

| Scoring Indicators | | | |
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| Q no | Scoring Indicators | split score | Total score |
| I | PART A | | |
| 1 | a radio transmitter/receiver, including an antenna, used in a <i>mobile</i> telecommunications <i>network</i> . It is a fixed point of communication for customer <i>cellular</i> phones. | | 2 |
| 2 | <i>Wireless local loop (WLL)</i> technology means that the subscriber is connected to the nearest exchange through a radio link instead of wired connection. | | 2 |
| 3 | Infrared (IR) LANs Spread spectrum LANs Narrowband microwave | Any 2 | 2 |
| 4 | <ul style="list-style-type: none"> • The Industrial, Scientific, and Medical (<i>ISM</i>) frequency <i>bands</i> • Reserved internationally for the use of radio frequency • Unlicensed | Any 2 points | 2 |
| 5 | Data and voice access points Cable replacement Adhoc networking | Any 2 points | 2 |
| II | PART B | | |
| 1 | <ul style="list-style-type: none"> • Adding new channels: When a system is set up in a region, not all channels are used, and growth and expansion can be managed in an orderly fashion by adding new channels. • Frequency borrowing: Frequencies are taken from adjacent cells by congested cells, and can also be assigned to cells dynamically. • Cell splitting: The distribution of traffic and topographic features is not uniform, and this presents opportunities of capacity increase. • Cell sectoring: - a cell is divided into a number of wedge-shaped sectors, each with its own set of channels • Microcells - useful in city streets in congested areas, along highways, and inside large public buildings. | List -3 exp any three-3 | 6 |

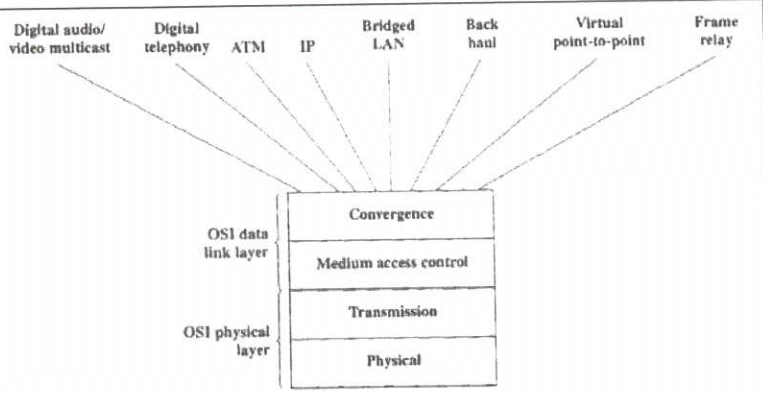
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| 2 | <p>Higher capacity:-</p> <p>-Achieved by frequency reuse.</p> <p>Less transmission power:-</p> <p>While using small cells, the base stations and receivers are nearer to each other.</p> <p>-Less transmitting power is necessary</p> <p>Local Interference-</p> <p>With small cells, mobile stations and base stations only to deals with local interference.</p> <p>Robustness</p> <p>Cellular systems are decentralized</p> <p>- so more robust against the failure of single component.</p> | List -2 exp-4 | 6 |
| 3 | <p>The performance of a satellite link depends on :</p> <p>Distance between earth and satellite</p> <p>Atmospheric Attenuation</p> <p>Affected by oxygen, water, angle of elevation, and higher frequencies</p> <p>Terrestrial Distance- between the receiving antenna and the aim point of the satellite (Satellite Footprint)</p> | List-2 exp 4 | 6 |
| 4 | <p><i>Mobile IP</i> is an Internet standard communications protocol that is designed to allow <i>mobile</i> device users to move from one network to another while maintaining a permanent <i>IP</i> address.</p> <p>Discovery – A mobile node uses a discovery procedure to identify prospective home agents and foreign agents</p> <p>Registration – A mobile node uses an authenticated registration procedure to inform its home agent of its care of address</p> <p>Tunneling – Is used to forward IP datagrams from a home address to a care-of address</p> | Def-2 functions -4 | 6 |

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| 5 | <p>LAN extension-Saves cost of installation of LAN cabling</p> <p>Cross building interconnect- Connect LANs in nearby buildings – may be wired or wireless</p> <p>nomadic access - Provides a wireless link between LAN hub and mobile data terminal</p> <p>ad hoc networks- Peer-to-peer network</p> | List -2 exp-4 | 6 |
| 6 | <p>Wi-Fi Alliance developed Wi-Fi Protected Access (WPA) as a Wi-Fi standard.</p> <p>802.11i provides three encryption schemes.</p> <p>It provides the use of the Advanced Encryption Standard (AES) with 128-bit keys.</p> <p>IEEE 802.11i addresses three main security areas: - authentication key management data transfer privacy</p> <p>To improve authentication, 802.11i requires the use of an authentication server (AS) and defines authentication protocol.</p> | 6 | 6 |
| 7 | <p>It consists number of small devices equipped with a sensing unit, microprocessors, wireless communication interface and power source.</p> <p>Two main operations performed by WSN are:</p> <ol style="list-style-type: none"> 1. QUERING – Queries are used when user requires only the current value of the observation. 2. TASKING – More Complex operation used when a phenomenon over a large period of time. <p>Functions of gateway:-</p> <p>Communication with sensor networks:</p> <ul style="list-style-type: none"> Short range Wireless Communication Discovery of smart sensor nodes <p>Gateway Logic:</p> <ul style="list-style-type: none"> Controlling Gateway interface and data flow Providing uniform access to sensors <p>Communication with users:</p> <ul style="list-style-type: none"> Communication over Internet, WAN, Satellite, etc. | 2+4 | 6 |

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| | <p>Applications:</p> <p>Military applications</p> <p>Environmental applications</p> <p>Health applications</p> <p>Drug administration in hospitals</p> | | |
| | PART C | | |
| III a | <p>Digital traffic channels: The notable difference between two generations is that 1G systems are analog, whereas 2G systems are digital.</p> <p>Encryption: Because all of user traffic, as well as control traffic, is digitized in 2G systems, it is a relatively simple matter to encrypt all of traffic to prevent eavesdropping. All 2G systems provide this capability</p> <p>Error detection and correction: The digital traffic stream of 2G systems also lends itself to use of error detection and correction techniques. The result can be very clear voice reception.</p> <p>Time Division Multiple Access:</p> <p>TDMA was introduced. Each cell is allocated a number of channels, half reverse and half forward. For full duplex communication, a MU is assigned capacity on matching reverse and forward channels. Each physical channel is further subdivided into a number of logical channels. Transmission is in the form of a repetitive sequence of frames, each of which is divided into a number of time slots. Each slot position across sequence of frames forms a separate logical channel.</p> <p>Global System for Mobile Communications</p> <p>GSM was developed to provide a common 2G technology so that same subscriber units could be used throughout a continent. The technology is extremely successful and is probably the most popular standard, worldwide, for new implementations. GSM was first appeared in 1990.</p> | <p>List-2 exp 3x2</p> | 8 |
| b | <p>Cell blocking probability: probability of a new call being blocked, due to heavy load on BS traffic capacity. In this case, MU is handed off to a neighboring cell based not on signal quality but on traffic capacity.</p> | <p>List any 4 -2 epl-5</p> | 7 |

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| | <p>Call dropping probability: probability that, due to a handoff, a call is terminated.</p> <p>Call completion probability: probability that an admitted call is not dropped before it terminates.</p> <p>Probability of unsuccessful handoff: probability that a handoff is executed while reception conditions are inadequate.</p> <p>Handoff blocking probability: probability that a handoff cannot be successfully completed.</p> <p>Handoff probability: probability that a handoff occurs before call termination.</p> <p>Rate of handoff: number of handoffs per unit time.</p> <p>Interruption duration: duration of time during a handoff in which a MU is not connected to either BS.</p> <p>Handoff delay: distance the MU moves from point at which handoff should occur to point at which it does occur.</p> <p>The principal parameter used to make handoff decision is measured signal strength from MU at BS. Typically, BS averages the signal over a moving window of time to remove rapid fluctuations due to multipath effects.</p> | | |
| IV a | <p>Base station (BS)</p> <p>Is at the center of each cell Includes an antenna, a controller and number of transceivers. Controller handles call process.</p> <p>Mobile telecommunications switching office (MTSO)</p> <p>BS is connected to MTSO. One MTSO serves multiple BS</p> <p>MTSO and BS are link by wired line or wireless.</p> <p>Connects calls between mobile units and from mobile to fixed telecommunications network</p> <p>Assigns voice channel to each call</p> <p>Performs handoffs</p> <p>Monitors the calls (billing)</p> <p>Channels</p> <p>Two types of channels are available</p> <p>Control Channels -</p> | Listing-2 exp- 6 | 8 |

| | <p>To exchange information</p> <p>Setting up and maintaining calls</p> <p>Establish relationship between a mobile unit and the nearest BS</p> <p>Traffic Channels - Carry voice or data between users</p> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|----------------------|--|--|---|---|------|------|---------|--|---|---|-------------------------------|------------------|---|--|--|--|-------------------|------------------------|-------------------------|-----------------|---|---------|--------------|--------------|--------------|------------------------|------------|-------------------|----------|----------|--|---------------|---|---|---|---|----------------------|--------------------------------|-------------|-------------|--|--------------|---|
| b | <p>Comparison of Various Multiple Division Techniques</p> <table border="1"> <thead> <tr> <th>Technique</th> <th>FDMA</th> <th>TDMA</th> <th>CDMA</th> <th>SDMA</th> </tr> </thead> <tbody> <tr> <td>Concept</td> <td>Divide the frequency band into disjoint subbands</td> <td>Divide the time into non-overlapping time slots</td> <td>Spread the signal with orthogonal codes</td> <td>Divide the space into sectors</td> </tr> <tr> <td>Active terminals</td> <td>All terminals active on their specified frequencies</td> <td>Terminals are active in their specified slot on same frequency</td> <td>All terminals active on same frequency</td> <td>Number of terminals per beam depends on FDMA/TDMA/CDMA</td> </tr> <tr> <td>Signal separation</td> <td>Filtering in frequency</td> <td>Synchronization in time</td> <td>Code separation</td> <td>Spatial separation using smart antennas</td> </tr> <tr> <td>Handoff</td> <td>Hard handoff</td> <td>Hard handoff</td> <td>Soft handoff</td> <td>Hard and soft handoffs</td> </tr> <tr> <td>Advantages</td> <td>Simple and robust</td> <td>Flexible</td> <td>Flexible</td> <td>Very simple, increases system capacity</td> </tr> <tr> <td>Disadvantages</td> <td>Inflexible, available frequencies are fixed, requires guard bands</td> <td>Requires guard space, synchronization problem</td> <td>Complex receivers, requires power control to avoid near-far problem</td> <td>Inflexible, requires network monitoring to avoid intracell handoffs</td> </tr> <tr> <td>Current applications</td> <td>Radio, TV, and analog cellular</td> <td>GSM and PDG</td> <td>2.5G and 3G</td> <td>Satellite systems, others being explored</td> </tr> </tbody> </table> | Technique | FDMA | TDMA | CDMA | SDMA | Concept | Divide the frequency band into disjoint subbands | Divide the time into non-overlapping time slots | Spread the signal with orthogonal codes | Divide the space into sectors | Active terminals | All terminals active on their specified frequencies | Terminals are active in their specified slot on same frequency | All terminals active on same frequency | Number of terminals per beam depends on FDMA/TDMA/CDMA | Signal separation | Filtering in frequency | Synchronization in time | Code separation | Spatial separation using smart antennas | Handoff | Hard handoff | Hard handoff | Soft handoff | Hard and soft handoffs | Advantages | Simple and robust | Flexible | Flexible | Very simple, increases system capacity | Disadvantages | Inflexible, available frequencies are fixed, requires guard bands | Requires guard space, synchronization problem | Complex receivers, requires power control to avoid near-far problem | Inflexible, requires network monitoring to avoid intracell handoffs | Current applications | Radio, TV, and analog cellular | GSM and PDG | 2.5G and 3G | Satellite systems, others being explored | Any 4 points | 7 |
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| Current applications | Radio, TV, and analog cellular | GSM and PDG | 2.5G and 3G | Satellite systems, others being explored | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| V a | <p>Geostationary Satellites: The most common type of communications satellite today is geostationary (GEO) satellite. If satellite is in a circular orbit 35,863 km above earth's surface and rotates in equatorial plane of earth, it will rotate at exactly the same angular speed as earth and will remain above same spot on equator as earth rotates.</p> <p>LEO satellites</p> <p>Circular/slightly elliptical orbit under 2000 km.</p> <p>The diameter of coverage is about 8000 Km.</p> <p>Orbit period ranges from 1.5 to 2 hours</p> <p>Round-trip signal propagation delay less than 20 ms</p> <p>Maximum satellite visible time up to 20 min</p> <p>Atmospheric drag results in orbital deterioration</p> <p>LEO satellites were mainly used for espionage.</p> <p>These are less expensive to launch into orbit</p> <p>MEO satellites</p> <p>Circular orbit at an altitude in the range 5000 to 12000 Km. The orbit period is about 6 hours</p> <p>The diameter of coverage is from 10000 to 15000 Km.</p> <p>Round trip signal propagation delay is less than 50 ms.</p> <p>The maximum time that the satellite is visible from a fixed</p> | 3+3+2 | 8 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

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| | <p>point on earth (above the radio horizon) is a few hours</p> <p>Applications are digital voice, data, facsimile, high-penetration notification, and messaging services</p> | | |
| <p>b</p> |  <p>The diagram illustrates the IEEE 802.16 Protocol Architecture. At the top, several services are listed: Digital audio/video multicast, Digital telephony, ATM, IP, Bridged LAN, Back haul, Virtual point-to-point, and Frame relay. Lines from these services converge into a central box labeled 'Convergence'. Below this box is a stack of four layers: 'Medium access control', 'Transmission', and 'Physical'. To the left of this stack, the 'OSI data link layer' is associated with the Medium access control layer, and the 'OSI physical layer' is associated with the Physical layer.</p> <p>Figure 11.14 IEEE 802.16 Protocol Architecture</p> <p>Physical</p> <p>Transmission</p> <p>Medium access control</p> <p>Convergence layer</p> | <p>Architecture -4 exp-3</p> | <p>7</p> |
| <p>VI a</p> | <p>TDMA (Time Division Multiple Access)</p> <p>Breaks a transmission into multiple time slots, each one dedicated to a different transmitter.</p> <p>TDMA is increasingly becoming more widespread in satellite communication.</p> <p>TDMA uses the same techniques (FAMA and DAMA)</p> <p>Advantages of TDMA over FDMA.</p> <p>Digital equipment used in time division multiplexing is increasingly becoming cheaper.</p> <p>Advantages of digital components:</p> <p>Ex: error correction.</p> <p>Lack of intermodulation noise</p> <p>FAMA-TDMA Operation</p> <p>Transmission in the form of repetitive sequence of Frames</p> <p>Each frame is divided into a number of time slots__</p> <p>Each slot is dedicated to a particular transmitter</p> <p>Earth stations take turns using uplink channel</p> <p>Sends data in assigned time slot</p> | <p>Def-2 exp-6</p> | <p>8</p> |

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| | <p>Satellite repeats incoming transmissions</p> <p>Broadcast to all stations</p> <p>Stations must know which slot to use for transmission and which to use for reception</p> | | |
| VI b | <p>Requirements for IEEE 802.16 standards are defined in terms of bearer services</p> <p>Digital audio/video multicast: Transports one-way digital audio/video streams to subscribers.</p> <ul style="list-style-type: none"> • Digital telephony: Supports multiplexed digital telephony streams. • ATM: Provides a communications link that supports transfer of ATM cells as part of an overall ATM network. • Internet protocol: Supports transfer of IP datagrams. • Bridged LAN: A bridge LAN service enables transfer of data between two LANs with switching at MAC layer. • Back-haul: For cellular or digital wireless telephone networks. • Frame relay: Frame relay uses variable-length frames in contrast to fixed-length cells of ATM. | Any 4 with exp | 7 |
| VII a | <p>Directed Beam Infrared</p> <p>can be create point-to-point links.</p> <p>The range depends on the emitted power and on the degree of focusing.</p> <p>range can be kilometers.</p> <p>Used for cross-building interconnect between bridges or routers located in buildings within a line of sight.</p> <p><u>Omnidirectional</u></p> <p>An omnidirectional configuration involves a single base station that is within line of sight of all other stations</p> <p><u>Diffused</u></p> <p>All of the IR transmitters are focused and aimed at a point on a diffusely reflecting ceiling.</p> | List 2 exp 6 | 8 |
| b | <p>It relates to the LAN protocols to the OSI architecture</p> <p>Physical layer</p> <p>It is the lowest layer</p> <p>Functions includes:</p> <p>Encoding/decoding of signals</p> | List -3 exp 4 | 7 |

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| | <p>Preamble generation/removal (for synchronization)</p> <p>Bit transmission/reception</p> <p>Specification of transmission medium and topology</p> <p>It is further subdivided into sublayers :</p> <p>Physical layer convergence procedure (PLCP)</p> <p>Physical medium dependent sublayer (PMD)</p> <p>Medium Access Control layer (MAC)</p> <p>On transmission, assemble data into a frame with address and error detection fields</p> <p>On reception, disassemble frame, and perform address recognition and error detection</p> <p>Govern access to the LAN transmission medium</p> <p>Logical Link Control (LLC) layer</p> <p>Provide an interface to higher layers and perform flow and error control.</p> | | |
| VIII a | <p>A wireless LAN requirement are:</p> <p>high capacity</p> <p>coverage distance</p> <p>connectivity among stations</p> <p>broadcast capability.</p> <p>In addition, the most important requirements for wireless LANs:</p> <p>Throughput: Efficient use of the wireless medium to maximize capacity.</p> <p>Number of nodes:</p> <p>support hundreds of nodes across multiple cells.</p> <p>Connection to backbone LAN:</p> <p>Interconnection with stations on a wired backbone LAN is required. Use of control modules that connect to both types of LANs.</p> <p>Service area: 100 to 300 m.</p> <p>Battery power consumption:</p> <p>Transmission robustness and security:</p> | List 3 exp-5 | 8 |

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| | <p>License-free operation:</p> <p>Handoff/roaming:</p> <p>Dynamic configuration:</p> | | |
| b | <p>It defines nine services.</p> <p>Service Providers can be either Station or DS.</p> <p>Station services are implemented by 802.11 station, including access point (AP) stations.</p> <p>Distribution services are provided between basic service sets (BSSs).</p> <p>Association</p> <p>Authentication</p> <p>Deauthentication</p> <p>Dissociation</p> <p>Distribution</p> <p>Integration</p> <p>MSDU delivery</p> <p>Privacy</p> <p>Reassociation</p> | <p>List -4</p> <p>exp-3</p> | 7 |

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| IX a | <p>It is a short-range, low cost and power efficient radio frequency based wireless technology.</p> <p>Uses 2.4-GHz band</p> <p>Available globally for unlicensed uses.</p> <p>Devices within 10 m range can share upto 720 kbps of capacity.</p> <p>It enable to easily connect a wide range of computing and telecommunication devices.</p> <p>It makes wireless communication and networking in a small localized area.</p> <p>Upto eight device can be connected in a Bluetooth network, known as a Piconet.</p> <p>A scatternet is formed when two or more piconets connected via bridge node.</p> <p>Bluetooth support a list of applications, including data, audio, graphics, and video.</p> | Def-3 exp 5 | 8 |

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| IX b | <p>Bluetooth Low Energy (Bluetooth LE, BLE, formerly, Bluetooth Smart) is a wireless personal area network technology. Mobile operating systems including iOS, Android, Windows Phone and BlackBerry, as well as macOS, Linux, Windows 8 and Windows 10, natively support Bluetooth Low Energy.</p> | | 7 |
| X a | <p>Piconets and Scatternets</p> <p>Basic unit of networking in Bluetooth is a piconet, consisting of a master and one to seven active slave devices.</p> <p>A slave only communicate with master and may only communicate when granted permission by master. A device in one piconet may also exist as part of another piconet and may function as slave/master in each piconet (Figure 15.3). This form of overlapping is called a scatternet.</p> <div data-bbox="411 965 995 1406" data-label="Diagram"> </div> <p>Figure 15.3 Master/Slave Relationships</p> | 3+3+diagram 2 | 8 |
| b | <p>Three-in-one phone</p> <p>In office, phone functions as an intercom, at home functions as a cordless phone and on move, functions as a mobile phone</p> <p>Internet bridge</p> <p>Portable PC to surf the Internet anywhere, whether connected wirelessly through a mobile.</p> <p>Interactive conference</p> | List 2 exp 5 | 7 |

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| | <p>In meetings and conferences, share information instantly with other participants, also operate projector remotely without wire connectors.</p> <p>The ultimate headset</p> <p>Connect a headset to mobile PC or to any wired connection and free our hands for important tasks at the office.</p> <p>Portable PC speakerphone</p> <p>Connect cordless headsets to a portable PC, and use it as a speaker phone.</p> <p>Briefcase e-mail</p> <p>Access e-mail while portable PC is still in the briefcase.</p> <p>Delayed messages</p> | | |
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