SCHEME OF EVALUATION

Scoring Indicators

VERSION A

Revision : 2015
Course Title : MOBILE COMMUNICATION **Course Code : 6134**

Qst No	Scoring Indicators	Split Score	Total
I	**PART – A**		
1.	Handoff is the procedure for changing the assignment of a mobile unit from one Base Station to another as the mobile unit moves from one cell to another.	4 * ½ 2	2
2.	Frequency division multiple access, Time division multiple access, code division multiple access, Space division multiple access	4 v ½	2
3.	The component in the satellite that takes an uplink signal and converts it to a downlink signal is called a transponder.	2	2
4.	High capacity, ability to cover short distances, full connectivity among attached stations, broadcast capability, throughput, number of nodes, handoff/roaming, dynamic configuration etc.	Any 4 * ½	2
5.	A device in one piconet may exist as part of another piconet and may function as either a slave or a master in each piconet. This form of overlapping is called a scatternet.	2	2
II	**PART – B**		
1.	The original cellular telephone networks provided analog traffic channels are now referred to as first-generation systems. The first generation system in North America was Advanced Mobile Phone Service (AMPS) . Spectral Allocation of AMPS: In North America two 25-MHz bands are allocated, one for transmission from the base station to the mobile unit (869-894 MHz), the other for transmission from the mobile unit to the base station (824-849 MHz). Each of these bands is split in two. An operator is allocated only 12.5 MHz in each direction for its system. The channels are spaced 30 kHz apart, which allows a total of 416 channels per operator. Twenty-one channels are allocated for control, leaving 395 to carry calls. The control channels are data channels operating at 10 kbps. The conversation channels carry the conversations in analog using frequency modulation. Control information is also sent on the conversation channels in bursts as data.		6
2.	In CDMA, each cell is allocated a frequency bandwidth, which is split into two parts, half for reverse (mobile unit to base station) and half for forward (base station to mobile unit). For full duplex communication, a mobile unit uses both reverse and forward channels. Transmission is in the form of direct-sequence spread spectrum (DS-SS), which uses a chipping code to	6	6

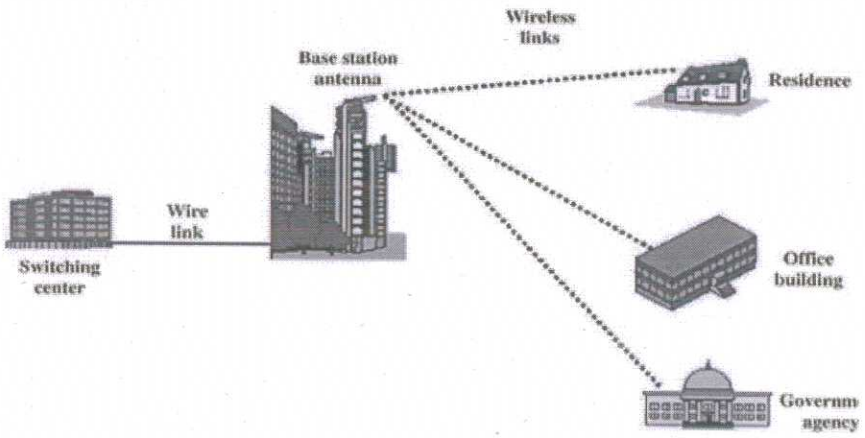
	increase the data rate of the transmission, resulting in an increased signal bandwidth. In addition, multiple users share same bandwidth at the same time. These users are differentiated by a unique pseudorandom orthogonal code sequence. In this, all the users use the same frequency band using a different pseudo code and operate independently. The capacity of CDMA system is interference limited. The reduction of interference increases the capacity of CDMA and can be achieved by using time division multiplexing.		
3.	(i) The area of coverage of a satellite system exceeds that of a terrestrial system. In geostationary satellite, a single antenna is visible to about one-fourth of the earth's surface. (ii) Spacecraft power and allocated bandwidth are limited resources that call for careful tradeoffs in earth station/satellite design parameters. (iii) Conditions between communicating satellites are more time invariant than those between satellite and earth station or between two terrestrial wireless antennas. (iv) Transmission cost is independent of distance, within the satellite's area of coverage. (v) Broadcast, multicast, and point-to-point applications are readily accommodated. (vi) Very high bandwidths or data rates are available to the user. (vii) Quality of transmission is extremely high. (vii) For a geostationary satellite, there is an earth-satellite-earth propagation delay of about one-fourth of a second. (viii) A transmitting earth station can in many cases receive its own transmission.	Any six * 1	6
4.	Working from the bottom up, the lowest layer of the IEEE 802 reference model corresponds to the physical layer of the OSI model and includes the functions as • Encoding/decoding of signals (e.g., PSK, QAM, etc.) • Preamble generation/removal (for synchronization) • Bit transmission/reception In addition, the physical layer of the 802 model includes a specification of the transmission medium and the topology transmission medium and the		6

	topology. Above the physical layer is two layers - Medium Access control layer and logical link control layer. Higher-level data are passed down to LLC, which appends control information as a header, creating an LLC protocol data unit (PDU). This control information is used in the operation of the LLC protocol. The entire LLC PDU is then passed down to the MAC layer, which appends control information at the front and back of the packet, forming a MAC frame.		
5.	It use microwave radio frequency band for signal transmission. Recently, all narrowband microwave LAN products used a licensed microwave band. At least one vendor has produced a LAN products in the ISM band. Classified into two - Licensed Narrowband RF and Unlicensed Narrowband RF Licensed Narrowband RF - Microwave radio frequencies usable for voice, data, video transmission are licensed. It avoids potential interference between systems within specific geographic areas. A narrowband scheme use cell configuration. Adjacent cells use non-overlapping frequency bands within the overall 18-GHz band. All transmissions are encrypted for providing security. It guarantees interference-free communication. Unlicensed Narrowband RF – This spectrum can used for narrowband transmission at low power of about 0.5 watts or less. The Radio LAN operates at 10 Mbps in the 5.8-GHz band. Radio LAN has a range of 50 m in a semi-open office and 100 m in an open office. The LAN also includes a dynamic relay function, which allows each station to act as a repeater to move data between stations that are out of range of each other.	Clasificati on – 1, Explanatio n – 2.5 each	6
6.	Bluetooth support three general application areas **Data and voice access points:** Bluetooth facilitate real-time voice and data transmissions by providing effortless wireless connection of portable and stationary communication devices. **Cable replacement:** Bluetooth eliminates the need for numerous cable attachments for connection of practically any kind of communication devices. Connections are instant and are maintained when devices are not within line of sight. **Ad hoc networking:** A device equipped with a Bluetooth radio can establish instant connection with another when in range.	3 x 2	6
7.	It was designed to enable wireless connectivity of high-speed, low-power, low-cost, multimedia-capable portable consumer electronic devices. This standard provides data rates from 11 to 55Mb/s at distances of greater than 70 m while maintaining quality of service (QoS) for the data streams. It also provide simple, ad-hoc connectivity that allows the devices to automatically form networks and exchange information without the direct	~~1~~ x 6	6

	intervention of the user. Privacy and integrity are provided for data and commands with 128-bit AES encryption used in CCM mode. This standard has also provided a variety of techniques that can be used to enhance the coexistence of 802.15.3 piconets with other wireless networks. The MAC layer specification is designed to support ad hoc networking, multimedia QoS provisioning, and power management. In an ad hoc network, devices can assume either master or slave functionality based on existing network conditions. Devices in an ad hoc network can join or leave an existing network without complicated setup procedures.		
	PART – C **Unit – I**		
III (a)	The ways of increasing the capacity of a cellular system are : 1. Adding new channels 2. Frequency borrowing 3. Cell Splitting 4. Cell sectoring 5. Microcells **Adding new channels :** When a system is set up in a region, all of the channels are not used, and growth and expansion can be managed in an orderly fashion. **Frequency borrowing :** The frequencies are taken from adjacent cells by congested cells. The frequencies can also be assigned to the cells dynamically. **Cell splitting:** The distribution of traffic and topographic features are not uniform. Cells in areas of high usage can be split into smaller cells. To use a smaller cell, the power level used must be reduced to keep the signal within the cell. Also, as the mobile units move, they pass from cell to cell, which requires transferring of the call from one base transceiver to another. This process is called a *handoff.* As the cells get smaller, these handoffs become much more frequent. **Cell sectoring:** A cell is divided into a number of wedge shaped sectors, each with its own set of channels, typically 3 or 6 sectors per cell. Each sector is assigned a separate subset of the cell's channels, and directional antennas at the base station are used to focus on each sector. **Microcells:** As cells become smaller, antennas move from the tops of tall buildings or hills, to the tops of small buildings or the sides of large buildings, and finally to lamp posts, where they form microcells. Each decrease in cell size is accompanied by a reduction in the radiated power levels from the base stations and the mobile units. Microcells are useful in city streets in congested areas, along highways, and inside large public buildings.	List – 2.5 Explanation – 1.5 x 5 = 7.5	10

III (b).	**Hard handoff:** In hard handoff, a mobile station communicates with only one base station. This type of connection, the source channel/BTS/BSC is first broken before making connection with the target channel/BTS/BSC. In an FDMA or TDMA system, neighbouring cells use different portions of the available frequency .When the signal strength of a neighbouring cell exceeds that of the current cell, plus a threshold, the mobile station is instructed to switch to a new frequency band that is within the allocation of the new cell. This is referred to as a **hard handoff.** **Soft handoff :** In soft handoff, a mobile station is temporarily connected to more than one base station simultaneously. In this type of connection, the source channel/BTS/BSC is retained for some time before making connection with the target channel/BTS/BSC is established. While in the soft handoff state, the transmissions from the mobile unit reaching the two base stations are both sent on to the mobile switching center, which estimates the quality of the two signals and selects one.	2.5 x 2	5
IV (a)	Different multiple access techniques in cellular system are: 1. Frequency Division Multiple Access (FDMA) 2. Time Division Multiple Access (TDMA) 3. Code Division Multiple Access (CDMA) and 4. Space Division Multiple Access (SDMA). **<u>FDMA (Frequency Division Multiple Access)</u>** - This scheme allocates frequencies to transmission channels according to the FDM scheme either in a fixed or dynamic manner. Users are assigned a pair of voice channels for forward and reverse transmission separately and simultaneously. In FDMA, each user transmits at single frequency. It can be used with analog and digital transmission. **TDMA (Time Division Multiple Access)** - It offers a flexible scheme by allocating time slots through TDM. In this, a user is given a particular slot for transmission and reception in a cycle way. **CDMA (Code Division Multiple Access)** - Multiple users share the same band at the same time. These users are differentiated by a corresponding unique pseudorandom orthogonal code sequence. In this, all users use the same frequency band using a different spreading PN code and operate independently. **SDMA(Space Division Multiple Access)** – It controls radio signal for each user using a spot beam antenna, In this different antenna beams are generated to cover the different areas of the cell thus serving users thro' these beam on the same frequency using TDMA or CDMA.	List – ½ x 4 = 2 Explanation – 1.5 x 4 = 6	8

IV (b).	The advantages of CDMA are: 1. Frequency diversity 2. Multipath resistance 3. Privacy 4. Graceful degradation **Frequency diversity:** The transmission is spread out over a larger bandwidth, frequency-dependent transmission impairments, such as noise bursts and selective fading, have less effect on the signal. **Multipath resistance:** In addition to the ability of Direct spread spectrum sequence (DS-SS) to overcome multipath fading by frequency diversity, the chipping codes used for CDMA not only exhibit low cross correlation but also low autocorrelation. **Privacy:** Because spread spectrum is obtained by the use of noise like signals, where each user has a unique code, privacy is inherent. **Graceful degradation:** With FDMA or TDMA, a fixed number of users can access the system simultaneously. However, with CDMA, as more users access the system simultaneously, the noise level and hence the error rate increases; only gradually does the system degrade to the point of an unacceptable error rate	3.5 + 3.5	7
	UNIT – II		
V (a).	WLL is a system that connects subscribers to the local telephone station wirelessly. It is based on a cellular satellite. WLL is the best system to handle high data traffic in the local loop system. A WLL provider services one or more cells. Each cell includes a base station antenna, mounted on a highest place. Individual subscribers have a fixed antenna mounted on a building or pole that has a line of sight to the base station antenna. The base station and the switching station is connected by using either a wired or a wireless link. The switching center is telephone company local office. WLL need to be evaluated with respect to two alternatives: ■ Wired scheme using existing installed cable. ■ Mobile cellular technology	Figure – 4 Explanation – 4	8

			
V (b).	IEEE 802.16 standards support the following bearer services: 1. **Digital audio/video multicast:** Transports one-way digital audio/video streams to subscribers. 2. **Digital telephony:** Supports multiplexed digital telephony streams. This service is a classic WLL service that provides a replacement for wired access to the public telephone network. 3. **ATM:** Provides a communications link that supports the transfer of ATM cells as part of an overall ATM network. The 802.16 link must support the various QoS services defined for ATM. 4. **Internet protocol:** Supports the transfer of IP datagrams. The 802.16 link provide efficient timely service. 5. **Bridged LAN:** Similar to the IP-based support. A bridge LAN service enables transfer of data between two LANs with switching at the MAC layer. 6. **Back-haul:** For cellular or digital wireless telephone networks. An 802.16 system may provide wireless trunks for wireless telephony base stations. 7. **Frame relay:** Similar to ATM. Frame relay uses variable-length frames in contrast to the fixed-length cells of ATM.	1 x 7	7
VI (a).	Satellite orbits may be classified in a number of ways: 1. **According to shape of the orbit**, they are classified into two – circular or elliptical. The orbit may be circular, with the center of the circle at the center of the earth, or elliptical, with the earth's center at one of the two foci of the ellipse.	List – 3 2	10

2. **According to different planes in earth,** orbits may classified into three – Equatorial orbit, polar orbit and inclined orbit. An **equatorial orbit** is directly above the earth's equator. A **polar orbit** passes over both poles. Other orbits are referred to as **inclined orbits.**

3. **According to the altitude of communication,** satellites are classified as geostationary orbit (GEO), medium earth orbit (MEO), and low earth orbit (LEO).

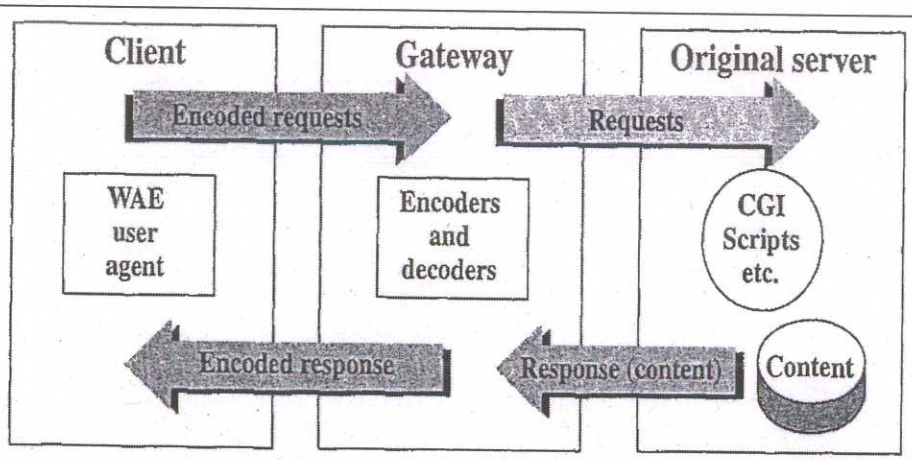
Parameter	LEO	MEO	GEO
Satellite Height	500 – 1500 km	5000 – 12000 km	35800 km
Orbital Period	10 – 40 minutes	2 – 8 hours	24 hours
Number of satellites	40 – 80	8 – 20	3
Satellite Life	Short	Long	Long
Handoffs	High	Low	Least (none)
Propagation Loss	Least	High	Highest
Gateway Cost	Very Expensive	Expensive	Cheap

2x2=4

2

3

VI (b).



5

5

WAP programming model has three elements:

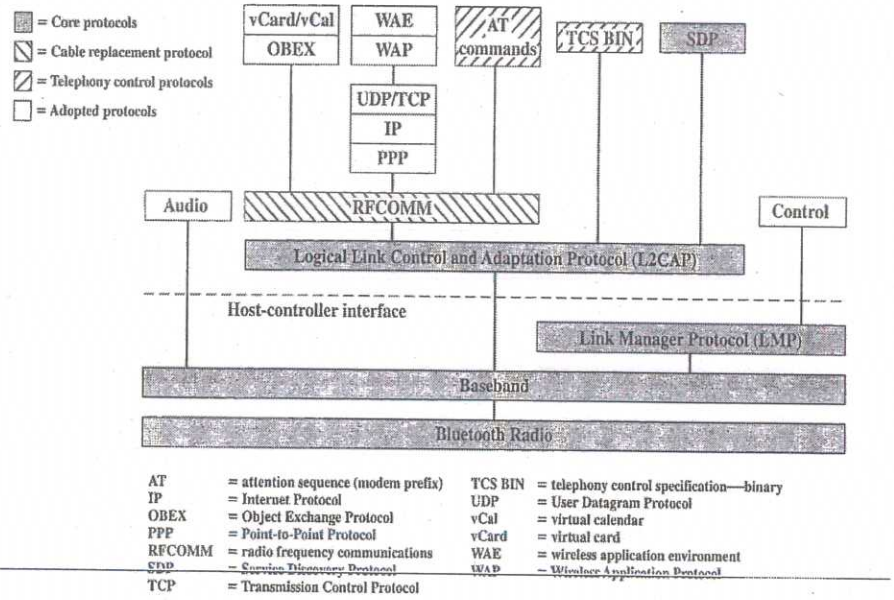
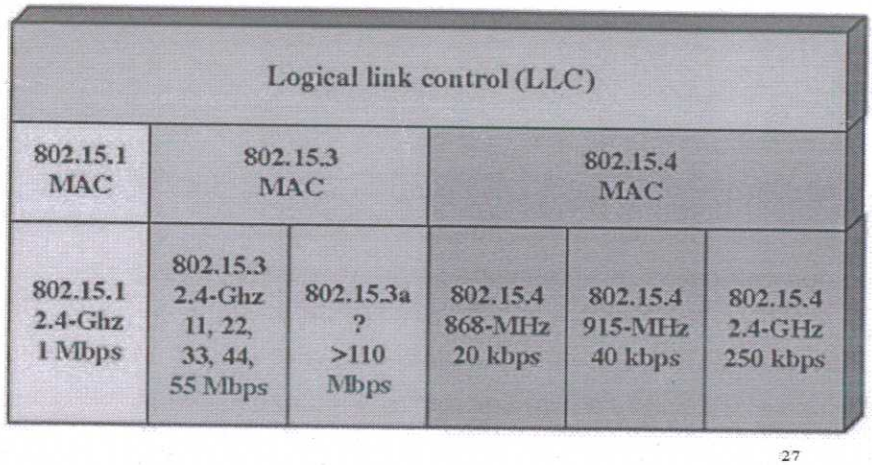
- Client, Gateway and original server
- HTTP is used to transfer the content between the gateway and the original server.
- Gateway acts as a proxy sever and provide services that offload the limited capabilities of the handheld, mobile, wireless terminals.
- Gateway also catches frequently requested information.

	UNIT – III		
VII (a).	• MAC layer covers three functional areas - Reliable data delivery, Access control and Security • **Reliable data delivery** • 802.11 Physical and MAC layers are unreliable. • Number of frames are lost due to the effects of Noise, interference, and other propagations. • Even, Error-correction codes, a number of MAC frames may not be received successfully. • More efficient to deal with errors at the MAC level, timers are used for retransmission at higher layers on the order of seconds. • For this, IEEE 802.11 includes a frame exchange protocols viz. two frame exchange and four frame exchange. • **Access Control** • The 802.11 supports two types MAC algorithm: o **Distributed access protocols** - distribute the decision to transmit all the nodes using a carrier-sense mechanism o **Centralized access protocols** - regulation of transmission by a centralized decision maker. • A distributed access protocol makes sense for an ad hoc network of peer workstations. • A centralized access protocol, a number of wireless stations are interconnected with each other and some base stations are attaches to a backbone wired LAN • 802.11 MAC algorithm is called DFWMAC (distributed foundation wireless MAC) • It provides a distributed access control mechanism with an optional centralized control on top. • The lower sublayer is the distributed coordination function (DCF). • DCF uses a contention algorithm to access all traffic. • The point coordination function (PCF) is a centralized MAC algorithm used to provide contention-free service. • PCF is built on top of DCF. • The DCF sub layer make use of simple CSMA algorithm. • DCF does not includes a collision detection algorithm. • To ensure the smooth and fair functioning of this algorithm, DCF includes a set of delays that amounts to a priority scheme. • PCF is an alternative access method implemented on top of the DCF.	9	9

VII (b).	• It uses microwave radio frequency band for signal transmission • Recently, all narrowband microwave LAN products used a licensed microwave band. • At least one vendor has produced a LAN products in the ISM band. • It can be classified into two - Licensed Narrowband RF and Unlicensed Narrowband RF **Licensed Band** • Microwave radio frequencies usable for voice, data, video transmission are licensed. • It avoids potential interference between systems within specific geographic areas. • United States, licensing is controlled by the FCC. • Each geographic area : o has a radius of 28 km and contains five licenses o Each license covering two frequencies. o Motorola holds 600 licenses (1200 frequencies) in the 18-GHz range that cover all metropolitan areas with populations of 30,000 or more. • A narrowband scheme use cell configuration • Adjacent cells use non-overlapping frequency bands within the overall 18-GHz band. • In the United States, because Motorola controls the frequency band. o it assure independent LANs in nearby geographical locations do not interfere with one another. • All transmissions are encrypted for providing security. • It guarantees interference-free communication. • The license holder has a legal right to an interference-free data communications channel. **Unlicensed** • 1995, Radio LAN introduced narrowband wireless LAN using the unlicensed ISM(Industrial, Scientific and Medical) spectrum. • ISM spectrum used for narrowband transmission at low power of about 0.5 watts or less. • The Radio LAN operates at 10 Mbps in the 5.8-GHz band. • Radio LAN has a range of 50 m in a semiopen office and 100 m in an open office. • The Radio LAN uses a peer-to-peer configuration. • Radio LAN automatically elects one node as the Dynamic Master, based on location, interference, and signal strength. • Master can change automatically as conditions change.	6	6

	• The LAN includes a dynamic relay function, which allows each station to act as a repeater to move data between stations that are out of range of each other.		
VIII (a).	The following are the requirements for wireless LANs: • **Throughput:** Efficient use of the wireless medium to maximize capacity. • **Number of nodes:** Support hundreds of nodes across multiple cells. • **Connection to backbone LAN:** Interconnection with stations on a wired backbone LAN is required. For infrastructure wireless LANs, this is easily accomplished through the use of control modules that connect to both types of LANs. • **Service area:** A typical coverage area has a diameter of 100 to 300 m. • **Battery power consumption:** Mobile workers use battery-powered workstations that need to have a long battery life when used with wireless adapters. Typical wireless LAN implementations have features to reduce power consumption while not using the network, such as a sleep mode. • **Transmission robustness and security:** LAN may be interference prone and easily eavesdropped. • **Collocated network operation:** It is quite likely for two or more wireless LANs to operate in the same area or in some area where interference between the LANs is possible. Such interference may thwart the normal operation of a MAC algorithm and may allow unauthorized access to a particular LAN. • **License-free operation:** Secure license for the frequency band used by the LAN. • **Handoff/roaming:** The MAC protocol used in the wireless LAN should enable mobile stations to move from one cell to another. • **Dynamic configuration:** The MAC addressing and network management aspects of the LAN should permit dynamic and automated addition, deletion, and relocation of end systems without disruption to other users.	1 x 10	10
VIII (b).	The MAC and LLC are two layers in IEEE 802. The MAC layer receives a block of data from the LLC laver and is responsible for performing functions related to medium access and for transmitting the data. As with other protocol layers, MAC implements these functions making use of a protocol data unit at its layer. ln this case, the PDU is referred to as a MAC frame. The MAC frame consists of MAC control, destination MAC address, source MAC address, Data and CRC. LLC is concerned with the transmission of a link-level PDU between two stations, without the necessity of an intermediate switching node. LLC specifies the mechanisms for addressing stations across the medium and for controlling the exchange of data between two users	2.5 + 2.5	5

	UNIT IV		
IX (a).	Bluetooth has as a layered protocol architecture consisting of • Core protocols • Cable replacement protocols • Telephony control protocols • Adopted protocols **Core Protocol** • It is a 5 layer stack which consists of the elements : **Radio -** Specifies the details of the air interface, including frequency, usage of frequency hopping, modulation scheme and power transmission. **Base band :** Deals with connection establishment within the piconet, addressing, packet format, timing, and power control. **Link manager protocol (LMP)**: Responsible for link setup between blue-tooth devices and ongoing link management. This includes security aspects such as authentication and encryption, Control and negotiation of base band packet size. **Logical link control and adaptation protocol (L2CAP)** : Adapts upper-layer protocols to the baseband layer. L2CAP provides both connectionless and connection-oriented services. **Service discovery protocol (SDP)** : Device information, services, and the characteristics of the services can be queried to enable the establishment of a connection. **Cable replacement protocol** • RFCOMM is the cable replacement protocol • RFCOMM present a virtual serial port that is designed to make replacement of cable technologies as transparent. **Telephony control protocol :** • TCS BIN (Telephony Control Specification – Binary) is a bit-oriented protocol • It defines call control signaling for speech and data calls between blue-tooth device. • It defines mobility management procedures for handling groups of Bluetooth TCS devices **Adopted protocol** Defined in specifications issued by other standards making organizations. • PPP: The point-to-point protocol is an internet protocol for transporting IP datagram over a point-to-point link • TCP/UDP/IP: Foundation protocol of the TCP/IP	Figure – 5 Explanation - 7	12

	• OBEX: The object exchange protocol is a session-level protocol for the exchange of object. • WAE/WAP: Wireless application protocol into its architecture.  Figure 15.1 Bluetooth Protocol Stack		
IX (b)	The basic unit of networking in Bluetooth is a piconet. It consists of a master and one to seven active slave devices. The radio designated as the master makes the determination of the channel or the frequency hopping sequence and the phase or timing offset that shall be used by all devices on this piconet. A slave may only communicate with the master and may only communicate when granted permission by the master.	3	3
X (a)	**IEEE 802.15 Protocol Architecture**  27 • The IEEE 802.15 Working Group for WPANs was formed to develop standards for short range wireless PANs. • Different standards of WPAN are 802.15.1, 802.15.2, 802.15.3	Figure – 4 Explanation – 5	9

	• 802.15.1- creating a formal standard of the Bluetooth specification • 802.15.2 - to develop recommended practices for coexistence. • 802.15.3 - standards for devices that are low cost and low power but with significantly higher data • Each of the three wireless PAN standards has not only different physical layer specifications but different requirements for the MAC layer. **Medium Access Control** • An 802.15network consists of a collection of devices . • One of the DEVs also acts as a piconet coordinator (PNC). • PNC is used to control access to the time resources of the piconet and is not involved in the exchange of data frames between DEVs. • The QoS feature of MAC layer is based on the use of a TDMA **Physical Layer** • The 802.15.3 physical layer operates in the 2.4-GHz • Can achieve data rates from 11 to 55 Mbps. • The most significant aspect of the scheme is the use of trellis-coded modulation (TCM).		
X (b)	• Wireless sensor network consists of number of small devices equipped with a sensing unit, microprocessors, wireless communication interface and power source. • WSNs measure environmental conditions like temperature, sound. pollution levels, humidity, wind, and so on. • These are similar to wireless ad hoc networks in the sense that they rely on wireless connectivity and spontaneous formation of networks so that sensor data can be transported wirelessly. • Two main operations performed by WSN are: 1. QUERING – Queries are used when user requires only the current value of the observation. 2. TASKING – More Complex operation Used when a phenomenon has to be observed over a large period of time. • Different applications are Military applications, Commercial applications, Health care monitoring, Environmental sensing, Air pollution monitoring, Landslide detection etc..	6	6