WIRELESS COMMUNICATIONS

CHAPTER 6

UNIT INTRODUCTION

Wireless communication is a fast growing field in wireless communications and networking. The cost is reduced in wireless communication solutions. It allows companies to expand their geographical coverage into remote areas without the need to build a wired infrastructure. Wireless communication is the method for making wireless communication networks to service which distance and data transmission without the requirement for extensive physical infrastructure.

6.1 INTRODUCTION

Q1. Give a brief introduction of Wireless communications.

Wireless Communication

Wireless communication is the term used to describe communications between two or more devices without any physical connection. The radio waves are of certain frequencies and wavelengths that are used to transmit the signals. The wireless devices are the devices that are capable of receiving and transmitting the signals. Wireless communication refers to technology that transmits information over a distance without the help of wires, cables or any other forms of electrical conductors. The demand for wireless communication is rapidly increasing today.

6.1.1 WIRELESS NETWORKS

Q2. Type the terms "wireless". Describe important attributes of wireless/devices of data and communications.

Wireless

The term wireless refers to the communication or transmission of information over a distance without the help of wires, cables or any other forms of electrical conductors.

Today, the term wireless refers to a variety of devices ranging from smart phones to devices, data, networks and communications.

Important traditions of transmission of data

The important attribute of wireless is one of the important traditions of transmission of data or information in all the devices.

Transmission of information

In wireless networks, the information is transmitted through the air, without requiring any cables, by using a wireless network technology.

Q3. These were important wireless technologies. Who describe the functions of wireless networks, devices and systems.

Important wireless technologies

Some important wireless technologies are as follows:

- Wireless Ethernet (802.11b) or Wi-Fi (802.11a) or WiMAX (802.16)
- Wireless Broadband

Functions of wireless networks

A wireless network enables people to communicate and access applications and information without wires. This provides freedom to the people to move from place to place while working. Wireless network is the term used to describe a wireless network. Wireless network refers to any type of computer network that is wireless.

Many types of wireless communication systems exist, but a distinguishing attribute is wireless networks that connect computers without the use of wires.

These devices include Personal Digital Assistants (PDAs), cellular phones and computers (PCs), among others. Wireless networks are also used to connect wireless access points to the wired network. Because of the high cost of network, in such cases, wireless networks transfer data, such as e-mail messages and files, but also enable users to share Internet connections and printers without requiring support for wires and other communications as well.

A wireless network is shown in Fig 6.1.



Fig 6.1 Wireless Network

6.1.2 ADVANTAGES AND DISADVANTAGES OF WIRELESS NETWORKS

Q4. Write down the advantages and disadvantages of wireless networks.

Advantages of Wireless Networks

1. Wireless networks are easily add users without having to change the physical connection.
2. Wireless networks provide robust security protection. Traffic of a wireless network can be hidden from the unauthorized users.
3. Wireless networks are flexible. Data can be sent between computers anywhere in or outside the company. Wireless networks support roaming, such that a user can move from one access point to another.
4. Installation of a wireless networks, users can connect automatically if they are within the range.
5. Setting up a wireless network can be much more cost effective than setting up a wired network.
6. Wireless networks are scalable. They can be configured in various topologies.
7. Adding new computers to a wireless network is very easy. We can easily expand wireless networks. Wireless networks can be configured to meet a variety of application needs.
8. Wireless networks provide easy access to the consumers to the applications and decrease help employees to get the job done when they are away from the company.

Disadvantages of Wireless Networks

1. The main disadvantage of the wireless network is security issues. Intruders themselves can tap into the network and can easily steal the valuable information.
2. Wireless technology is about to overcome the connectivity issues that is a problem of large changes.
3. Sometimes wireless network speed can be slower than wired networks because of the low bandwidth.
4. Multiple wireless networks can easily operate and similar spectrum that overlaps. This usually creates interference from magnetic or electronic effects.
5. Wireless networks are also more vulnerable to intrusion through the environment consisting of radio technology.
6. Wireless networks are susceptible also used as a denial of service attack.

6.1.3 WIRELESS NETWORK TERMINOLOGY

Q5. Write a note on radio signal.

Radio Signal

A radio signal or radio wave is an electromagnetic wave propagated by an antenna. Radio waves are used in many communication systems. They are generated artificially and can carry audio, video or other signal signals.

Two Way Radio Frequency Systems

All the Radio Frequency (RF) systems consist of the following two components:

1. Transmitter
2. Receiver



Fig 6.2 Communication using radio signal

Working of Radio Frequency Systems

The transmitter sends the signal to the antenna. The antenna converts the signal and receives it. RF system should have a RF line of sight for working. It is used for transmitting and receiving the signals. The radio communication system is RF. It is used for the transmitter must communicate with the receiver at a specific frequency. The receiver must be tuned to the same frequency as the transmitter. The receiver is also a transceiver. It is also sometimes known as a repeater.

Q6. Briefly explain radio transceiver.

Radio Transceiver

Radio transceiver is a device, which can transmit and receive a radio signals and have a common circuitry to share the signal. It is highly integrated. Both the transmitter and the receiver are combined. This device is implemented whether to transmit or receive and this is a common. But in many cases, the two are not used at the same time. Therefore, it will provide a transceiver is also sometimes known as a repeater.

Fig 6.3 Radio Transceiver

Q7. Write a note on wireless access point.

Wireless Access Point

A Wireless Access Point (WAP) is a device that allows wireless devices to connect to a wired network using Wi-Fi. The access point connects to the wired network and then broadcasts signals that allow wireless devices to connect to the network within a certain range.

Fig 6.4 Wireless Access Point

For computers to communicate over a wireless network, they must support the wireless. LAN communication is Wi-Fi. Wi-Fi is a term used for the IEEE 802.11 standard. The standard IEEE 802.11 is the basis to get communication for the wireless access point.

Q8. Briefly explain ILOS communications.

ILOS

Line of Sight Communication

In line of sight (LOS) communication, the transmitter and receiver antennas are in line of sight as shown in Fig 6.5.



Fig 6.5 Line of Sight Communication

Line of sight communication is also in high frequency communication where the signals cannot propagate through the earth. The signals are transmitted in a straight line through the air from one antenna to another. Sometimes at high speed. Many antenna structures are used to amplify the signals and appropriate from beam to beam.

6.1.4 SHORT AND LONG DISTANCE WIRELESS COMMUNICATIONS

Q9. Explain short and long distance wireless communications.

Short Distance Wireless Communication

Wireless communication may be effective based on the region it covers may limit distance and short distance communication.

Short Distance Wireless Communication

Short distance wireless communication provides a number of key short ranges in the holders. Ultra-HD Hi-fi distance of up to 50 km (30 miles).

Some of the short distance Wireless Communications

- Following are the types of short distance wireless communications
- Bluetooth
- Wi-Max
- Wireless USB
- Infra-red

Long Distance Wireless Communication

Long distance wireless communication consists of distance above 50 Km using either cellular communication technology or Global Positioning Systems, which utilizes satellites.

6.1.5 SHORT DISTANCE WIRELESS COMMUNICATIONS

Q.10 Describe the characteristics of Wi-Fi.

Wi-Fi

Wi-Fi, or Wireless Fidelity, is a wireless communication system was commonly used at home and business networks. Wi-Fi is a technology that allows an electronic device to exchange data or connect to the Internet wirelessly using radio waves. Wireless networks that are Wi-Fi certified are interoperable and are easy to setup and are inexpensive. In Wi-Fi, information travels over the air. The information is first turned into a radio signal and transmitted using an antenna. A computer, known as a wireless client, receives the signal and decodes it. The client sends information back to an access point across the radio signal. Wireless networks are also connected to the wired network and referred to as wireless LAN (WLAN).

6.1.6 Wi-Max

Q.11 Write a note Wi-Max.

Wi-Max

Worldwide Interoperability for Microwave Access is a wireless network that provides super wireless coverage. It can cover hundreds of square miles depending on the frequency used. Wi-Max is a wireless broadband connection. It provides service over about kilometers you are within a city. It transmits information using radio signals over a specific area.

6.1.7 Bluetooth

Q.12 Briefly explain Bluetooth.

Bluetooth

Bluetooth is a short range and low power wireless communication technology. Its range is around 10 meters with the data transfer rate up to 722 Kbps and it consumes low power. It provides a way to connect and exchange information between devices such as mobile phones, laptops, PCs, printers, digital cameras and video game consoles through a secure, low-cost, globally available radio frequency.

6.2.1 INFRA-RED

Q.13 What is Infra red? Describe its applications?

Infra-red

Infra-red waves are extremely high frequency waves which are used for short range communication purposes.

Applications of Infra red Technology

Following are the applications of infra red technology and data below.

- Infra-red wireless telephone technology for automatic dialing and unlocking the doors of cars.
- Remote Computers have infra red like wireless mouse, keyboards, and printers.
- Home security systems have infra red, wireless burglar alarm system.
- Remote control system in TVs, Toys, etc. uses infra red technology.

6.2.2 LONG DISTANCE WIRELESS COMMUNICATION

Q.14 Define long distance wireless communications.

Long Distance Wireless Communication

Long distance wireless communication provides services that are not provided with the use of cables. It includes cellular and global positioning systems.

6.3.1 CELLULAR COMMUNICATION

Q.15 Explain cellular communications.

Cellular Communication

Cellular communication refers to wireless communication systems that divide a geographical region into sections called cells. Each cell has a Base Station (BS) at its center that is connected to the rest of the network and to the mobile units in the cell.

Base Station

Cellular communication and mobile phone uses a separate transceiver radio frequency channel to talk to the Base Station (BS). The BS talks to many mobile users at the same time as shown in Fig 6.6.

Fig 6.6 Cellular Communication

Channels are a pair of frequencies for communication. One frequency the uplink is used by the mobile unit to transmit to the BS. The other frequency the downlink is used by the BS to transmit in accordance with the mobile phone.

Rank Concept of Cellular Communication

The rank concept of cellular communication is that it reuses the radio frequency by the cell that is at a minimum since there is no interference of the other cells.

6.3.2 GLOBAL POSITIONING SYSTEM

Q.16 What is meant by GPS? Describe its applications.

GPS

Global Positioning System

Global Positioning System (GPS) is a radio navigation system that allows people on land, in sea or in air to determine their exact position. It is also a key ingredient in the world's air navigation system.

Global positioning system is shown in Fig 6.7.

Fig 6.7 Global Positioning System

Uses of GPS

GPS are used for navigation, air guidance, ships ground vehicles and by individuals. Also the relative positioning and time data is used to study the movement of tectonic plates to understand the earthquakes and volcanoes and other geological activities.

Q.17 Define satellite and uses its uses.

Satellite

Satellite is used in communication, satellites are widely used.

Satellite

A satellite is a star station, which is placed into orbit by humans. They are sometimes called artificial satellites to distinguish them from natural satellites such as moon.

Uses of satellites

Satellites are used for various purposes such as military and civilian applications, earth observation satellites, navigation satellites, weather satellites, and research satellites. The orbits and the instruments they use defines any Geostationary Earth Orbit (GEO) satellite or any other satellite.

Q.18 Describe the classification of satellite systems in detail.

Satellite Systems

Satellite systems can be classified based upon their orbits into the following three types:

1. Geostationary Earth Orbit (GEO)
2. Medium Earth Orbit (MEO)
3. Low Earth Orbit (LEO)

1. **Geostationary Earth Orbit (GEO)**

A Geostationary Earth Orbit (GEO) or Geostationary Orbit is an orbit directly above the **earth's EQUATOR**. A satellite should be in the earth's rotational period. An object in a geostationary orbit appears motionless, in a fixed position in the sky, to ground observers. Communication satellites are generally placed in geostationary orbits, so that ground antennas can point permanently at the satellite without tracking it. Satellites in geostationary orbits are also known as geosynchronous orbit position where they stay.

2. **Medium Earth Orbit (MEO)**

A Medium Earth Orbit (MEO) is located above the earth with altitudes of 2,000 into nearest and 35,786 km into furthest. It is also known as intermediate circular orbit. It is also known as a circular geocentric orbit for navigation, such as the Global Positioning System at an altitude of 20,200 km. It is also known as a circular geocentric orbit for navigation, such as the Global Positioning System at an altitude of 20,200 km. Communication GEO satellites provide navigation systems to an altitude of 35,786 km.

3. **Low Earth Orbit (LEO)**

Low Earth Orbit (LEO) is the known as low orbit. It generally defined that the earth's surface up to an altitude of 2,000 km. Its orbital period was defined for 127 to 248 for 90 min to 2,000 km and altitude 1,037 to 1,487 km for 105 min. Low Earth Orbit (LEO) satellites are placed in orbit at a much lower altitude for communication. Therefore, the orbit is used for many communication applications. Low Earth Orbit (LEO) satellites are used for mobile phones for communication with the satellite. Iridium Communications and Globalstar are LEO satellites.

6.4 MOBILE DEVICE COMMUNICATION

Q.19 What is mobile communications?

Mobile

Mobile communication

Mobile communication combines the use of mobile devices such as mobile phones, smart phones, PDAs and tablet and mobile computers. Mobile communication is the ability to use a mobile device to communicate with other mobile devices, computers or telephones.

6.4.1 REQUIREMENTS OF MOBILE COMMUNICATION

Q.20. Which components are required for mobile communication.

Components

Components of Mobile Communication

Following are the components required for communication to connecting to a cellular network as shown in Fig 6.7.

Fig 6.7 Mobile Phone Network

- The following are the components required for mobile communications
- Mobile station
- Base station
- Switching center
- Public switched telephone network

1. **Mobile phones**

Mobile phone is a device that allows making and receiving calls over a cellular network. Modern mobile phones also support a wide variety of other services such as text messaging.

2. **Base station**

Base station communicates with many mobile phones at the same time. It is equipped with the transceiver and antenna for transmitting and receiving signals from mobile phones. It is responsible for communicating with each mobile phone in its area.

3. **Switching unit**

Switching unit is a computer or similar network that carries out routing functions and the two-way switching of calls between subscribers. It is also used to set up calls to other networks and to handle requests for additional services such as mobile phones for communication with other networks.

4. **Telephone Landline**

Public Switched Telephone Network is a worldwide Public Switched Telephone Network (PSTN). It is the network of the world's public circuit-switched telephone networks.

6.4.2 FEATURES AND LIMITATIONS OF MOBILE COMMUNICATION SYSTEMS

Q.21. Describe the features and limitations of mobile communication systems.

Features and limitations of mobile communication systems

Following are the features and limitations of mobile communication systems:

1. Mobile devices have limited resources.
2. Mobile devices rapidly exchange information from the World Wide Web. The validity and accuracy of information cannot be guaranteed since anybody can easily upload any information on Web sites.
3. Mobile devices are not always connected to the network.
4. Mobile Internet does more slow and greater interaction with time zone without the permission of connection to the network.
5. Data use of mobile computing devices will eventually make people more dependent on them and more vulnerable to their failure.

Limitations of mobile communications systems

Following are the limitations of mobile communication systems as follows as mentioned below:

- Limited CPU intensive, account login details and password, which can be very hard to type.
- Mobile communication devices and mobile phones to communicate with each other.
- Mobile Internet devices have the limitations of small display, low memory, limited battery power and slow CPU.

6.4.3 ARCHITECTURE FOR COMMUNICATION SYSTEMS IN MOBILE DEVICES

Q.22. Explain the architecture for roadandwireless and mobile devices.

Architecture

Architecture for Communication over Mobile Devices

The Mobile Service Communication Architecture includes the following wireless data communication equipment.

1. Web Protocol Stack
2. Wireless Markup Language (WML)
3. Wireless Application Protocol (WAP)
4. Web Protocol Stack (HTTP, TCP, IP)

Web protocol stack is a set of protocols HTTP and HTTP. Its purpose is to allow two computers to communicate with each other over the Internet. When a message is sent over Internet, it is translated into a set of packets. Each packet is sent over the Internet and reassembled when it reaches its destination. Each packet contains the destination address, the sender's address and a portion of the message to be sent. The protocols that are used to send packets over the Internet are TCP and IP. The protocol that is used to transmit an TCP/IP protocol stack. Fig 6.8 shows how messages is sent over Internet from source to destination using protocol stack.

Fig 6.8 Working of Web Protocol Stack

5. **Wireless Markup Language (WML)**

Wireless Markup Language (WML) is HTML and XML are designed to format internet contents to small wireless devices, such as browser-equipped mobile phones and other handheld devices. These devices have small screens, limited input capabilities, low memory and bandwidth and use wireless networks that have low capabilities. WML documents are stored as text and presented by a browser on the wireless device. WML documents are also compiled into a binary format for transmission to the wireless device.

6. **Wireless Application Protocol (WAP)**

Wireless Application Protocol (WAP) is a standard that allows mobile phones to initiate users of wireless phones and other wireless devices such as pagers and personal digital assistants (PDAs). These devices receive the standard for providing access to Internet content and advanced services.

KEY POINTS

- Wireless communication is the process of exchanging information between two or more devices over a distance without the help of wires, cables or any other forms of electrical conductors.
- Wireless networks are flexible. Data can be sent between computers anywhere in or outside the company. Wireless networks support roaming, such that a user can move from one access point to another.
- Wireless Ethernet (802.11b) or Wi-Fi (802.11a) or WiMAX (802.16) or Wireless Broadband are the important wireless technologies.
- A radio signal or radio wave is an electromagnetic wave propagated by an antenna. Radio waves are used in many communication systems. They are generated artificially and can carry audio, video or other signal signals.
- A Wireless Access Point (WAP) is a device that allows wireless devices to connect to a wired network using Wi-Fi. The access point connects to the wired network and then broadcasts signals that allow wireless devices to connect to the network within a certain range.
- Wireless communication is the term used to describe communications between two or more devices without any physical connection. The radio waves are of certain frequencies and wavelengths that are used to transmit the signals. The wireless devices are the devices that are capable of receiving and transmitting the signals. Wireless communication refers to technology that transmits information over a distance without the help of wires, cables or any other forms of electrical conductors. The demand for wireless communication is rapidly increasing today.
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- Wireless networks provide easy access to the consumers to the applications and decrease help employees to get the job done when they are away from the company.
- The main disadvantage of the wireless network is security issues. Intruders themselves can tap into the network and can easily steal the valuable information.
- Wireless technology is about to overcome the connectivity issues that is a problem of large changes.
- Sometimes wireless network speed can be slower than wired networks because of the low bandwidth.
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- Wireless networks are susceptible also used as a denial of service attack.

- Wi-Fi Wireless Local Area Network (WLAN)
- Wireless networks network has a range of up to 50 to 70 m. It provides wireless alternative to Cable TV and DSL.
- Wi-Fi provides a short-range wireless connection to exchange information between devices such as mobile phones, laptops, digital cameras and video game consoles.
- Wi-Max is a wireless broadband connection. It provides service over about kilometers you are within a city and other similar devices.
- Global Positioning System (GPS) is a radio navigation system that allows people on land, in sea or in air to determine their exact position.
- Global Positioning System (GPS) are widely used for navigation, air guidance, ships ground vehicles and by individuals.
- Geostationary Earth Orbit is an orbit directly above the earth's EQUATOR. An object in a geostationary orbit appears motionless, in a fixed position in the sky, to ground observers.
- Low Earth Orbit is located above the earth orbit and below geostationary earth orbit. It is also known as low orbit.
- Low Earth Orbit is located at an altitude of 2,000 km. It is also known as a circular geocentric orbit for navigation, such as the Global Positioning System at an altitude of 20,200 km.
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- Base station communicates with many mobile phones at the same time. It is equipped with the transceiver and antenna for transmitting and receiving signals from mobile phones. It is responsible for communicating with each mobile phone in its area.
- Switching unit is a computer or similar network that carries out routing functions and the two-way switching of calls between subscribers. It is also used to set up calls to other networks and to handle requests for additional services such as mobile phones for communication with other networks.
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EXERCISE

Multiple Choice Questions

1. What is the following the range of Wi-Fi?
   a. 50 to 70 m b. 100 to 150 m c. 200 to 250 m d. 300 to 350 m
2. Which of these is not a wireless technology?
   a. Bluetooth b. Wi-Max c. Infra-red d. Wireless Broadband
3. What is the full form of Wi-Fi?
   a. Wireless Fidelity b. Wireless Frequency c. Wireless Signal d. Wireless Frequency
4. What is the full form of Wi-Max?
   a. Worldwide Interoperability for Microwave Access b. Worldwide Interoperability for Microwave Antenna c. Worldwide Interoperability for Microwave Signal d. Worldwide Interoperability for Microwave Frequency
5. Which of these is performance more than 100 to 3,000 Mbps?
   a. Wireless Broadband b. Wi-Max c. Infra-red d. Bluetooth
6. Which of these is not a wireless technology?
   a. Wireless Broadband b. Wi-Max c. Infra-red d. Bluetooth
7. Which of these is used for short distance communication?
   a. Wireless Broadband b. Wi-Max c. Infra-red d. Bluetooth
8. Which of these is not a wireless technology?
   a. Wireless Broadband b. Wi-Max c. Infra-red d. Bluetooth
9. What is the full form of Bluetooth?
   a. Wireless Broadband b. Wi-Max c. Infra-red d. Bluetooth
10. What is the full form of Wi-Max?
    a. Worldwide Interoperability for Microwave Access b. Worldwide Interoperability for Microwave Antenna c. Worldwide Interoperability for Microwave Signal d. Worldwide Interoperability for Microwave Frequency
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19. What is the full form of Wi-Max?
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20. What is the full form of Wi-Fi?
    a. Wireless Fidelity b. Wireless Frequency c. Wireless Signal d. Wireless Frequency

Answers

1. a 2. c 3. a 4. a 5. a 6. c 7. c 8. c 9. a 10. a 11. a 12. a 13. a 14. a 15. a 16. a 17. a 18. a 19. a 20. a

Fill in the Blanks

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- Cellular communication divides a geographical region into sections called cells and here a Base station is located in each cell. The BS contains a transceiver and controller that provides radio communication to mobile phones.
- Global Positioning System (GPS) is a radio navigation system that allows people on land, in sea or in the air to determine their exact position.
- Geostationary Earth Orbit is an orbit directly above the earth's equator with a period equal to the earth's rotational period.
- Medium Earth Orbit is located above low earth orbit and below geostationary earth orbit. It is mainly used for navigation satellites.
- Low Earth Orbit is located up to an altitude of 2,000 Km from the earth's surface. Less energy is required to place a satellite into a low earth orbit and it requires low power amplifiers for communication.
- Wireless Markup Language (WML) is a markup language used to deliver Internet contents to small wireless devices such as mobile phones and other hand-held devices.

EXERCISE

Q1. Tick (√) the most correct one for the following: (10 X1=10)

i. Which of the following has a range of 40 to 50 Km?
A. Wi-Fi B. Wi-Max C. Bluetooth D. Infra-red

ii. Which of these uses extremely high frequency waves for short range communication?
A. Wi-Fi B. Wi-Max C. Bluetooth D. Infra-red

iii. Which of these is used for communication between mobile phones, laptop computers and digital cameras?
A. Wi-Fi B. Wi-Max C. Bluetooth D. Radio Signal

iv. Which of these is positioned from 160 to 2,000 Km above the earth surface?
A. Geostationary Earth Orbit B. Medium Earth Orbit
C. Low Earth Orbit D. GALILEO

v. Which orbit is located directly above the earth's equator?
A. Geostationary Earth Orbit B. Medium Earth Orbit
C. Low Earth Orbit D. GALILEO

vi. What is a fixed station in a cellular wireless network called that provides local coverage for communication purposes?
A. Base station B. Satellite
C. Mobile Terminal D. Global Positioning System

vii. What is used to create web pages?
A. HTML B. HTTP C. WAP D. TCP

viii. What is HTTP?
A. Markup language B. Protocol for mobile phones
C. Application layer protocol D. Transport layer protocol

ix. Which of these provides wireless alternative to cable TV and DSL?
A. Wi-Fi B. Infra-red
C. Wi-Max D. Wireless Access Point

x. In which earth orbit satellite is placed for navigation purposes?
A. Geostationary earth orbit B. Medium earth orbit
C. Low earth orbit D. High earth orbit

Answers

i.	B	ii.	D	iii.	C	iv.	C	v.	A
vi.	A	vii.	A	viii.	C	ix.	C	x.	B

Q2. Write short answers of the following questions:

i. Define radio signal and transceiver.
Answer
Radio Signal
Radio signal or radio wave is an electromagnetic wave propagated by an antenna. Radio waves have different frequencies and tuning a radio receiver to a specific frequency you can pick up a specific radio signal.
Transceiver
A transceiver is a device, which can transmit and receive a radio signal and have a common circuitry in a single housing. In case of radio, the transmitter and the receiver are separated.

ii. What is Wireless Access Point?
Answer
Wireless Access Point
A Wireless Access Point (WAP) is a device that allows wireless devices to connect to a wired network using Wi-Fi. The access point connects to the wired network and then broadcasts signals that allow nearby wireless devices such as laptop computers.

iii. What is meant by line of sight communication?
Answer
Line of Sight Communication
In Line of Sight (LOS) communication, the transmitter and receiver antennas are in line of sight with each other. Signals travel in a straight line and cannot penetrate solid objects. They cannot travel through structures and hills. For long distance communication, transmitters are installed on high buildings, mountaintops or high towers. Relay stations (boosters) are used to amplify the signals and retransmit from station to station.

iv. Differentiate between short distance and long distance wireless communication.
Answer
Difference between short distance and long distance wireless communication:

Short Distance Wireless Communication	Long Distance Wireless Communication
Short distance wireless communication consists of very short distance of few meters to a distance of up to 50 Km. Wi-Fi, Wi-Max, Bluetooth and infra-red are the types of short distance wireless communications.	Long distance wireless communication comprises of distance above 50 Km using either cellular communication or global positioning system.

v. What is base station?
Answer
Base station
Base station communicates with many mobile phones at the same time. It is equipped with a transceiver and antenna for transmitting and receiving signals from mobile phones. It is responsible for handing traffic and signaling between mobile phones.

vi. Define Global Positioning System (GPS)?
Answer
Global Positioning System
Global Positioning System (GPS) is a radio navigation system that allows people on land, in sea or in the air to determine their exact position, 24 hours a day anywhere in the world in all weather conditions.

vii. What is Wireless Markup Language?
Answer
Wireless Markup Language (WML)
Wireless Markup Language is based on HTML and XML and it delivers Internet contents to small wireless devices, such as browser-equipped mobile phones and other handheld devices. These devices have small screens and limited keypads. They have low memory and processing power. Despite restricted user-input capabilities, WML demands more memory and processing power from browsers than HTML. WML also includes features that support relatively small display sizes of today's wireless devices.

viii. What is Wireless Application Protocol?
Answer
Wireless Application Protocol (WAP)
WAP consists of multiple protocols that provide Internet access to mobile users of wireless phones and other wireless devices such as pagers and personal digital assistants (PDAs). Today, it has become the standard for providing data and voice services to wireless hand-held devices.

ix. What is web protocol stack?
Answer
Web Protocol Stack
Web Protocol Stack consists of TCP/IP and HTTP. Its purpose is to allow two computers to communicate with each other over the Internet whether a message is sent over Internet or it is retrieved from text form to electronic signals at the source computer and then translated back to text form at the destination computer. TCP/IP is usually built in the operating system such as Windows. The protocol stack is usually built in the operating system such as Windows. The protocol stack used for the Internet is known as TCP/IP protocol stack.

x. What is HTTP?
Answer
HTTP
The Hypertext Transfer Protocol (HTTP) is an application protocol for distributed, collaborative, and hypermedia information systems. HTTP is the foundation of data communication for the World Wide Web. Hypertext is structured text that uses logical links (hyperlinks) between nodes containing text.

Q3. Write long answers of the following questions:

i. Define wireless communication and mention its advantages and disadvantages.
Answer
Wireless Communication
Wireless communication is a term used to describe communications between two or more devices without any physical connection. The wide spread use of mobile technology, various satellite services, and now the wireless Internet and wireless LANs are generating incredible changes in telecommunications and networking. Wireless communication refers to technology that transmits information over a distance without the help of connections such as wires. An alternative to using network cables. The demand for wireless communication is rapidly increasing today.
Advantages of Wireless Networks
1. Wireless networks can easily add users without having to change the physical connection.
2. Wireless networks provide robust security protections. Traffic of a wireless network can be filtered or simply blocked very easily.

3. Using wireless networks users 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.
4. In most of the wireless networks, users can connect automatically if they are within the range.
5. Setting up a wireless network can be much more cost effective than buying and installing cables. Because wireless networks eliminate or reduce wiring costs.
6. Wireless networks are flexible and easy to change and grow. We can easily expand wireless network with existing equipment, while a wired network might require additional wiring.
7. Wireless networks provide remote access to the company's key applications and resources help employees to get the job done while they are away from the company.

Disadvantages of Wireless Networks
1. The main disadvantage of the wireless network is security breach. Intruders (hackers) can tap into a wireless network relatively easier than a wired network.
2. Another disadvantage is about the coverage area somewhere users might face problems of range of signals.
3. Sometimes wireless networks speed can be slower than wired networks because of the low signals.
4. Because wireless networks use radio signals and similar techniques for transmission they are susceptible to interference from magnetic or electronic effects.
5. Wireless signal energy weakens rapidly as the signal passes through the environment consisting of trees, buildings, etc.
6. In wireless networks, bad weather also plays a role in weakening the signals.
7. Describe the following short distance communications.
   - Wi-Fi
   - Wi-Max
   - Bluetooth
   - Infra-red

Answer
Wi-Fi
Wi-Fi (Wireless Fidelity) is a wireless communication system very commonly used at home and office. It is also called WLAN (Wireless LAN). It is a popular wireless networking technology, which uses radio waves to provide wireless high-speed Internet and network connections. Wi-Fi networks are easy to setup and are inexpensive. In Wi-Fi, information travels over the air. These networks are extremely limited in range due to low power of transmissions allowing users to connect only within close proximity of the wireless access point. Wi-Fi is common in home networking applications, which provides portability without any need of cables. Wi-Fi networks need to be secured with passwords for security purposes in order not to be accessed by others.
Wi-Max
Wi-Max (Worldwide Interoperability for Microwave Access) is a wireless network that provides point-to-multipoint broadband connections across different locations. It operates at 40 GHz. Wi-Max creates a Metropolitan Area Network (MAN) and provides a wireless alternative to Cable TV and DSL Internet connection. It provides service just about anywhere you go within a city. It transmits information through microwave and uses a more complex technology than Wi-Fi.
Bluetooth
Bluetooth is a short-range and low speed wireless communication technology. Its range is around 10 meters with the data transfer rate up to 723 Kbps and it consumes low power. It provides a way to connect and exchange information between devices such as mobile phones, laptop computers, PCs, printers, digital cameras, and video game consoles. Bluetooth can be used to replace cables between the PC and the linking devices such as mouse, keyboards, mouse, etc.

Infra-red
Infra-red (IR) waves are extremely high frequency waves which are used for short range communication.
Applications of Infra-red Technology
Some common applications of Infra-red technology are listed below.
1. Car locking systems use Infra-red technology for automatic locking and unlocking the doors of cars.
2. Modern Computers have Infra-red enabled mouse, keyboards, and printers.
3. Home security systems have Infra-red enabled burglar alarm system.
4. Infra-red is used in Night Vision in TVs, Toys, etc. uses Infra-red technology.

ii. Describe cellular communication and mention its advantages and disadvantages.
Answer
Cellular Communication
Cellular communication refers to wireless communication systems that divide a geographical region into sections called cells. Each cell has a base station (BS) in the center that contains a transceiver and controller that provides radio communication to mobile phones.
In cellular communication, each mobile phone uses a separate temporary radio frequency (channel) to talk to the Base Station (BS). The BS talks to many mobile users at the same time as shown in Fig 6.3.

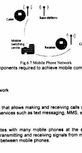

Fig 6.3 Cellular communication network

Channels use a pair of frequencies for communication. For example, the uplink is used for the mobile phone to communicate with the BS and another frequency for the downlink for the BS to communicate with the mobile phone.
The basic concept of cellular communication is that it reuses the radio frequency by the cell that is at a distance of the minimum interference of the other.
Advantages of cellular communication
1. Cellular communication makes communicating with family, friends and colleagues a lot easier.
2. Cellular communication is really useful in emergency situations.
Disadvantages of cellular communication
1. Privacy risk is a big disadvantage of cellular communication.
2. Frequent use of cellular communication is really harmful because of the designe nowadays.
3. Potential loss of data if stolen.

iv. Describe GEO, MEO and LEO.
Answer
GEO (Geostationary Earth Orbit)
A Geostationary Earth Orbit (GEO) or Geostationary Orbit is an orbit directly above the earth's equator (at 0° latitude), with a period equal to the earth's rotational period. An object in a geostationary orbit appears to be fixed in the sky if observed from the earth. Communication satellites and weather satellites are commonly placed in geostationary orbits, so that the earth-based antennas (located on the earth) that communicate with them do not have to track them, but can be placed permanently at the fix position where they stay.

MEO (Medium Earth Orbit)
A Medium Earth Orbit (MEO) is located above low earth orbit (altitude of 2,000 kilo meters) and below geostationary earth orbit (altitude of 35,786 kilo meters). Medium earth orbits are generally used for navigation, such as the Global Positioning System at an altitude of 20,200 km. For example, GLONASS (a Russian satellite-based navigation system) is at an altitude of 19,100 Km and GALILEO (a European Union (EU) satellite-based navigation system) is at an altitude of 23,222 Km above earth.
LEO (Low Earth Orbit)
A Low Earth Orbit (LEO), also known as low orbit, is generally defined from the earth's surface up to an altitude of 2,000 km. But the commonly used definition for LEO is from 160 km to 2,000 km above the earth surface. Less energy is required to place a satellite into a low earth orbit and it requires low power amplifiers for communication. Therefore, this orbit is used for many communication applications. The International Space Station, Iridium satellites, the Space Shuttle, and the mobile Satellite Telescope are at work in Low Earth Orbit.

v. Explain how mobile communication is achieved?
Answer
Communication between mobile phones is achieved by connecting to a cellular network as shown in Fig 6.7.

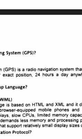

Fig 6.7 Mobile Phone Network

The following are the components required to achieve mobile communications:
- Mobile phone
- Base station
- Switching node
- Landline telephone network

1. Mobile phone

Mobile phone is a device that allows making and receiving calls over a cellular network. Modern mobile phones also support services such as text messaging, MMS, email and Internet.

2. Base station

Base station communicates with many mobile phones at the same time. It is equipped with a transceiver and antenna for transmitting and receiving signals from mobile phones. It is responsible for handing traffic and signaling between mobile phones.

3. Switching node

Switching node is a component of cellular network that carries out switching and mobility management functions for mobile phones on network of base stations. Switching nodes are owned and deployed by mobile phone operators and allow mobile phones to communicate with each other and telephone landline network.

4. Telephone Landline

Telephone Landline Network is a wired Public Switched Telephone Network (PSTN) that is connected with cables to provide communication between mobile phone and telephone on PSTN.

vi. What are the features and limitations of mobile communication?
Answer
Features of mobile communication systems
Following are the features and limitations of mobile communication system:
1. Mobile phones are used to communicate and to surf the Web. The validity and accuracy of information cannot be guaranteed since anybody can easily put any information on Web sites unlike books that undergo a process of scrutiny before publication.
2. Mobile phones are used to download songs and movies which is a violation of the creation of publisher and this is violations of property rights.
3. Daily use of mobile computing devices will eventually make people more dependent on them instead of relying on their own potentials.
Limitations of mobile communication systems
1. Without proper protection, hackers can install spyware on other's mobile devices for capturing credit card information, account login details and password, which can be very harmful.
2. Wireless mobile communication has the limitation of low processing capability, high error rate and low storage availability.
3. Handheld mobile devices have the limitations of small display, low memory, limited battery power and small keyboard.

LAB ACTIVITIES

Following lab activities are to be carried out during the practical periods.

1) Configure Local Area Network (WLAN) should be created to demonstrate wireless communication.
Answer
Practical Work
2) Sharing of files/folders on WLAN should be demonstrated.
Answer
Practical Work
3) Use of Bluetooth for communication between a mobile and computer should be demonstrated.
Answer
Practical Work
4) GPS installed in a Car may be demonstrated to the students through video/animation.
Answer
Practical Work

Q.1 Select the best answer for the following MCQs.

1. **It is a term used to describe communications between two or more devices without any physical connection:**
   A. Wireless communication B. Data communication
   C. Data transmission D. Data manipulation
2. **It is an electromagnetic wave propagated by an antenna:**
   A. Radio signal B. Wi-Fi signal C. Infra-red signal D. Electric signal
3. **All the Radio Frequency (RF) systems consist of ____ components:**
   A. Two B. Three C. Four D. Five
4. **It transmits a radio signal to a receiver, which listens for the signal and receives it:**
   A. Transmitter B. Receiver C. Sender D. Compiler
5. **It is a device, which can transmit and receive a radio signal and have a common circuitry in a single housing:**
   A. Transmitter B. Receiver C. Transceiver D. Sender
6. **Long distance wireless communication comprises of distances above:**
   A. 10 Km B. 50 Km C. 30 Km D. 20 Km
7. **Wi-Max covers a big range of:**
   A. 10 to 20 Km B. 15 to 25 Km C. 40 to 50 Km D. 30 to 60 Km
8. **Wi-Max creates a:**
   A. MAN B. WAN C. LAN D. PAN
9. **GPS provides the location in the:**
   A. World B. Universe C. City D. Country
10. **GPS stands for:**
    A. Global Positioning system B. Grand Positioning system
    C. Great Position system D. Globalization Positioning system
11. **For exchanging data over short distances, we use:**
    A. GPS B. Bluetooth C. Modem D. NIC
12. **It is an orbit directly above the earth's equator (at 0° latitude), with a period equal to the earth's rotational period:**
    A. GEO B. MEO C. LEO D. AEO
13. **It is located above low earth orbit and below geostationary earth orbit:**
    A. GEO B. MEO C. LEO D. AEO
14. **It is generally defined from the earth's surface up to an altitude of 2,000 km:**
    A. GEO B. MEO C. LEO D. AEO
15. **LEO is from _____ above the earth surface:**
    A. 160 km to 2,000 km B. 1000 km to 2,000 km
    C. 100km to 1,000 km D. 180km to 1,500 km
16. **Its purpose is to allow two computers to communicate with each other over the Internet:**
    A. Web Protocol Stack B. Wireless Mark-up Language
    C. Wireless Application Protocol D. Wireless Software Protocol
17. **It is based on HTML and XML and it delivers Internet contents to small wireless devices, such as browser-equipped mobile phones and other handheld devices:**
    A. Web Protocol Stack B. Wireless Mark-up Language
    C. Wireless Application Protocol D. Wireless Software Protocol
18. **It includes features that support relatively small display sizes of today's wireless devices:**
    A. Web Protocol Stack B. Wireless Mark-up Language
    C. Wireless Application Protocol D. Wireless Software Protocol

19. **It consists of multiple protocols that provide Internet access to mobile users of wireless phones and other wireless devices.**
    A. Web Protocol Stack B. Wireless Mark-up Language
    C. Wireless Application Protocol D. Wireless Software Protocol

Answers:

1.	Wireless communication	**2.**	Radio signal
3.	Two	**4.**	Transmitter
5.	Transceiver	**6.**	50 Km
7.	40 to 50 Km	**8.**	MAN
9.	City	**10.**	Global Positioning system
11.	Bluetooth	**12.**	GEO
13.	MEO	**14.**	LEO
15.	160 km to 2,000 km	**16.**	Web Protocol Stack
17.	Wireless Mark-up Language	**18.**	Wireless Mark-up Language
19.	Wireless Application Protocol		

Q.2 Give short answers of the following questions.

Q1: Define wireless communication.

Ans. Wireless communication refers to technology that transmits information over short or long distance without using connecting wires. It is alternative to using network cables.

Q2: State the term "wireless".

Ans. The term wireless refers to the communication or transmission of information over a distance without requiring wires, cables or any other electrical conductors.

Q3: Name some important wireless technologies.

Ans. Some important wireless technologies are

- ⇨ Satellite
- ⇨ Microwave
- ⇨ Wi-Fi
- ⇨ Wi-MAX
- ⇨ Infra-red

Q4: Describe the function of wireless network.

Ans. A wireless network enables people to communicate and access applications and information without wires. This provides freedom of movement and the ability to extend locations to different parts of a building, city, or nearly anywhere in the world. Wireless works allow people to interact with e-mail or browse the Internet from a location the way they prefer.

Q5: Write down any three Advantages of Wireless Networks.

Ans.

1. Wireless networks can easily add users without having to change the physical connection.
2. Wireless networks provide robust security protections. Traffic of a wireless network can be filtered or simply blocked very easily.
3. Using wireless networks users 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.

Q6: Write any three Disadvantages of Wireless Networks.

Ans.

1. The main disadvantage of the wireless network is security breach. Intruders (hackers) can tap into a wireless network relatively easier than a wired network.
2. Another disadvantage is about its coverage that somewhere users might face problems of range of signals.

19. It consists of multiple protocols that provide Internet access to mobile users of wireless phones and other wireless devices.

A Web Protocol Stack
B Wireless Mark-up Language
C Wireless Application Protocol
D Wireless Software Protocol

Answers:

1.	Wireless communication	2.	Radio signal
3.	Two	4.	Transmitter
5.	Transceiver	6.	50 Km
7.	40 to 50 Km	8.	MAN
9.	City	10.	Global Positioning system
11.	Bluetooth	12.	GEO
13.	MEO	14.	LEO
15.	160 km to 2,000 km	16.	Web Protocol Stack
17.	Wireless Mark-up Language	18.	Wireless Mark-up Language
19.	Wireless Application Protocol		

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- ⇨ Microwave
- ⇨ Wi-Fi
- ⇨ Wi-MAX
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Ans.

1. The main disadvantage of the wireless network is security breach. Intruders (hackers) can tap into a wireless network relatively easier than a wired network.
2. Another disadvantage is about its coverage that somewhere users might face problems of range of signals.

3. Sometimes wireless networks speed can be slower than wired networks because of the low signals.

Q7: Define radio signal.
Ans. A radio signal or radio wave is an electromagnetic wave propagated by an antenna. Radio waves have different frequencies and tuning a radio receiver to a specific frequency you can pick up a specific radio signal.

Q8: Name the Parts of Radio Frequency Systems.
Ans. All the Radio Frequency (RF) systems consist of two components:
- ⇨ Transmitter
- ⇨ Receiver

Q9: How do radio frequency systems work?
Ans. A transmitter transmits a radio signal to a receiver, which listens for the signal and receives it. RF systems include a set of rules that define how the transmitter and receiver communicate. For example, a rule set can specify that the transmitter must communicate with the receiver at a specific frequency. Early radio signals were analogue but today most of the radio signals are digital.

Q10: Define radio transceiver.
Ans. A transceiver is a device, which can transmit and receive a radio signal and have a common circuitry in a single housing.

Q11: What is meant WAP?
Ans. WAP stands for Wireless Access Point (WAP). WAP is a device that allows wireless devices to connect to a wired network using Wi-Fi. The access point connects to the wired network and then broadcasts signals wirelessly to all the other wireless devices such as laptop computers as shown in Fig.6.3.

Q12: Where line of sight is used?
Ans. Line of sight communication is used in high frequency communication where the signals cannot pass through structures and hills. For long distance communication, transmitters are installed on high buildings, mountaintops or high towers. Relay stations (boosters) are used to amplify the signals and retransmit from station to station.

Q13: What is meant by short distance wireless communication?
Ans. Short distance wireless communication consists of very short distance of few meters (Infra-red) to a distance of up to 50 Km (Wi-Max).

Q14: Name the types of short distance wireless communications.
Ans. Following are the types of short distance wireless communications:
- ⇨ Wi-Fi
- ⇨ Wi-Max
- ⇨ Bluetooth
- ⇨ Infra-red

Q15: What is meant by long distance wireless communication?
Ans. Long distance wireless communication comprises of distances above 50 Km using either cellular communication methods or Global Positioning Systems, which utilizes satellites.

Q16: Write a short note on Wi-Max.
Ans. Wi-Max (Worldwide Interoperability for Microwave Access) is a wireless network that provides public network service to users. It covers a big range of 40 to 50 Km. Wi-Max creates a Metropolitan Area Network and provides a wireless alternative to Cable TV and DSL Internet connection. It provides service just about anywhere you go within a city. It transmits information through microwave and uses a more complex technology than Wi-Fi.

Q17: Write a short note on Bluetooth.
Ans. Bluetooth is a short-range and low speed wireless communication technology. Its range is around 10 meters with the data transfer rate up to 723 Kbps and it consumes low power. It provides a way to connect and exchange information between devices such as mobile phones, laptop

computers, PCs, printers, digital cameras, and video game consoles.

Q18: What are infra-red rays?
Ans. Infra-red (IR) waves are extremely high frequency waves which are used for short range communication.

Q19: Write down some common applications of infra-red technology.
Ans. Some common applications of infra-red technology are listed below.

1. Car locking systems use Infra-red technology for automatic locking and unlocking the doors of cars.
2. Modern Computers have infra-red enabled mouse, keyboards, and printers.
3. Home security systems have infra-red enabled burglar alarm system.
4. Remote control system in TVs, Toys, etc. uses infra-red technology.

Q20: Which service is provided by long distance wireless communications?
Ans. Long Distance wireless communication systems provide services that are not possible with the use of cables. It includes cellular and global positioning systems.

Q21: State the term "Cellular Communication".
Ans. Cellular communication refers to wireless communication systems that divide a geographical region into sections called cells. Each cell has a Base Station (BS) at the center bat contains a transceiver and controller that provides radio communication to mobile phones.

Q22: Define base station.
Ans. In cellular communication, each mobile phone uses a separate temporary radio frequency (channel) to talk to the Base Station (BS). The BS talks to many mobile users at the same time.

Q23: What is the basic concept of cellular communication?
Ans. The basic concept of cellular communication is that it reuses the radio frequency by the cell that are at a distance where there is no interference of the other.

Q24: Define GPS.
Ans. Global Positioning System (GPS) is a radio navigation system that allows people on land, in sea or in the air to determine their exact position, 24 hours a day anywhere in the world in all weather conditions.

Q25: Write down the uses of GPS.
Ans. GPS are used for navigation, on airplanes, ships, ground vehicles, and by individuals. Also the relative positioning and time data is used to study the movement of tectonic plates to understand the earthquakes, astronomical observations, telecommunications, etc.

Q26: Define satellite.
Ans. A satellite is a relay station, which is placed into orbit by humans.

Q27: State the uses of satellites.
Ans. Satellites are used for various purposes such as military and civilian earth observation satellites, communications satellites, navigation satellites, weather satellites, and research satellites. The orbits used by the satellites may be defined as Geostationary Earth Orbit, Medium Earth Orbit or Low Earth Orbit.

Q28: Into how many types, satellite systems can be classified?
Ans. 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)

Q29: Define mobile communication.
Ans. Mobile communication involves the use of mobile devices such as mobile phones, smart phones, PDAs and laptop and tablet computers. Mobile communication devices give the freedom to communicate with others or access information everywhere. These devices improve our efficiency and productivity.

Q30: Which components are required for mobile communications?
Ans. The following are the components required for mobile communications:
- ⇨ Mobile phone
- ⇨ Base station
- ⇨ Switching node
- ⇨ Landline telephone network

Q31: What is considered a mobile device?
Ans. Mobile phone is a device that allows making and receiving calls over a cellular network.

Q32: Define switching node.
Ans. Switching node is a component of cellular network that carries out switching and mobility management functions for mobile phones on network of base station.

Q33: Write down any two features of mobile communication systems.
Ans.

1. Mobile Internet users' copy and paste information from Web sites without the permission of publisher and this is violations of property rights.
2. Daily use of mobile computing devices will eventually make people more dependent on them instead of relying on their own potentials.

Q34: Write down any two limitations of mobile communication systems.
Ans.

1. Wireless mobile communication has the limitation of low processing capability, high error rate and low storage availability.
2. Handheld mobile devices have the limitations of small display, low memory, limited battery power and limited CPU power.

Q35: Which capabilities are included in mobile device communication?
Ans. The Mobile Device Communication Architecture includes the following wireless data communication capabilities.
- ⇨ Web Protocol Stack
- ⇨ Wireless Mark-up Language (WML)
- ⇨ Wireless Application Protocol (WAP)

Q36: What is meant by Web Protocol Stack?
Ans. Web Protocol Stack consists of TCP/IP and HTTP. Its purpose is to allow two computers to communicate with each other over the Internet. When a message is sent over Internet, it is translated from text form to electronic signals at the source computer and then translated back to text form at the destination computer. Every computer needs protocol stack to communicate over the Internet and it is usually built in the operating system such as Windows. The protocol stack used for the Internet is known as TCP/IP protocol stack.

Q37: What is meant by Wireless Mark-up Language?
Ans. Wireless Mark-up Language is based on HTML and XML and it delivers Internet contents to small wireless devices, such as browser-equipped mobile phones and other handheld devices. These devices have very small displays, slow CPUs, limited memory capacity, low bandwidth and restricted user-input capabilities. WML demands less memory and processing power from browsers than HTML. WML also includes features that support relatively small display sizes of today's wireless devices.

Q38: What is meant by Wireless Application Protocol?
Ans. WAP consists of multiple protocols that provide Internet access to mobile users of wireless phones and other wireless devices such as pagers and personal digital assistants PDAs). Today, it has become the standard for providing data and voice services to wireless hand-held devices.