated base station, which is also connected to a dedicated telephone line with a specific telephone number on PSTN.
- The fixed port of a cordless telephone is nothing but the base unit on which cordless handset is placed, is connected to a telephone line and an adapter to produce a dc supply for various electronic circuits inside the base unit.
- The communication between the base unit and the handset is wireless and the range is limited to 50 meters.
- In the base unit all call processing circuits like amplifiers and also ring circuit is present. In addition a transceiver is also present which is used for communication with the handset.
- In handset also the transceiver along with an antenna, amplifier, microphone and loud speaker are present.



- 1st generation cordless telephone systems could cover only distance of a few ten meters(approximately 50m)and can be operated solely as extension telephones to a transceiver connected to a subscriber line on the PSTN and are primarily for in-home use.
- 2nd generation cordless telephone systems could cover distance of a few hundred meters which allows subscribers to use their handsets at many outdoor locations within urban centers.
- Cordless telephone systems provide the user with limited range and mobility, as it is not possible to maintain a call if the user travels outside the range of the base station.
- Digital Enhanced Cordless Telecommunications standard has been used for wireless communication in cordless telephony.
- The [DECT](#) standard is widely established for wireless communication between the base and the handsets.

## **Performance**

- Many cordless phones in the 21st century are digital. Digital technology has helped provide clear sound and limit casual eavesdropping.
- Many cordless phones have one main base station and can add up to three or four additional bases. This allows for multiple voice channels that allow three-way conference calls between the bases.
- "Plain old telephone service" (POTS) landlines are designed to transfer audio with a quality that is just adequate for the parties to understand each other. Typical bandwidth is 3.6 kHz;

## **Causes of limitation** (bad voice quality):

- Sidetone: hearing one's own voice echoed in the receiver speaker
- Interference from noise within the cordless telephone system.
- Most manufacturers claim a range of about 30 meters (98 ft) for their 2.4 GHz and 5.8 GHz systems