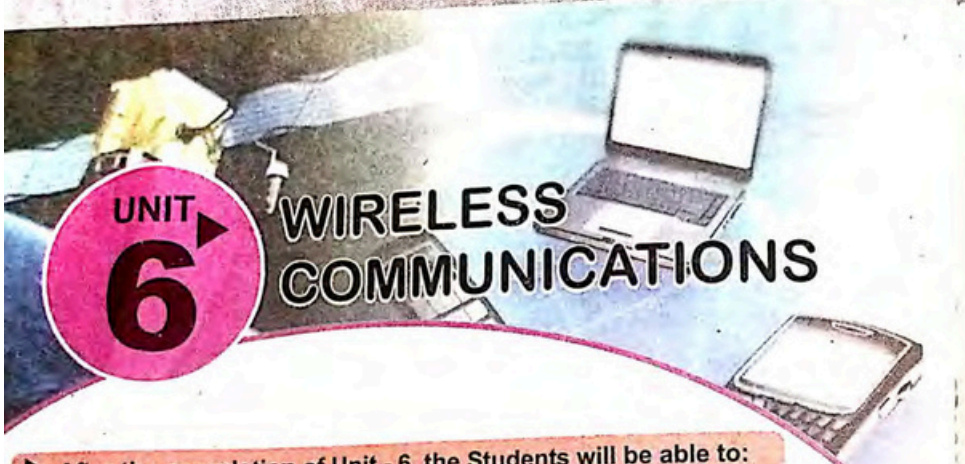

UNIT 6 WIRELESS COMMUNICATIONS

After the completion of Unit - 6, the Students will be able to:

- *explain a wireless network.*
- *explain the advantages and disadvantages of wireless networks.*
- *define radio signals, radio transceiver, access point and line of sight communication.*
- *differentiate between short distance and long distance wireless communication.*
- *explain the types of short distance wireless technologies (Wi-Fi, WiMax, Bluetooth and Infra-red).*
- *explain the types of long distance wireless communication (Cellular Communication and Global Positioning System).*
- *explain requirements of mobile communication.*
- *identify features and limitations of mobile communication system.*
- *explain the architecture for communication over mobile devices.*

6.1 INTRODUCTION

Wireless communication is an important area in telecommunications and networking. Wireless communication is a term used to describe communications between two or more devices without any physical connection. The widespread use of mobile telephone, various satellite services, and now the wireless Internet and wireless LAN's are generating incredible changes in telecommunications and networking. The use of mobile phones which may be cellular, cordless and satellite phones as well as wireless local area networks (WLANs) are increasing day by day. Wireless networks gain so much popularity in the recent years that we will soon reach the point where the number of worldwide wireless subscribers will be higher than the number of wireline subscribers. This popularity is due to its advantages compared to wireline systems. The most significant of these advantages is the freedom from cables, which enables the users to communicate anywhere at anytime. For example, you can contact your friend by dialing his mobile phone number in a variety of geographical locations, thus overcoming the disability of fixed telephony.

6.1.1 Wireless Network

Wireless network is a network set up by using radio signal frequency to communicate among computers and other network devices. Sometimes it is also referred to as WLAN (Wireless LAN). This network is getting popular nowadays due to its easy setup feature and no cabling involved. User can connect computers anywhere in the office/home without the need for wires. Wireless networks use radio waves and/or microwaves to maintain communication channels between computers or devices. They connect computers such as laptops and mobile phones to the Internet or to our business network and its applications.

The two main components of a wireless network are wireless router or access point and wireless clients.

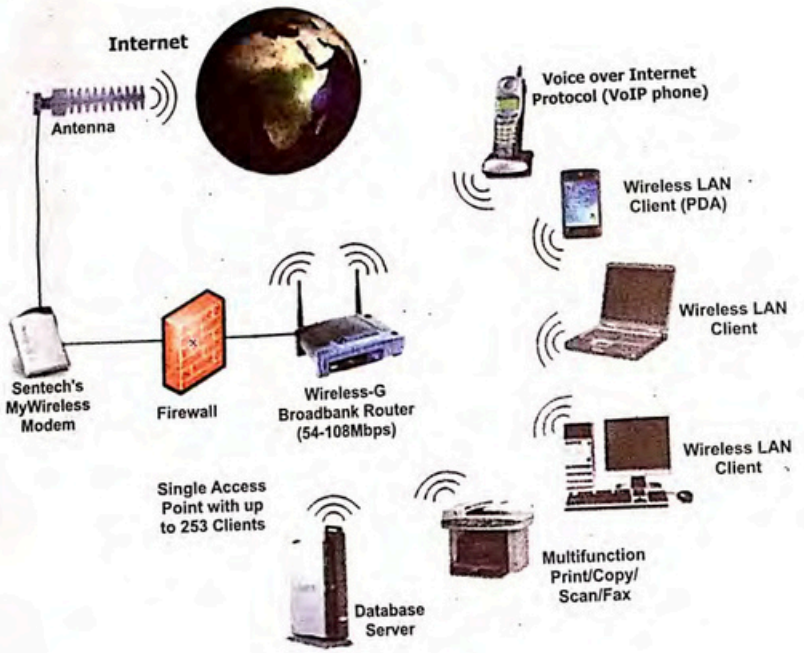

Figure 6.1 Wireless Network

Access points act as a central transmitter and receiver of wireless radio signals including Wi-Fi and are used to support public internet hot spots.

A computer or a device equipped with a wireless LAN network adaptor is known as **wireless client**. These can communicate directly with each other or through a wireless access point.

6.1.2 Advantages and disadvantages of Wireless Networks

A wireless network offers the following advantages and disadvantages

Advantages of Wireless networks

- **Manageability** – Users can be easily connected to a different wireless network without having to change the physical connection.
- **Security** – Traffic of a wireless network can be filtered or simply blocked. Advancement in wireless networks provide robust security protections.
- **Mobility** – We are no longer tied to a specific location, as were with a wired connection. With a laptop computer or mobile device, access can be available at different locations.
- **Fast setup** - If a computer has a wireless adapter, locating a wireless network is very simple and in some cases, user can connect automatically to networks within the range.
- **Cost** - Setting up a wireless network can be much more cost effective than buying and installing cables. Because wireless networks eliminate or reduce wiring costs.
- **Expandability** - Adding new computers to a wireless network is very easy. We can easily expand wireless network with existing equipment, while a wired network might require additional wiring.
- **Productivity.** Wireless access to the Internet and to company's key applications and resources, helps staff to get the job done and encourages collaboration.
- **Last mile data delivery:** Wireless connections can be a very suitable replacement for wired connections in areas where it may be difficult or expensive to extend the cable network to every location.

Disadvantages of Wireless networks

- A common disadvantage of the wireless network is security. A malicious individual can tap into a wireless network relatively easier than a wired network.
- Another disadvantage is about its coverage that somewhere users might face problems of range of signals also some routers allow limited access.
- Sometimes their speed can be slower than wired networks because of their signals dropage problem.
- Wireless network is usually inexpensive but sometimes it is more expensive to install than wired network.
- Because wireless networks use radio signals and similar techniques for transmission, they are susceptible to interference from fluorescent lights and other electronic devices.
- The machinery in factories often produces electromagnetic interference (EMI), which can drastically reduce the data throughput in a wireless network.
- Because of the interference caused by electrical devices and the items blocking the path of transmission, wireless connections are not as stable as compared to a dedicated cable.
- Due to the limitation of data transfer rates, wireless LAN technologies are not suitable for network backbones.

6.1.3 Important Wireless Communication Terminologies

The following are some important wireless communication terminologies.

a. Radio Signals
b. Radio Transceiver
c. Wireless Access Point
d. Line-of-Sight Communication

a. Radio Signals

Radio signals are electromagnetic waves which are used as a medium in wireless communication. The frequency range of radio signal is between 3 KHz to 1 GHz. Radio waves are generated in two ways naturally and artificially.

b. Radio Transceiver (Transmitter and Receiver)

Radio transceiver is a wireless communication device which is used to send as well as receive data through radio signals. It is a full duplex device that can perform both the functions of sending and receiving data simultaneously. The transceiver is connected to the station by means of a transceiver cable that provides separate paths for sending and receiving the data.

Figure 6.2 Radio Transceiver

c. Wireless Access Point

An Access point is a device that both transmits and receives data (sometimes referred to as a transceiver). It has a built-in network adapter, antenna, and radio transmitter. The access point connects users to other users within the wireless local area network (WLAN) and can also serve as the point of interconnection between the WLAN and a wired network. A single access point can serve multiple users within a defined network area. When people move beyond the range of one access point, they are automatically handed over to

the next one. Wireless Access Point can typically communicate with 30 client systems located within a radius of 100 meter. The older and base model of access points allow a maximum of only 10 or 20 clients but many newer access points support up to 255 clients.

Figure 6.3 Wireless Access Point

d. Line of Sight Communication

A line-of-sight communication uses highly directional transmitter and receiver antennas facing each other to communicate via a narrowly focused radio beam in straight line with very high frequency. The transmission path of a line-of-sight microwave link can be established between two land-based antennas, between a land-based antenna and a satellite-based antenna, or between two satellite antennas. A common example of line of sight communication is infrared (TV remote) for short distance, and for long distance the example is very high frequency Microwavws.

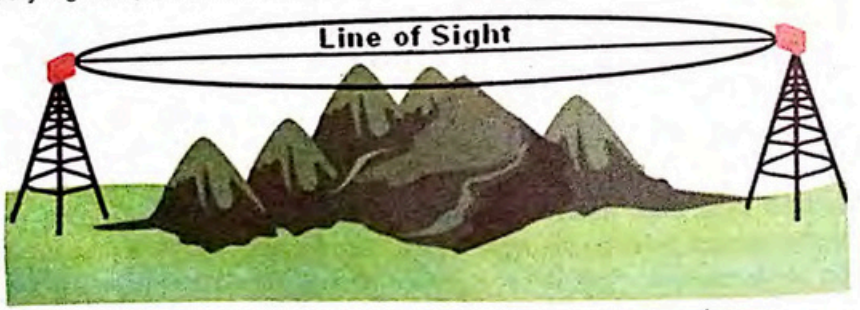

Figure 6.4 Line of sight communication

6.1.4 Short distance and Long distance Wireless Communication

In telecommunications, wireless communication may be used to transfer information over short distances (a few meters as in television remote control) or long distances (thousands or millions of kilometers for radio communications). In short distance communication information is transferred from one station to another in a few meters (e.g. Infrared) or few kilometers (e.g. Wi-Max) range. Short distance communication includes Wi-Fi, Wi-Max, Bluetooth and Infrared. Long distance communication includes cellular communication and satellite communication such as global positioning system (GPS), geostationary earth orbit (GEO), medium earth orbit (MEO) and low earth orbit (LEO).

6.2 SHORT DISTANCE WIRELESS COMMUNICATION TECHNOLOGIES

The following are some common short distance wireless communication technologies.

- Wi-Fi
- WiMax
- Bluetooth
- Infra-red

6.2.1 Wi-Fi

Wi-Fi is short for "*wireless fidelity*. It is a popular wireless networking technology which uses radio waves to provide wireless high-speed Internet and network connections. It uses the 802.11 standard, developed by the Institute of Electrical and Electronics Engineers (IEEE) and released in 1997. A person or business can use a Wi-Fi router or similar device to create a

"**hotspot**" or area in which appropriate devices can be connected wirelessly to a network or gain Internet access.

Wi-Fi router translates data into a radio signal and transmits it using an antenna. It then sends the information to the Internet using a physical, wired Ethernet connection. The process also works in reverse, with the router receiving information from the Internet, translate it into a radio signal and sends it to the computer's wireless adapter. Different electronic devices like computers, mobiles PDAs can be wirelessly connected with Internet access points. The access point or hotspot range is 20 meters indoor and it may be in many square miles by overlapping of multiple access points.

Wi-Fi is supported by many applications and devices including video game consoles, home networks, PDAs, mobile phones, major operating systems, and other types of consumer electronics.

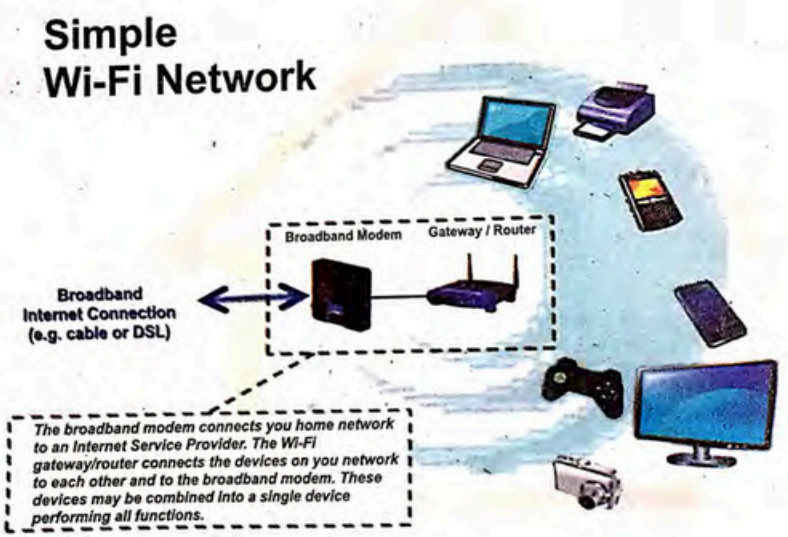

Figure 6.5 Wi-Fi network

6.2.2 WiMAX

WiMAX is an acronym for "Worldwide Interoperability for Microwave Access". WiMax technology is a standard based wireless technology which is used to provide Internet access and multimedia services at very high speed to the end users. WiMAX is an IP based, wireless broadband access technology that provides performance similar to Wi-Fi networks with the coverage and quality of service of cellular networks. It uses IEEE 802.16 standard for communication and can provide broadband wireless access up to 30 miles (50 km) for fixed stations, and 3 - 10 miles (5 - 15 km) for mobile stations.

WiMax technology offers transmission of wireless data via a number of transmission methods; such as portable or fully mobile internet access via point to multipoint links. The WiMax technology offers around 72 mega bits per second without any need for the cable infrastructure.

6.2.3 Bluetooth

Bluetooth is a high-speed, low-power microwave wireless link technology, designed to connect phones, laptops, PDAs and other portable equipment together. Unlike infra-red, Bluetooth does not require line-of-sight positioning of connected units. The technology uses modifications of existing wireless LAN techniques but is most notable for its small size and low cost. Whenever Bluetooth-enabled device come within range of each other, they instantly transfer address information and establish small networks between each other, without the user being involved.

Bluetooth is popular for providing connectivity between non-network devices, such as laptops, mobile phones, telephones, fax machines, PCs, Printers GPS receivers, digital photo camera and video games controllers. The specified maximum data transfer rate is 1 Mbps, but in reality it is much lower.

Wireless signals transmitted with Bluetooth cover short distances, typically up to 30 feet (10 meters). Bluetooth networks have called a piconet or PAN. Piconets contain a minimum of two and a maximum of eight Bluetooth peer devices.

6.2.4 Infrared

Infrared is similar to visible light, but with a longer wavelength. Infrared signals can be used for short-range communication in a closed area using line-of-sight propagation. Infrared waves, having high frequencies, can not penetrate walls. Due to this characteristic, it prevents interference between one system and another system that is a short range communication in one room cannot be affected by another in the next room. Infrared equipment is relatively economical and simple. In Infrared communication the transmitter and receiver must be in line of sight to communicate with each other. Also data rate in this type of communication is very low as compared to other methods of data communication. Some common applications of infrared technology are listed below.

- Car locking systems use Infrared technology for automatic locking and unlocking the doors of cars.
- Modern Computers have infrared enabled mouse, keyboards, and printers.
- Home security systems have infrared enabled burglar alarm.
- Remote control system in TVs, Toys, etc uses infrared technology.

6.3 LONG DISTANCE WIRELESS COMMUNICATION TECHNOLOGIES

The following are some common long distance wireless communication technologies.

- Cellular Communication
- Global Positioning System (GPS)

6.3.1 Cellular Communication

Of all the tremendous advancements in data communications and telecommunications, perhaps the most revolutionary is the development of cellular networks. Cellular technology is the foundation of mobile wireless communications and connects users in locations that are not easily possible by wired networks. Cellular technology is the underlying technology for mobile telephones, personal communication system, wireless Internet and wireless web applications.

In cellular network, multiple low-power transmitters are used. Because the range of such transmitters is small, an area can be divided into cells, each one served by its own antenna. Each cell is allocated a band of frequencies and is served by a base station, consisting of transmitter, receiver, and control unit. Adjacent cells are assigned different frequencies to avoid interference or crosstalk. However, cells sufficiently apart from each other can use the same frequency band.

Early radio systems (FM radio) cover a large area by using a single, high powered transmitter with an antenna mounted on a tall tower. There were no concept of frequency reuse and hence have no interference problem because they use the same frequency. But with this there was a problem of limited user capacity.

Cellular concept, based on frequency reuse solved the problem of user capacity which occurs in radio system. In Cellular communication a single, high power transmitter (large cell) is replaced with many low power transmitters (small cells). The available channels can be reused as many times as necessary as long as the co-channel interference is kept below acceptable levels.

Characteristics of Cellular networks

- Consist of several thousand radio cells, each with a coverage area of between 500 m to 35 km radius.
- Comprised of several access networks and a single core network.
- Usually cover an entire country and serve millions of subscribers.
- Initially designed for speech telephony, but increasingly used for data transmission.
- Support of terminal and personal mobility.
- Examples: GSM and CDMA

6.3.2 Global Positioning System (GPS)

The Global Positioning System (GPS) is a satellite-based navigation system. The GPS system consists of 24 satellites, constructed and operated by the U.S. Department of Defense. It is used for land, sea and air navigation to provide time and locations for vehicles and ships. GPS works in any weather conditions, anywhere in the world, 24 hours a day. There are no subscription fees or setup charges to use GPS. The 24 satellites are moving around the Earth about 12,000 miles above the Earth surface. They are constantly moving, making two complete orbits in less than 24 hours. These satellites are traveling at speeds of roughly 7,000 miles an hour. GPS satellites are powered by solar energy. They have backup batteries onboard to keep them running, when there is no solar power.

Figure 6.6 GPS satellite orbits

GPS is used to provide accurate location and time information anywhere any time on or near the Earth. GPS can be used for cartography, forestry, mineral exploration, surveying, disaster management, weather forecasting, wildlife habitation management, monitoring the movement of people and things and bringing precise timing to the world.

GPS Segments

GPS has three segments or components.

Space Segment

The space segment consists of a nominal constellation of 24 operating satellites that transmit one-way signals that give the current GPS satellite position and time.

Control Segment

GPS control segment consists of a global network of ground facilities that track the GPS satellites, monitor their transmissions, perform analysis, and send commands and data to the constellation.

User Segment

The user segment consists of the GPS receiver equipment, which receives the signals from the GPS satellites and uses the transmitted information to calculate the user's three-dimensional position and time.

6.3.3 Categories of Satellite Systems

Satellite Systems can be classified based upon their orbits into the following three types.

- Geostationary Earth Orbit (GEO)
- Medium Earth Orbit (MEO)
- Low Earth Orbit (LEO)

a. Geostationary Earth Orbit (GEO)

The Geostationary Earth Orbit is located in the equatorial plane such that the period of rotation equals that of the Earth. Geostationary satellites have the special property of remaining permanently fixed in exactly the same position in the sky, meaning that ground-based antennas do not need to track them but can remain fixed in one direction. Such satellites are called geostationary.

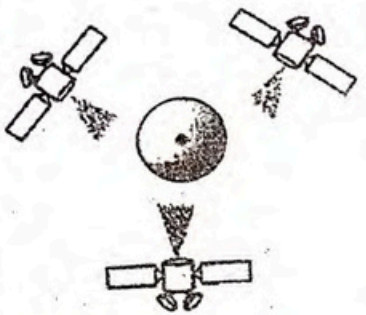

Figure 6.7 Satellites in geostationary orbit

Because orbital speed is based on the distance from the planet, only one orbit can be geostationary. This orbit occurs at the equatorial plane and is approximately 22,000 miles from the surface of the Earth. But one geostationary satellite cannot cover the whole Earth. One satellite in orbit has line-of-sight contact with a vast number of stations, but the curvature of the earth still keeps much of the planet out of sight. It takes a minimum of three satellites equidistant from each other in geostationary Earth orbit (GEO) to provide full global transmission. These three satellites are 120° from each other in geosynchronous orbit around the equator.

b. Medium Earth Orbit (MEO)

Medium or Middle Earth Orbit (MEO) is a satellite system used in telecommunications. MEO satellites orbit the earth between 1,000 and 22,300 miles above the earth's surface. MEOs are mainly used in Geographical Positioning Systems (GPS) and are not stationary in relation to the rotation of the earth. MEO are higher than low earth orbit (LEO) satellites, but lower than geostationary satellites (GEO). Closer to the Earth, satellites in a medium earth orbit move more quickly.

A geostationary orbit is valuable for the constant view it provides, but satellites in a geostationary orbit are parked over the equator, so they do not work well for far northern or southern locations, which are always on the edge of view for a geostationary satellite.

Telstar is the one of the first and most famous experimental satellites, orbited in MEO.

c. Low Earth Orbit (LEO)

In satellite communications systems, a Low Earth Orbit (LEO) satellite operates at heights of between 500 and 2,000 km above the Earth's surface. Low earth orbit satellites can be used for many purposes including satellite communications and surveillance.

LEO satellites can be divided into "Big LEOs" and "Little LEOs." "Little LEOs" provide pager, cellular telephone and location services. "Big LEOs" carry voice and data broadband services to be on Internet in the sky.

LEOs are mostly used for data communication such as e-mail, paging and videoconferencing.

Most of the satellites, the International Space Station, the Space Shuttle, and the Hubble Space Telescope are all in Low Earth Orbit.

6.4 MOBILE DEVICE COMMUNICATION

Mobile communication today is the most powerful catalyst for change in lifestyle of the people all over the world. Mobile communication is evolving as the backbone for business transactions, efficiency and success. It is taking over the role of the PSTN (public switch telephone network). The mobile communications market requires **mobility**. The goal of mobility is anytime and anywhere communications. Mobile communications technology must be able to allow roaming (the ability to provide service to mobile phone users while outside their home system). On the other hand, fixed wireless is simply an alternative to wired communications. The fixed wireless user does not need

mobility. Instead, the fixed wireless user needs cost effective telecommunications from fixed locations. Wireless is an alternative means of providing service. It is sometimes the only means, when the customer is in a remote location.

6.4.1 Requirements of Mobile Communication System

Mobile communication system consists of the following major components that work together to provide mobile service to subscribers.

a. Public switched telephone network (PSTN)
b. Mobile telephone switching office (MTSO)
c. Cell site with antenna system
d. Mobile subscriber unit (MSU)
e. Mobile Station
f. Base Station Subsystem
g. Network and Switching Subsystem
h. Operation Subsystem

a. Public switched telephone network (PSTN)

The PSTN is made up of local networks, the exchange area networks, and the long-haul network that interconnect telephones and other communication devices on a worldwide basis.

b. Mobile Telephone Switching Office (MTSO)

The MTSO is the central office for mobile switching. It houses the mobile switching center (MSC), field monitoring and relay stations for switching calls from cell sites to wire-line central offices (PSTN). In analog cellular networks, the MSC controls the system operation. The MSC controls calls, tracks billing information, and locates cellular subscribers.

c. Cell Site

The term cell site is used to refer to the physical location of radio equipment that provides coverage within a cell. A list of hardware located at a cell site includes power sources, interface equipment, radio frequency transmitters and receivers, and antenna systems.

d. Mobile Subscriber Units (MSUs)

The mobile subscriber unit consists of a control unit and a transceiver that transmits and receives radio transmissions to and from a cell site.

e. Mobile Station (MS)

The MS includes mobile equipment and a subscriber identity module (SIM). The SIM (normally a card) is a subscriber module which stores all the subscriber-related information. When the SIM is inserted into the mobile equipment, the relevant information is checked and a call is then delivered to the mobile station. The mobile equipment is not associated with a caller number - that is contained in the SIM, and hence any mobile equipment could be used by a subscriber by simply inserting the SIM into the unit.

f. Base Station Subsystem (BSS)

The BSS connects to the MS through a radio interface and also connects to the NSS (network and switching subsystem). The BSS consists of a base transceiver station (BTS) located at the antenna site and a base station controller (BSC). A rate adaption unit carries out encoding and speech decoding and rate adaption for transmitting data.

g. Network and Switching Subsystem (NSS)

The NSS is composed of the Mobile Services Switching Center (MSC), the Home Location Register (HLR) and the Visitor Location Register (VLR). The MSC coordinates call set-up to and from mobile users.

The HLR consists of a database which contains subscriber information (e.g. current location).
The VLR temporarily contains administrative information that is relative to whatever mobile is currently in its area.

h. Operation Subsystem (OSS)

There are three areas in the OSS: Network operation and maintenance functions, Subscription management (including charging and billing) and mobile equipment management.

6.4.2 Features and Limitations of Mobile Communication System

a. Features of Mobile Communication System

Mobile Communication technology has helped to make the communication process more convenient and easier. Organizations utilize this communication in day-to-day operations while people personally use mobile communication technology to strengthen social lives.
Mobile or Cellular communication technology offers a number of desirable features:

- The mobile communication provides the mobility. Two aspects of mobility are:
  - (i) User mobility: User communicate (wirelessly) "anytime, anywhere, with anyone".
  - (ii) Device portability: Devices can be connected anytime, anywhere to the network.
- More capacity than a single large transmitter, since the same frequency can be used for multiple links as long as they are in different cells.
- Mobile devices use less power than with a single transmitter a satellite, since the cell towers are closer.

- Larger coverage area than a single terrestrial transmitter, since additional cell towers can be added indefinitely and are not limited by the horizon.
- The key characteristic of a mobile network is the ability to re-use frequencies to increase both coverage and capacity.
- The mobile communication provides the handover or handoff which refers to the process of transferring an ongoing call or data session from one channel connected to the core network to another channel. In case of satellite communications it is the process of transferring satellite control responsibility from one earth station to another without loss or interruption of service.
- It is the fastest way to communicate and provide roaming services all around the world which has played a vital role in business, emergencies and management.
- The cost of messaging and talking wirelessly is significantly lower.
- In mobile devices the services of MMS, GPRS and WAP can be used for effective communication.
- The mobile communication system uses the GSM (Global System for Mobile Communication) a standard for, improved spectrum efficiency, international roaming, low-cost mobile sets and base stations (BSs), high-quality speech, compatibility with Integrated Services Digital Network (ISDN) and other telephone company services.
- GSM is expanded over time to improve data communication and higher data rates, first by circuit-switched technique, then packet data transport via GPRS (General Packet Radio Services) and EDGE (Enhanced Data rates for GSM Evolution of EGPRS).

b. Limitations of Mobile Communication System

The following are the limitations of mobile communication system.

i. Inadequate bandwidth

Mobile Internet access is generally slower than direct cable connections, using technologies such as GPRS (General Packet Radio Service) and EDGE (Enhanced Data Rate for Global Evolution). These networks are usually available within range of commercial cell phone towers. Higher speed wireless LANs are inexpensive, but have very limited range.

ii. Security issues

The privacy issues become more severe with mobile systems. For example, it is much easier for an individual to eavesdrop on mobile calls than on wired calls.

iii. Power issue

When a power outlet or portable generator is not available, mobile computers must rely entirely on battery power. Combined with the compact size of many mobile devices, this often means unusually expensive batteries must be used to obtain the necessary battery life.

iv. Interference

Weather, terrain, and the range from the nearest signal point can all interfere with signal reception. Reception in tunnels, some buildings, and rural areas is often poor.

v. Health hazards

More car accidents are related to drivers who were talking through a mobile device. Cell phones may interfere with sensitive medical devices. There are allegations that cell phone signals may cause health problems.

vi. Human interface with device

Screens and keyboards tend to be small, which may make them harder to use. Alternate input methods such as speech or handwriting recognition require training.

6.4.3 Architecture for Communication over Mobile Devices

The Mobile Device Communication Architecture encompasses the aggregate of all wireless data communication capabilities. These include:

a. Web Protocol Stack
b. Wireless Markup Language (WML)
c. Wireless Application Protocol (WAP)

a. Web Protocol Stack

A web service protocol stack is a protocol stack that is used to define, locate, implement, and make Web services to interact with each other.
A Web service protocol stack includes the following four protocols.

i. Transport Protocol

It is responsible for transporting messages between network applications and includes protocols such as HTTP(Hypertext Transfer Protocol), SMTP(Simple Mail Transfer Protocol), FTP(File Transfer Protocol), as well as the more recent Blocks Extensible Exchange Protocol (BEEP).

ii. Messaging Protocol

It is responsible for encoding messages in a common XML (Extensible Markup Language) format so that they can be understood at either end of a network connection. Currently, this area includes such protocols as XML and SOAP (Simple Object Access Protocol).

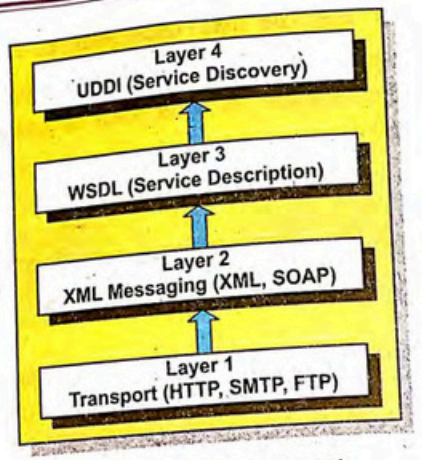

Figure 6.8 Web Protocol Stack

iii. Description Protocol

This protocol is used for describing the public interface to a specific Web service. The WSDL (Web Services Description Language) interface format is typically used for this purpose. WSDL is an XML-based language used to describe the services a business offers and to provide a way for individuals and other businesses to access those services electronically.

iv. Discovery Protocol

This protocol centralizes services into a common registry. It can publish their location and description, and makes it easy to discover what services are available on the network. Universal Description Discovery and Integration (UDDI) is intended for this purpose. UDDI (Universal Description, Discovery, and Integration) is an XML-based registry for businesses worldwide to list themselves on the Internet. Its ultimate goal is to streamline online transactions by enabling companies to find one another on the Web and make their systems interoperable for e-commerce.

b. Wireless Markup Language (WML)

Wireless Markup Language is a markup language created for devices that implement the Wireless Application Protocol (WAP), such as mobile phones. WML provides navigational support, data input, hyperlinks, text and image presentation, and forms, much like HTML (Hypertext Markup Language).

WML (Wireless Markup Language) is the first markup language standard for wireless devices. It is supported by all the major mobile phone manufacturers.

c. Wireless Application Protocol (WAP)

The Wireless Application Protocol (WAP) is an open standard protocol which provides Internet access to mobile users of wireless phones and other wireless devices such as pagers and personal digital assistants (PDAs).

In 1998 WAP Forum is formed by Nokia, Ericsson, Motorola and Unwired Planet. The basic objectives of this WAP are to bring diverse Internet content (e.g. web pages) and other data services (e.g. stock quotes) to mobile phones and other wireless terminals (e.g. PDAs, laptops). WAP allows terminals and software from different vendors to communicate with networks from different providers.

SUMMARY

- Wireless communication is a term used to describe communications between two or more devices without any physical connection.
- Wireless network is a network set up by using radio signal frequency to communicate among computers and other network devices.
- Radio signals are electromagnetic waves which are used as a medium in wireless communication.
- Radio transceiver is a wireless communication device which is used to send as well as receive data through radio signals.
- Wireless Access Point is a device that both transmits and receives data (sometimes referred to as a transceiver).
- Wi-Fi is short for "wireless fidelity. It is a popular wireless networking technology which uses radio waves to provide wireless high-speed Internet and network connections.
- WiMAX is an acronym for "Worldwide Interoperability for Microwave Access". Wimax technology is a standard based wireless technology which is used to provide Internet access and multimedia services at very high speed to the end user.
- Bluetooth is a high-speed, low-power microwave wireless link technology, designed to connect phones, laptops, PDAs and other portable equipment together.
- Infrared is similar to visible light, but with a longer wavelength. Infrared signals can be used for short-range communication in a closed area using line-of-sight propagation.

- Cellular technology is the underlying technology for mobile telephones, personal communication system, wireless Internet and wireless web applications.
- The Global Positioning System (GPS) is a satellite-based navigation system. The GPS system consists of 24 satellites, constructed and operated by the U.S. Department of Defense.
- The Geostationary Earth orbit is located in the equatorial plane such that the period of rotation equals that of the Earth.
- Medium or Middle Earth Orbit (MEO) is a satellite system used in telecommunications. MEO satellites orbit the earth between 1,000 and 22,300 miles above the earth's surface.
- Low Earth Orbit (LEO) satellite operates at heights of between 500 and 2,000 km above the Earth's surface.
- Web Service Protocol stack is a protocol stack that is used to define, locate, implement, and make Web services to interact with each other.
- Wireless Markup Language is a markup language created for devices that implement the Wireless Application Protocol (WAP), such as mobile phones.
- The Wireless Application Protocol (WAP) is an open standard protocol which provides Internet access to mobile users of wireless phones and other wireless devices such as pagers and personal digital assistants (PDAs).

EXERCISE

Q1. Select the best choice for the following MCQs.

i. The frequency range of radio signal is between 3 KHz to _____ GHz.
A. 1 B. 2
C. 3 D. 4

ii. Which of the following is a wireless communication device used to send as well as receive data through radio signals?
A. Sender B. Transceiver
C. Receiver D. Infrared

iii. What does WAP stand for?
A. Wireless Access Place B. Wired Application Protocol
C. Wireless Access Protocol D. Wireless Access Portion

iv. _____ uses 802.11 standard, developed by the Institute of Electrical and Electronics Engineers (IEEE).
A. Wi-Fi B. Bluetooth
C. Infra-red D. WiMax

v. Which of the following is used to provide Internet access and multimedia services at very high speed to the end users?
A. Wi-Fi B. Bluetooth
C. Infra-red D. WiMax

vi. _____ signals can be used for short-range communication in a closed area using line-of-sight propagation.
A. Wi-Fi B. Bluetooth
C. Wi-Max D. Infra-red

vii. The GPS system consists of _____ satellites.
A. 20 B. 22
C. 24 D. 25

viii. GPS _____ segment facilities that track the GPS satellites, monitor their transmissions, perform analysis, and send commands and data to the constellation.
A. User B. Control
C. Space D. Air

ix. Which of the following orbits is at the distance of 22,000 miles from the surface of the Earth.?
A. Geostationary Earth Orbit B. Low Earth Orbit
C. Medium Earth Orbit D. High Earth Orbit

x. _____ is the first markup language standard for wireless devices.
A. HTML B. WAP
C. HTTP D. WML

Q2. Give short answers to the following questions.

i. What is Radio Transceiver?
ii. What is 'Hotspot'?
iii. What does IEEE stand for?
iv. What is meant by line of sight communication?
v. Differentiate between short distance and long distance wireless communication.
vi. What is Global Positioning System (GPS)?
vii. What is Wireless Markup Language?
viii. What is Wireless Application Protocol?
ix. Write short note on Web Protocol Stack?