IT6601 MOBILE COMPUTING

UNIT – I
INTRODUCTION


COURSE OBJECTIVE: Understand the basic concepts of mobile computing.

PART – A

Mobile Computing also called as Ubiquitous Computing or Nomadic Computing is described as the ability to compute remotely while on the move. It makes possible for people to access information from anywhere and at any time.
Mobile Computing = Mobility + Computing

2. What do you mean by the terms Mobility and Computing?
Mobility: Provides the capability to change location while communicating to invoke computing services at some remote computers.
Computing: Capability to automatically carry out certain processing related to services invocation on a remote computer.

3. Name the type of Mobility.
a) User Mobility
b) Device Portability

(i) Location Flexibility
(ii) User Mobility
(iii) Device Portability
(iv) Saves Time
(v) Enhanced Productivity
(vi) Entertainment

5. Mention the disadvantages of Mobile Computing.
(i) Expensive
(ii) Power Consumption
(iii) Small Screen Display
(iv) Slow Internet Speed
(v) Risky to carry
(vi) Security Concerns
(vii) Communication depends upon network
6. **Compare Wired Networks and Mobile Networks.**

<table>
<thead>
<tr>
<th>S.No</th>
<th>Wired Networks</th>
<th>Mobile Networks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Users cannot get any information at any place (does not support mobility)</td>
<td>Users can get information at any place (Supports Mobility)</td>
</tr>
<tr>
<td>2.</td>
<td>Bandwidth is high</td>
<td>Bandwidth is low</td>
</tr>
<tr>
<td>3.</td>
<td>Low bandwidth variability</td>
<td>High bandwidth variability</td>
</tr>
<tr>
<td>4.</td>
<td>Listen on wire</td>
<td>Hidden Terminal problem</td>
</tr>
<tr>
<td>5.</td>
<td>Productivity is low</td>
<td>Productivity is high</td>
</tr>
<tr>
<td>6.</td>
<td>High Power Machines</td>
<td>Low Power machines</td>
</tr>
<tr>
<td>7.</td>
<td>High Resource machines</td>
<td>Low Resource machines</td>
</tr>
<tr>
<td>8.</td>
<td>Need physical access</td>
<td>Need proximity</td>
</tr>
<tr>
<td>9.</td>
<td>Low delay</td>
<td>Higher delay</td>
</tr>
<tr>
<td>10.</td>
<td>Connected Operations</td>
<td>Disconnected Operations</td>
</tr>
</tbody>
</table>

7. **List out the differences between Mobile Computing and Wireless Networking.**

<table>
<thead>
<tr>
<th>S.No</th>
<th>Mobile Computing</th>
<th>Wireless Networking</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>It is a technology that access data through wireless network</td>
<td>It is a network that uses wireless data connections for connecting network nodes</td>
</tr>
<tr>
<td>2.</td>
<td>It denotes accessing information and remote computational services while on the move</td>
<td>It provides the basic communication infrastructure necessary for mobile computing</td>
</tr>
<tr>
<td>3.</td>
<td>It refers to computing devices that are not restricted to a desktop. Eg: Smart Phone, PDA, Laptop etc.,</td>
<td>It is a method of transferring information between a computing devices such as PDA &amp; data sources without a physical connection</td>
</tr>
<tr>
<td>4.</td>
<td>It refers to a device performing computation that is not always connected to a central network</td>
<td>It refers to the data communication without the use of a landline. Eg. Cellular Telephone, Two way radio, Satellite, Wireless Connection.</td>
</tr>
</tbody>
</table>

8. **Name some of the Mobile Computing Devices.**

- Mobile Phones
- Laptops
- PDA
- Notebook PCs

9. **Point out the problems faced by devices in Wireless Transmission?**

1. Lower Bandwidth
2. Bandwidth Fluctuations
3. Host mobility
4. Intermittent disconnections
5. High bit error rate
6. Poor link reliability
7. Higher delay
8. Power consumption
10. **What are the classifications of Wireless Networks?**
   i) Extension of Wired Networks: Uses fixed infrastructures such as base stations to provide single hop wireless communication (or) two-hop wireless communication.
      a. Example: WLAN, Bluetooth
   ii) Adhoc Networks: It does not use any fixed infrastructure and it is based on multi-hop wireless communication. Example: MANET, VANET.

11. **What are the applications of mobile computing?**
   - Emergency services
   - Stock Broker
   - Vehicles
   - For Estate Agents
   - In courts
   - In companies
   - Stock Information Collection/Control
   - Credit Card Verification
   - Taxi/Truck Dispatch
   - Electronic Mail/Paging

12. **List out the characteristics of Mobile Computing.**
    (i) Ubiquity
    (ii) Location Awareness
    (iii) Adaptation
    (iv) Broadcast
    (v) Personalization

13. **Draw the structure of Mobile Computing Application.**

<table>
<thead>
<tr>
<th>Presentation (tier -1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application (tier -2)</td>
</tr>
<tr>
<td>Data tier (tier -3)</td>
</tr>
</tbody>
</table>

14. **Specify the functionalities of Application Tier.**
   - Responsible for making logical decisions and performing calculations.
   - Moves and Process data between the presentation and data layers.

15. **What is the use of Data Tier?**
   - Responsible for providing the basic facilities of data storage, access and manipulation.
   - Contains a database where the information is stored and retrieved.

16. **Describe about MAC Protocol.**
    MAC Protocol is access control protocol which is responsible for regulating access to the shared channel when multiple nodes compete to access that channel. It is a sub layer of the data link layer protocol and it directly invokes the physical layer protocol.
17. **What are the Objectives of MAC Protocol?**
   - Maximization of the channel utilization
   - Minimization of average latency of transmission

18. **List out the properties required of MAC protocol.**
   (i) It should implement some rules to enforce discipline when multiple nodes compete for a shared channel.
   (ii) It should help maximize the channel utilization.
   (iii) Channel allocation needs to be fair. No node should be discriminated against at any time and made wait for a long time for transmission.
   (iv) It should be capable of supporting several types of traffic having different bit rates.
   (v) It should be robust in the face of equipment failure and changing network conditions.

19. **What is meant by Hidden Node and Exposed Node?**
   - Hidden Node: A hidden node is a node that does not hear the transmission that a node within its range is receiving and thus does not attempting to gain access.
   - Exposed Node: An exposed node is a node that hears multiple disjoint sections of a network and never gets an opportunity to compete for transmission since it is always deferring to someone.

20. **Explain hidden and exposed terminal problem in infrastructure-less network.**
    May/June 2016
    **Hidden Terminal Problem:**
    The Hidden Terminal Problem arises when at least three nodes (A, B and C) communicating.

    B is in the radio range of A, and B is also with the radio range of C. The nodes A and C are not in the radio range of each other. If both A and C start to transmit to B at the same time, the data received at B would get garbled. This situation arises because A and C are “hidden” from each other, because they are outside each other’s transmission range.
    Note:- Hidden Terminal causes Collisions.
    **Exposed Terminal Problem:**
    Exposed Terminal Problem arises when all the three nodes are in the radio range of all nodes.
Now B is transmitting to A, C wants to send to another terminal (not A or B) outside the range. C senses the carrier and detects that the carrier is busy, so C postpones the transmission until it detects the medium is free. But A is outside the radio range of C. This problem arises because “C is exposed to B”.

Note:- Exposed Terminal leads to inefficient spectrum usage and unnecessary transmission delays.

21. What are the classifications of MAC Protocols?
Wireless MAC protocols are classified into
A. Fixed-assignment schemes (Circuit-switched)
B. Random-Assignment schemes (CL packet-switched)
C. Reservation-based schemes (CO packet-switched)

(i) Fixed Assignment
   a. FDMA
   b. TDMA
   c. CDMA

(ii) Random Assignment
   a. ALOHA
   b. Slotted ALOHA
   c. CSMA
   d. CSMA/CD
   e. CSMA/CA

(iii) Reservation Based
     a. RTS / CTS

22. Compare CSMA / CD and CSMA / CA.

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<th>CSMA / CA</th>
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<tbody>
<tr>
<td>1.</td>
<td>It takes effect after a collision</td>
<td>It takes effect before a collision</td>
</tr>
<tr>
<td>2.</td>
<td>It will not take steps to prevent transmission collision until it is taken place</td>
<td>It will take actions not to take place any collision</td>
</tr>
</tbody>
</table>
3. It only minimizes the recovery time | It reduces the possibility of a collision
4. Typically used in wired networks | Typically used in wireless networks & WLANs
5. Standardized in IEEE 802.3 | Standardized in IEEE 802.11

23. **Summarize the steps involved in RTS / CTS scheme.**
- Sender transmits an RTS packet to the receiver before the actual data transmission.
- Receiver sends a CTS packet to the sender.
- Actual data transfer commences between the sender and receiver.
- Receiver will send acknowledgement to the sender.

24. **Formulate a reason why Collision Detection is based protocol not suitable for wireless networks?**
Because, in a wireless network, it is very difficult for a transmitting node to detect a collision, since any received signal from other nodes would be too weak compared to its original signal and can easily be masked by noise. As a result the transmitting node would continue to transmit the frame which leads to corrupted frame.

In wired network, when a node detects a collision, it immediately stops transmitting, thereby minimizing channel wastage.

25. **Assess why is the MAC protocol designed for infrastructure based wireless N/W may not work satisfactory in infrastructure-less environment. Justify your answer?**
Because,
- It is for a transmitting node to detect collisions
- Hidden and Exposed terminal problems makes MAC protocols inefficient.

**PART - B**

2. Discuss briefly about Wireless Network Classifications. [An]
6. Compare FDMA, TDMA & CDMA. [An]
8. Explain the following: [U]
   (i) Random Assignment Schemes
   (ii) Reservation-based schemes

**COURSE OUTCOME:** An ability to explain the basics of Mobile Computing and MAC protocol.
UNIT – II

MOBILE INTERNET PROTOCOL AND TRANSPORT LAYER


COURSE OBJECTIVE: Be familiar with the network protocol stack.

1. Define Mobile IP.
Mobile IP is a standard protocol created by extending Internet Protocol (IP) to enable users to keep the same IP address while travelling from one network to a different network.
Mobile IP = Mobility + Internet Protocol (IP)

2. Specify the goals of Mobile IP.
• Allows mobile hosts to stay connected to the internet regardless of their location and without changing their IP address.
• Enable packet transmission efficiently without any packet loss and disruptions in the presence of host and/or destination mobility.

3. What are the main requirements needed for mobile IP?
• Compatibility
• Transparency
• Scalability and efficiency
• Security

4. List out the various terminologies involved in Mobile IP.
a) Mobile Node
b) Home Network
c) Home Address
d) Foreign Agent
e) Correspondent Node
f) Care-of-Address
g) Tunnel
h) Foreign Network
i) Home Agent

5. Define COA.
It is an address that identifies the mobile node’s current location. The packets sent to the Mobile Node are delivered to COA. COA is associated with the mobile node’s Foreign Agent (FA).

6. Define Tunneling.
Tunneling is the process of delivering the packet sent by the Home Agent(HA) to foreign agent(COA) and frm COA to the mobile node via tunnel. Tunneling has two primary functions:
1. Encapsulation of data packet to reach the tunnel endpoint
2. Decapsulation when the packet is delivered at that endpoint.

7. **What is encapsulation in Mobile IP.**
   Encapsulation refers to arranging a packet header and data and putting it into the data part of a new packet. Thus the encapsulated packet will contain the new destination address as “Address of COA” and the new source address as “Address of HA”.

8. **What are the two types of COA?**
   1. Foreign Agent COA: It is an IP address of Foreign Agent(FA).
   2. Co-located COA: Temporary IP address that is assigned to MN.

9. **What is meant by Agent Discovery?**
   Agent Discovery is a process by which a mobile node determines its Foreign Agent(FA) during call establishment.
   Two methods of Agent Discovery:
   (i) Agent Advertisement
   (ii) Agent Solicitation

10. **What is meant by Agent Advertisement?**
    Foreign agents and home agents advertise their presence periodically using special agent advertisement messages. An Agent Advertisement Message lists one or more COA and a flag indicating whether.

11. **What is meant by Agent Solicitation?**
    Agent Solicitation is an Agent Discovery process which is used to search for a foreign agent. Agent Solicitation message is sent if a mobile node does not receive any COA.

12. **What are the mechanisms used for forwarding the packet?**
    - CN does not need to know anything about the MN’s current location and sends the packet as usual to the IP address of MN
    - The packet is not forwarded into the subnet as usual, but encapsulated and tunnelled to the COA
    - The foreign agent now decapsulates the packet, i.e., removes the additional header, and forwards the original packet with CN as source and MN as destination to the MN

13. **What are the key mechanisms associated with Mobile IP?**
    1. Discovering the Care-of-Address
    2. Registering the Care-of-Address
    3. Tunneling to the Care-of-Address

14. **What do you mean by the term binding of mobile node?**
    The association of the home address of a mobile node with a Care-Of-Address (COA) is called binding of mobile node.
15. **What is DHCP? May/June 2016**
DHCP (Dynamic Host Configuration Protocol) is a communication protocol that network administrators use to centrally manage and automate the network configuration of devices attaching to an Internet Protocol (IP) network.

16. **Define TCP.**
Transmission Control Protocol (TCP) is the standard transport layer protocol for applications that require guaranteed message delivery. It is a connection-Oriented protocol.

17. **Elaborate on TCP/IP protocol.**
TCP/IP is a combination of two separate protocols: Transmission Control Protocol (TCP) and Internet Protocol (IP). The Internet Protocol standard dictates the logistics of packets sent out over networks; it tells packets where to go and how to get there. The Transmission Control Protocol is responsible for ensuring the reliable transmission of data across Internet-connected networks. TCP checks packets for errors and submits requests for re-transmissions if any are found.

18. **Mention the layers involved in TCP/IP Protocol Suite**
1. Application Layer
2. Transport Layer
3. Internet Layer
4. Network Access Layer

19. **Name the protocols in Application Layer.**
1. HTTP (HyperText Transfer Protocol)
2. FTP (File Transfer Protocol)
3. SMTP (Simple Mail Transfer Protocol)
4. SNMP (Simple Network Management Protocol)
5. DNS (Domain Name System)
6. TELNET

20. **Mention the Transport Layer Protocols.**
1. TCP (Transmission Control Protocol)
2. UDP (User Datagram Protocol)

21. **List out the Internet Layer Protocols.**
1. IGMP (Internet Group Management Protocol)
2. ICMP (Internet Control Message Protocol)
3. IP (Internet Protocol)
4. ARP (Address Resolution Protocol)
5. RARP (Reverse Address Resolution Protocol)

22. **What is the use of HTTP and FTP?**
- **HTTP:**
  - HTTP stands for HyperText Transfer Protocol
  - HTTP takes care of the communication between a web server and a web browser.
- It is used for sending requests from a web client (a browser) to a web server, returning web content (web pages) from the server back to the client.
  - **FTP:**
  - FTP stands for File Transfer Protocol
  - FTP takes care of file transmission between computers.

23. **What is BOOTP?**

   BOOTP stands for Boot Protocol. It used for booting (starting) computers from the network.

24. **What are the various mechanisms used to improve traditional TCP performance?**

   1. Slow Start
   2. Congestion Avoidance
   3. Fast Retransmit / Fast Recovery

25. **What are the various mechanisms used to improve TCP performance in Mobile Networks?**

   1. TCP in Single-hop Wireless Networks:
      1. Indirect TCP (I-TCP)
      2. Fast Retransmission
      3. Snooping TCP (S-TCP)
      4. Mobile TCP (M-TCP)
      5. Freeze TCP (F-TCP)
   2. TCP in Multi-hop Wireless Networks:
      1. TCP-F (TCP Feedback)

26. **List out indirect TCP advantages. May/June 2013**

   - I-TCP does not require any changes in the TCP protocol as used by the hosts in the fixed network or other hosts in a wireless network that do not use this optimization. All current optimizations for TCP still work between the foreign agent and the correspondent host.
   - Due to the strict partitioning into two connections, transmission errors on the wireless link, i.e., lost packets cannot propagate into the fixed network

27. **Define disadvantage of I-TCP.**

   - The loss of the end-to-end semantics of TCP might cause problems if the foreign agent partitioning the TCP connection crashes.
   - The foreign agent must be a trusted entity because the TCP connections end at this point. If users apply end-to-end encryption.

28. **What is meant by Snooping TCP?**

   - The main function of the enhancement is to buffer data close to the mobile host to perform fast local retransmission in case of packet loss.
   - In this approach, the foreign agent buffers all packets with destination mobile host and additionally ‘snoops’ the packet flow in both directions to recognize acknowledgements
29. **List out advantage of M-TCP.**
   - It maintains the TCP end-to-end semantics. The SH does not send any ACK itself but forwards the ACKs from the MH.
   - If the MH is disconnected, it avoids useless retransmissions, slow starts or breaking connections by simply shrinking the sender’s window to 0

30. **Define fast retransmit and fast recovery.**
   - The mechanisms of fast recovery/fast retransmit a host can use after receiving duplicate acknowledgements, thus concluding a packet loss without congestion.
   - As soon as the mobile host registers at a new foreign agent using mobile IP, it starts sending duplicated

31. **Define time out freezing. May/June 12 and May/June 2013 Nov/Dec 2014**
The MAC layer can inform the TCP layer of an upcoming loss of connection or that the current interruption is not caused by congestion. TCP can now stop sending and ‘freezes’ the current state of its congestion window and further timers

32. **Define Selective retransmission. Nov / Dec 2012**
   - If a single packet is lost, the sender has to retransmit everything starting from the lost packet (go-back-n retransmission). This obviously wastes bandwidth, not just in the case of a mobile network, but for any network (particularly those with a high path capacity, i.e., bandwidth delay-product).
   - The advantage of this approach is obvious: a sender retransmits only the lost packets

33. **List out disadvantage of M-TCP.**
   - As the SH does not act as proxy as in I-TCP, packet loss on the wireless link due to bit errors is propagated to the sender. M-TCP assumes low bit error rates, which is not always a valid assumption.
   - A modified TCP on the wireless link not only requires modifications to the MH protocol software but also new network elements like the bandwidth manager

34. **What are the possible locations for care of address? Nov/Dec 2013**
The COA defines the current location of the MN from an IP point of view. All IP packets sent to the MN are delivered to the COA, not directly to the IP address of the MN. Packet delivery toward the MN is done using a tunnel, as explained later. To be more precise, the COA marks the tunnel endpoint, i.e., the address where packets exit the tunnel.
There are two different possibilities for the location of the COA:
   - Foreign agent COA
   - Co-located COA

35. **What are the possible locations of Tunnel end point of Mobile IP? May/June 2014**
A tunnel establishes a virtual pipe for data packets between a tunnel entry and a tunnel endpoint. Packets entering a tunnel are forwarded inside the tunnel and leave the tunnel unchanged. Tunneling, i.e., sending a packet through a tunnel is achieved by using encapsulation.
The possible locations of Tunnel end point are
1. Home Agent (HA)
2. Foreign Agent (FA)

36. **How does M-TCP split the connections?**
   - **Unmodified TCP**
     Used to handle wired part of connection and used in between the Fixed Host (FH) and the Supervisory Host (SH).
   - **Optimized TCP**
     Used to handle wireless part of connection and used in between the Supervisory Host (SH) and the Mobile Host (MH).

37. **What should the value of TTL Filed in the IP packet of agent advertisement? Why? May/June 2014**
The TTL field of the IP packet is set to 1 for all advertisements to avoid forwarding them. The IP destination address according to standard router advertisements can be either set to 224.0.0.1, which is the multicast address for all systems on a link or to the broadcast address 255.255.255.255.

38. **Differentiate snoopy TCP and mobile TCP. Nov/Dec 2014**
   - The Snoop protocol is a TCP-aware link layer protocol designed to improve the performance of TCP over networks of wired and single-hop wireless links. The main problem with TCP performance in networks that have both wired and wireless links is that packet losses that occur because of bit-errors are mistaken by the TCP sender as being due to network congestion, causing it to drop its transmission window and often time out, resulting in degraded throughput.
   - In wireless systems, WTCP is placed on a base station or intermediate gateway between a source host and a mobile (wireless) host. The base station is a wireless transmitter and receiver for the mobile host, and acts as a gateway to the internet for the host.

PART – B

1. Explain entities and terminology of Mobile IP. [U]
2. Describe the following terms in detail: [An]
   i) Corresponding Node
   ii) Care of Address
   iii) Agent Discovery
   iv) Tunneling and Encapsulation.
3. Explain in detail about the key mechanisms associated with Mobile IP. [U]
4. Express brief account of route optimization in Mobile IP. [U]
8. Explain the layered architecture of the TCP/IP protocol suite and compare it with the ISO/OSI Architecture. [An]
11. Write short notes on (i) TCP Tahoe   (ii) TCP Reno   [R]
12. Discuss and compare the various mechanisms used to improve the TCP performance. [An] May/June 2016

COURSE OUTCOME: An ability to explain the need of Mobile Internet Protocol and Transport Layer Protocol.

UNIT III

MOBILE TELECOMMUNICATION SYSTEM

SYLLABUS: Global System for Mobile Communication (GSM) – General Packet Radio Service (GPRS) – Universal Mobile Telecommunication System (UMTS)

COURSE OBJECTIVE: Learn the basics of mobile telecommunication system.

PART-A

1. Expand GSM, GPRS and UMTS.
   GSM – Global System for Mobile Communication
   GPRS – General Packet Radio Services
   UMTS – Universal Mobile Telecommunication Systems

2. What is meant by GSM?
   Global System for Mobile Communication (GSM) is a wide area wireless communications system that uses digital radio transmission to provide voice, data and multimedia communication services. A GSM system coordinates the communication between a mobile telephones (Mobile Stations), base stations (Cell Sites) and switching systems.

3. What is the important characteristic of GSM?
   GSM provides data services in addition to voice services and it is compatible to 1G system.

4. What is the use of GSM in mobile telecommunication? Nov/Dec 2011&12 May/June 12
   This system was soon named the Global System for Mobile communications (GSM), The primary goal of GSM was to provide a mobile phone system that allows users to roam and provides voice services compatible to ISDN and other PSTN systems

5. Specify the three different categories of services defined by GSM
   - Bearer services
   - Tele services
   - Supplementary services
6. **What is the use of emergency number?**
   Another service offered by GSM is the emergency number. This service is mandatory for all providers and free of charge. This connection also has the highest priority, possibly pre-empting other connections, and will automatically be set up with the closest emergency center.

7. **List the important supplementary services offered by GSM.**
   - User Identification
   - Call Forwarding (or Redirection)
   - Automatic call-back
   - Conferencing with up to 7 participants

8. **What is meant by SMS and EMS?**
   - A useful service for very simple message transfer is the short message service (SMS), which offers transmission of messages of up to 160 characters
   - The successor of SMS, the Enhanced Message Service (EMS), offers a larger message size (e.g., 760 characters, concatenating several SMs), formatted text, and the transmission of animated pictures

9. **What are the sub systems available in GMS?**
   - Radio subsystem
   - Network and switching subsystem
   - Operation subsystem

10. **What is RSS?**
    RSS stands for Radio Sub System. It comprises of all radio specific entities.

11. **Name the entities of RSS.**
    1. Mobile Station (MS)
    2. Base Station Subsystem (BSS)
    3. Base Transceiver Station (BTS)
    4. Base Station Controller (BSC)

12. **Classify the functions of HLR and VLR.**

<table>
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<tr>
<th>Home Location Registers(HLR)</th>
<th>Visitor Location Registers(VLR)</th>
</tr>
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<tbody>
<tr>
<td>HLR is a mobile operator database that includes details specific to each subscriber such as phone number, subscriber’s IMSI, pre/postpaid, user’s current location, billing details, phone status – parameters.</td>
<td>VLR is a temporary database that is updated whenever a new MS enters its area by roaming. The information is obtained from the corresponding HLR. i.e., VLR supports roaming functions for users outside the coverage area of their own HLR.</td>
</tr>
<tr>
<td>Basic Parameters stored in the HLR:</td>
<td>The additional data stored in the VLR in telecom is listed below:</td>
</tr>
<tr>
<td>• Subscriber ID (IMSI and MSISDN)</td>
<td>1. Location Area Identity (LAI).</td>
</tr>
<tr>
<td>• Current Location of the user</td>
<td>2. Temporary Mobile Subscriber Identity (TMSI).</td>
</tr>
<tr>
<td>• Supplementary Services Subscribed to (Caller Tone, Missed Call Alert, Any</td>
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III Year/VI SEM
### 13. List out the functions of OMC.
- Traffic Monitoring
- Subscribers
- Security Management
- Account Billing

### 14. List the 3 important features of GSM Security. May/June 2016
1. **Authentication** – used to protect the network against unauthorized use.
2. **Confidentiality** – Data on the radio path is encrypted between the Mobile Equipment (ME) and the BTS which protects user traffic and sensitive signaling data against eavesdropping.
3. **Anonymity** – Anonymity is achieved by allocating Temporary Mobile Subscriber Identity (TMSI) instead of permanent identities to protect against tracking a user’s location and obtaining information about a user’s call log.

### 15. What are the characteristics of GSM?
1. Communication
2. Total Mobility
3. World Wide Connectivity
4. High Capacity
5. High Transmission Quality
6. Security Functions
7. SIM Card Bounded Service

### 16. Give the block diagram of GSM Authentication. May/June 2014

![GSM Authentication Diagram](image)

<table>
<thead>
<tr>
<th>Other Services etc.</th>
<th>3. Mobile Station Roaming Number (MSRN).</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Subscriber Status (Registered or Deregistered)</td>
<td>4. Mobile status (busy/free/no answer etc.).</td>
</tr>
<tr>
<td>• Authentication Key and AUC Functionality</td>
<td></td>
</tr>
<tr>
<td>• Mobile Subscriber Roaming Number</td>
<td></td>
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</table>
17. **What is meant by GPRS? May/June 12**
GPRS (General Packet Radio Services) is a packet-oriented mobile data service on the GSM of 3G and 2G cellular communication systems. It is a non-voice, high-speed and useful packet-switching technology for GSM networks.

18. **List out the features of GPRS.**
1. Speed
2. Immediacy
3. Packet Switched Resource Allocation (Spectrum Efficiency)
4. Flexible Channel Allocation
5. Traffic characteristics suitable for GPRS
6. Mobility
7. Localization

19. **Explain in what ways is GPRS better than GSM?**
GSM uses a billing system based on the time of connection whereas GPRS uses a billing system based on the amount of transmitted data.

20. **What are the goals of GPRS?**
1. Open Architecture
2. Consistent IP services
3. Same infrastructure for different air interfaces
4. Integrated telephony and Internet infrastructure
5. Service innovation independent of infrastructure

21. **What are the services offered by GPRS?**
GPRS offers end-to-end packet-switched data transfer services which can be categorized into the following two types:
1. Point-To-Point Service (PTP): It is between two users and can either be connectionless or connection-oriented.
2. Point-To-Multipoint Service (PTM): It is a data transfer service from one user to multiple users.

22. **Point out the purpose of EIR in Mobile Computing.**
Equipment Identity Register (EIR) is a database that used to track handsets using the IMEI. It helps to block calls from stolen, unauthorized, or defective mobiles.

23. **What is the use of VOIP? May/June 2013**
Voice over Internet protocol, a technology for making telephone calls over the Internet in which speech sounds are converted into binary.

24. **What is meant by roaming?**
In wireless telecommunications, roaming is a general term referring to the extension of connectivity service in a location that is different from the home location where the service was registered. Roaming ensures that the wireless device is kept connected to the network, without losing the connection.
25. **What is the function of GGSN? May/June 2014**
   - The gateway GPRS support node (GGSN) is the interworking unit between the GPRS network and external packet data networks (PDN). This node contains routing information for GPRS users, performs address conversion, and tunnels data to a user via encapsulation.
   - The GGSN is connected to external networks (e.g., IP or X.25) via the Gi interface and transfers packets to the SGSN via an IP-based GPRS backbone network (Gn interface).

26. **What is UMTS?**
The Universal Mobile Telecommunications System (UMTS) is a 3G mobile communication system that provides a range of broadband services to wireless and mobile communications. The UMTS was developed mainly for countries with GSM networks.

27. **What are the main elements of UMTS? May/June 2016**
1. User Equipment / Mobile Station (MS): is the name by which a cell phone is referred to
2. Radio Network Subsystem (RNS): Equivalent of Base Station Subsystem (BSS) in GSM. It provides and manages the wireless interface for the overall network.
3. Core Network (CN): Equivalent of the Network Switching Subsystem (NSS) in GSM.

28. **Draw Architecture of UMTS?**

29. **List out UMTS Problems.**
   - Require more battery power
   - Can handoff UMTS to GSM but not GSM to UMTS
   - Initial poor coverage
   - More expensive than GSM

**PART-B**


III Year/VI SEM

COURSE OUTCOME: An ability to explain the various architectures of Mobile Telecommunication System.

UNIT IV

MOBILE AD-HOC NETWORKS


COURSE OBJECTIVE: Be exposed to Ad-Hoc networks.

PART – A

1. What is meant by Ad-hoc network?
The term implies spontaneous or impromptu construction. An ad hoc network is a network that is composed of individual devices communicating with each other directly. Instead of relying on a base station to coordinate the flow of messages to each node in the network, the individual network nodes forward packets to and from each other.

2. What are the basic principles of Ad-hoc networking?
   • Mobile device communicate in peer-to-peer fashion
   • Self-organizing network without the need of fixed network infrastructure,
   • Multi-hop communication,
   • Decentralized, mobility-adaptive operation

3. What are the needs of ad hoc networks?
   • Ease of deployment
   • Speed of deployment
   • Decreased dependence on infrastructure

4. What are the advantages of ad hoc networks?
The advantages of an ad hoc network include:
   1. Separation from central network administration.
   2. Self-configuring nodes are also routers.
   3. Self-healing through continuous re-configuration.
   4. Scalability incorporates the addition of more nodes.
5. Mobility allows ad hoc networks created on the fly in any situation where there are multiple wireless devices.
6. Flexible ad hoc can be temporarily setup at any time, in any place.
7. Lower getting - started costs due to decentralized administration.
8. The nodes in ad hoc network need not rely on any hardware and software. So, it can be connected and communicated quickly.

5. **What are the key challenges in ad hoc networks?**
   1. All network entities may be mobile ⇒ very dynamic topology
   2. Network functions must have high degree of adaptability (mobility, outage)
   3. No central entities ⇒ operation in completely distributed manner

6. **What is meant by MANET?**
   A mobile ad hoc network (MANET) is a continuously self-configuring, infrastructure-less network of mobile devices connected without wires. MANETs are established and maintained on the fly and work without the support of any form of fixed infrastructure such as base station or an access point.

7. **Give the difference between cellular and ad-hoc networks.**

<table>
<thead>
<tr>
<th>S.No</th>
<th>Cellular Networks</th>
<th>Ad-hoc Networks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Infrastructure Networks</td>
<td>Infrastructure-less Networks</td>
</tr>
<tr>
<td>2</td>
<td>Fixed, pre-located cell sites and base stations</td>
<td>No base station and rapid deployment</td>
</tr>
<tr>
<td>3</td>
<td>Static backbone network topology</td>
<td>Highly dynamic network topologies</td>
</tr>
<tr>
<td>4</td>
<td>Relatively caring environment and stable connectivity</td>
<td>Hostile environment and irregular connectivity</td>
</tr>
<tr>
<td>5</td>
<td>Detailed planning before base station can be installed</td>
<td>Ad-hoc networks automatically forms and adapts to changes</td>
</tr>
<tr>
<td>6</td>
<td>High setup costs</td>
<td>Cost-effective</td>
</tr>
<tr>
<td>7</td>
<td>Large setup time</td>
<td>Less setup time</td>
</tr>
</tbody>
</table>

8. **List out the characteristics of MANETs. May/June 2016**
   1) Lack of fixed infrastructure
   2) Dynamic Topologies
   3) Bandwidth constrained, variable capacity links
   4) Energy Constrained Operation
   5) Increased Vulnerability
   6) Distributed peer-to-peer mode of operation
   7) Multi-hop Routing
   8) Autonomous Terminal
   9) Lightweight Terminals
   10) Shared Physical Medium

9. **Analyze the operational constraints (challenges) associated with MANET.**
   1. Low Processing Capabilities & low bandwidth
2. Computational & Communication overhead
3. Mobility-induced route changes
4. Battery Constraints
5. Packet losses due to transmission errors
6. Security Threats
7. Dynamic Topology

10. **What are the advantages of MANETs?**
- They provide access to information and services regardless of geographic position.
- Independence from central network administration
- Self-configuring network, nodes are also act as routers. Less expensive as compared to wired network.
- Scalable—accommodates the addition of more nodes.
- Improved Flexibility.
- Robust due to decentralize administration.
- The network can be set up at any place and time.

11. **What are the disadvantages of MANET?**
1. Limited Resource
2. Limited Physical Security
3. Vulnerable to attacks. Lack of authorization facilitates
4. Variable network topology makes it hard to detect malicious nodes
5. Security protocols for wired network cannot work for adhoc network
6. Battery constraints
7. Frequent route changes leads to computational overhead

12. **List out some of the applications of MANETs.**
Some of the typical applications include:
1) Communication among portable computers
2) Environmental Monitoring
3) Sensor Networks
4) Military Sector
5) Personal Area Network and Bluetooth
6) Emergency Applications

13. **Analyze and list out the various design issues associated with MANET.**
1) Network Size and Node Density
2) Connectivity
3) Network Topology
4) User Traffic
5) Operational Environment
6) Energy Constraints

14. **What is meant by routing in ad hoc networks?**
“Routing is the process of finding the best path between the source and the destination for forwarding packets in any store-and-forward network. Routing is the mechanism of forwarding
packet towards its destination using most efficient path. Efficiency of the path is measured in various metrics like, Number of hops, traffic, security, etc. In Ad-hoc network each host node acts as specialized router itself.

15. Compare Link State and Distance Vector Routing.

<table>
<thead>
<tr>
<th>S.NO</th>
<th>Link Sate Routing</th>
<th>Distance Vector Routing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>It can be used in larger networks</td>
<td>It can be used in smaller networks</td>
</tr>
<tr>
<td>2.</td>
<td>It has unlimited number of hops</td>
<td>It has limited number of hops</td>
</tr>
<tr>
<td>3.</td>
<td>Convergence time is low</td>
<td>Convergence time is high</td>
</tr>
<tr>
<td>4.</td>
<td>Advertises only new changes</td>
<td>Periodically advertise updates</td>
</tr>
<tr>
<td>5.</td>
<td>Only advertise the updates and flood the advertisement</td>
<td>Advertises the entire routing tables to all its neighbors</td>
</tr>
<tr>
<td>6.</td>
<td>Metric used is cost</td>
<td>Metric used is hop count</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>S.NO</th>
<th>MANET routing strategies</th>
<th>Routing strategies of traditional networks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>In MANET, each node acts as a router</td>
<td>In traditional network, ordinary nodes do not participate in routing the packets.</td>
</tr>
<tr>
<td>2.</td>
<td>In MANET, the topology is dynamic because of the mobility of the nodes. Thus the routing table quickly becomes obsolete.</td>
<td>In traditional networks, the topology is static and the routing table is also constant during the data transmission.</td>
</tr>
<tr>
<td>3.</td>
<td>IP address encapsulated in the subnet structure does not work because of the node mobility</td>
<td>Simple IP-based addressing scheme is deployed in wired network.</td>
</tr>
</tbody>
</table>

17. Give the classification of MANET routing protocols.

[Diagram showing MANET Routing Protocols with categories: Proactive, Reactive, Hybrid. Examples: DSDV etc, AODV, DSR etc, ZRP]
18. List the types of communication in MANET.
   - **Unicast**: Message is sent to a single destination node
   - **Multicast**: Message is sent to a selected subset of network nodes
   - **Broadcast**: Broadcasting is a special case of multicasting. Message is sent to all the nodes in the network.

19. What is meant by VANET?
   A Vehicular Adhoc Network (VANET) is a special type of MANET in which moving automobiles form the nodes of the network. i.e., vehicles are connected to each other through an adhoc formation that forms a wireless network.

20. Mention the goals of VANET.
   - Improve traffic safety and comfort of driving
   - Minimize accidents, traffic intensity, locating vehicles
   - Up-to-date traffic information
   - Intersection collision warning
   - Weather information

21. What are the characteristics of VANETs?
   1) High mobility of nodes
   2) Rapidly changing network topology
   3) Unbounded network size
   4) Higher computational capacity
   5) Time-sensitive data exchange
   6) Potential support from infrastructure
   7) Abundant Resources
   8) Partitioned Network
   9) Unlimited Transmission Power

22. Mention the uses of VANET.
   1) A VANET can help drivers to get advance information and warnings from a nearby environment via message exchanges.
   2) A VANET can help disseminate geographical information to the driver as he continues to drive.
   3) Drivers may have the opportunity to engage in other task.

23. List out the applications of VANETs.
   1) Safety oriented
      a) Real-time traffic
      b) Cooperative message transfer
      c) Post-crash notification
      d) Road hazard control notification
      e) Traffic vigilance
   2) Commercial oriented
      a) remote vehicle personalization
b) internet access  
c) digital map downloading  
d) real time video relay  
e) value-added advertisement

3) Convenience oriented  
a) route diversion  
b) electronic toll collection  
c) parking availability

4) Productive Applications  
a) Environmental Benefits  
b) Time Utilization  
c) Fuel Saving

24. Compare MANET Vs VANET. May/June 2016

<table>
<thead>
<tr>
<th>S.No</th>
<th>VANET – Vehicular Adhoc Network</th>
<th>MANE – Mobile Adhoc Network</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Basic Idea</td>
<td>It is a collection of nodes(vehicles) that communicate with each other over bandwidth constrained wireless links with certain road side infrastructure or base station</td>
</tr>
<tr>
<td>2</td>
<td>Production Cost</td>
<td>Costly</td>
</tr>
<tr>
<td>3</td>
<td>Network Topology Change</td>
<td>Frequent and very fast</td>
</tr>
<tr>
<td>4</td>
<td>Mobility</td>
<td>High</td>
</tr>
<tr>
<td>5</td>
<td>Density in Node</td>
<td>Frequent variable and dense</td>
</tr>
<tr>
<td>6</td>
<td>Bandwidth</td>
<td>1000 kbps</td>
</tr>
<tr>
<td>7</td>
<td>Range</td>
<td>Up to 600 m</td>
</tr>
<tr>
<td>8</td>
<td>Node lifetime</td>
<td>It is depend on vehicle life time</td>
</tr>
<tr>
<td>9</td>
<td>Reliability</td>
<td>High</td>
</tr>
<tr>
<td>10</td>
<td>Nodes moving Pattern</td>
<td>Regular</td>
</tr>
</tbody>
</table>

PART – B

1. Explain the basic characteristics and applications of Mobile Ad hoc networks. [U] May/June2016

2. Explain the various routing strategies in mobile ad-hoc networks. [U]


5. Explain the following: [U]
   (i) DSDV routing protocol
   (ii) Ad-hoc DSR routing protocol
7. Discuss and detail the differences between DSDV and DSR routing protocols. [An]
8. What are the differences between AODV and the standard distance vector algorithm? Why are extensions needed? [An]
9. Explain about Hybrid Routing protocols in MANETs. [U]
10. Demonstrate how multicast routing is carried out in ad-hoc networks. [An]
11. Define VANET? Explain how does it differ from MANET? Explain any one application of VANET. [An]
13. Discuss about various schemes in VANET routing. [An]

COURSE OUTCOME: An ability to compare various routing protocols in Mobile Ad-hoc networks.

UNIT V

MOBILE PLATFORMS AND APPLICATIONS


COURSE OBJECTIVE: Gain knowledge about different mobile platforms and application development.

PART – A

1. What is meant by Mobile Operating System?
   A mobile operating system, also called a mobile OS, is software that is specifically designed to run on mobile devices such as mobile phones, smartphones, PDAs, tablet computers and other handheld devices. Much like the Linux or Windows operating system controls your desktop or laptop computer, a mobile operating system is the software platform on top of which other programs can run on mobile devices.

2. List out the features of Mobile Operating Systems.
   1. Multitasking
   2. Scheduling
   3. Memory Allocation
   4. File System Interface
   5. Keypad Interface
   6. I/O Interface
   7. Protection and Security
   8. Multimedia features
3. **Draw the architecture of Mobile OS.**

<table>
<thead>
<tr>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>OS Libraries</td>
</tr>
<tr>
<td>Device Operating System Base, Kernel</td>
</tr>
<tr>
<td>Low-Level Hardware, Manufacturer Device Drivers</td>
</tr>
</tbody>
</table>

4. **What are the constraints in Mobile OS?**
Design and capabilities of a Mobile OS (Operating System) is very different than a general purpose OS running on desktop machines:
- Mobile devices have constraints and restrictions on their physical characteristic such as screen size, memory, processing power and etc.
- Scarce availability of battery power
- Limited amount of computing and communication capabilities

5. **List out various Mobile Operating Systems.**
**Give four examples of Mobile OS.**  
May/June 2016
There are many mobile operating systems. The followings demonstrate the most important ones:
- Java ME Platform
- Palm OS
- Symbian OS
- Linux OS
- Windows Mobile OS
- BlackBerry OS
- iPhone OS
- Google Android Platform

6. **Define Android SDK.**
Android SDK is a software development kit that enables developers to create applications for the Android platform. The Android SDK includes sample projects with source code, development tools, an emulator, and required libraries to build Android applications.

7. **What are the advantages and disadvantages of Android Mobile OS?**

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large number of devices using Android</td>
<td>Some device manufacturers add alternative UI front-ends which reduces OS consistency</td>
</tr>
<tr>
<td>Frequent Enhancement</td>
<td>Updates are controlled by device manufacturers and may be slow or non-existent</td>
</tr>
<tr>
<td>Larger number of applications availability</td>
<td>Applications are not validated</td>
</tr>
<tr>
<td>Excellent UI</td>
<td></td>
</tr>
<tr>
<td>Multi-tasking</td>
<td></td>
</tr>
<tr>
<td>Free developer tools</td>
<td></td>
</tr>
<tr>
<td>No restrictions on applications</td>
<td></td>
</tr>
<tr>
<td>Phones are available from every service</td>
<td></td>
</tr>
</tbody>
</table>
provider
- Many devices can be unlocked with third-party applications

8. What are the advantages and disadvantages of Apple iOS?

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Excellent UI</td>
<td>• Closed architecture</td>
</tr>
<tr>
<td>• Larger number of applications availability</td>
<td>• Limited number of devices to choose from – all from apple</td>
</tr>
<tr>
<td>• Apple validates applications</td>
<td>• No multi-tasking for applications</td>
</tr>
<tr>
<td>• Consistent UI across devices</td>
<td>• Applications must be approved by Apple before being made available via the Marketplace</td>
</tr>
<tr>
<td>• Frequent free OS updates</td>
<td>• Can’t be unlocked</td>
</tr>
</tbody>
</table>

9. What are the advantages and disadvantages of BlackBerry OS?

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Secure send and receive email using proprietary encryption</td>
<td>• Closed architecture</td>
</tr>
<tr>
<td>• Multi-tasking</td>
<td>• Limited number of devices to choose from – all from Research In Motion</td>
</tr>
<tr>
<td>• Phones available form most service providers</td>
<td>• Limited number of applications available</td>
</tr>
<tr>
<td></td>
<td>• Application development is more complex and difficult than other Operating Systems</td>
</tr>
<tr>
<td></td>
<td>• Applications tend to be more costly</td>
</tr>
</tbody>
</table>

10. What are the advantages and disadvantages of Windows Phone OS?

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Built in support for Windows Office documents</td>
<td>• Closed architecture</td>
</tr>
<tr>
<td>• Multi-tasking</td>
<td>• Small number of applications available</td>
</tr>
<tr>
<td>• Phones available form most service providers</td>
<td>• Browser is a mix of IE7 and IE8 (a bit dated)</td>
</tr>
<tr>
<td>• Excellent development tools, with free versions available to students</td>
<td>• Applications must be approved by Microsoft before being</td>
</tr>
<tr>
<td>• Updates available directly from Microsoft</td>
<td></td>
</tr>
</tbody>
</table>


M-commerce (mobile commerce) is the buying and selling of goods, services or information by using Wireless handheld devices such as cellular telephone and personal digital assistants (PDAs). It is an important application of Mobile Computing. This includes purchases on Websites or apps, in-store or from vending machines; paying for travel, events or bills; or redeeming a coupon… any type of commerce that is conducted using a mobile device.
12. What are the characteristics of M-Commerce?
   1. Fast Processing
   2. Reduced Business Costs
   3. Little Need for Maintenance

13. List out the applications of M-Commerce.
   M-Commerce applications broadly categorized into
   1. Business-to-Consumer (B2C) Applications
      (i) Advertising
      (ii) Comparison Shopping
      (iii) Information about a product
      (iv) Mobile Ticketing
      (v) Content Purchase and Delivery
      (vi) Loyalty and Payment Services
      (vii) Mobile Banking
      (viii) Catalogue Shopping
      (ix) Mobile Brokerage

   2. Business-to-Business (B2B) Applications
      (i) Ordering and Delivery Conformation
      (ii) Stock Tracking and Control
      (iii) Supply Chain Management
      (iv) Mobile Inventory Management


15. What are the features required for a mobile device to enable mobile commerce?

   To enable M-Commerce to be used widely, a mobile device should support the following features:
   i) Good internet connectivity
   ii) Ability to display rich content such as images
   iii) Have a good quality camera with auto focus
   iv) Screen should be able to properly display the bar codes
   v) Ability to read the RFID tags
vi) MMS (Multimedia Message Service), SMS (Short Message Service)
vi) Ability to communicate between the mobile device and the supporting network
viii) Ability to scan bar codes
ix) Ability to interact with the Point-of-Sale (PoS) terminals

16. What are pros of M-Commerce?
1. For the business organizations, the benefits of using M-commerce include customer convenience, cost savings and new business opportunities.
2. For customers, M-commerce provides the flexibility of anytime, anywhere shopping using a lightweight device. Customers can save substantial time compared to visiting several stores to identify a right product at lowest price.
3. Cover wild distance: Mobile is the only technology which is now become necessary for any person in social and business life than computers. So, it is easy to reach users through mCommerce.
4. Consumer deals: As more users use mCommerce, there are lots of companies use mCommerce site to reach them by giving different and better deals in comparison of their competitor.
5. Savings: Companies try to reach to the consumer directly through mCommerce, so users have no need to go far to the store physically and at the end it saves user’s time and money.
6. Easy to use: There is no need of skilled consumer. Buyers can have look thousands of items on their cell phones and there is no need of online checkout process.

17. What are the cons of M-Commerce?
1. Smart phone limitation (Small Screen): Mobile has no big screen like desktop or laptops, so sometimes users tried to navigate more and more to choose just one item from thousands. It affects shopping rates.
2. Habituate: Every new technology has some problem at the starting phase. Here mCommerce is new application, so sometimes people avoid to change which are rapidly change. As they are habituate to buy products from eCommerce.
3. The underlying network may impose several types of restrictions. For example, the available bandwidth is restricted, international calls and SMS may be expensive. Therefore ubiquity of E-commerce is hard to achieve.
4. Security: unless a customer is extremely careful, he may fall to various types of frauds and may get billed for the items he did not purchase.
5. Risk factor: Each business has its own risk. Same Mobile commerce is the growing field and a lot of investment in this field is become risky. Because technology change day by day. Moreover, there less security in wireless network, so in data transfer hacking chances are more.
6. Connectivity: Mobile commerce needs high speed connectivity of 3G. Otherwise it is become hectic for user to go through entire product purchase process.

18. What is meant by M-Payment (Mobile Payment)?
A Mobile Payment (m-payment) may be defined as initiation, authorization and confirmation of a financial transaction using a mobile devices like mobile phones, PDAs and other devices that connects to a mobile network for making payments.
19. **What are the characteristics/properties of Mobile Payment System?**
   1. Simplicity and Usability
   2. Universality
   3. Interoperability
   4. Security, privacy and Trust
   5. Cost
   6. Speed / Swiftness
   7. Cross border payments

20. **What are the different Mobile Payment System models?**
   There are three different models available for mobile payment solutions on the basis of payment:
   1. Bank account based
   2. Credit card based
   3. Micro Payment

21. **List out the various technologies used for M-Payment systems.**
   a) SMS (Short Message Service)
   b) USSD (Unstructured Supplementary Services Delivery)
   c) WAP/GPRS
   d) Phone based applications (J2ME/BREW)
   e) SIM-based Application
   f) Near Field Communication (NFC)
   g) Dual Chip
   h) Mobile Wallet

22. **Who are the stakeholders of M-Payment systems?**
   The mobile payment ecosystem involves the following types of stakeholders:
   - Consumers
   - Financial service providers (FSPs)
   - Payment service providers (PSPs)
   - In-service providers (merchants), including content providers
   - Network service providers (NSPs)
   - Device manufacturers
   - Regulators
   - Standardization and industry bodies
   - Trusted service managers (TSMs)
   - Application developers

23. **What are the advantages of M-Payment System?**
   ✓ **Security**: Mobile payments are more secure than traditional credit or debit cards. The retailer’s system never has direct access to the cardholder’s account number, so current point-of-sale malware doesn’t work against it.
   ✓ **Speed**: Most mobile payments are fast. Customers simply pass their mobile device over a near-field communication (NFC) reader connected to the POS system. Some systems require entering a password or PIN, but others are just scan-and-go.
✓ **Fewer cards to carry around**: Instead of a wallet full of credit cards, customers can simply carry an identification card and mobile device.

✓ **Not limited to POS stations**: Some retailers have already started experimenting with mobile payment kiosks mounted around the retail floor. Customers can avoid long lines and use their mobile devices to pay from anywhere.

✓ **Tested and proven overseas**: Consumers in Kenya, Japan, Hong Kong, and Taiwan have been using mobile payment technology for over a decade. Japanese consumers can use their cell phones to buy at vending machines, ticket booths, and 1.8 million retailers.

24. **List out the disadvantages of M-Payment System.**

- **Cost**: In most cases, accepting mobile payments requires additional POS hardware. The NFC readers are not cheap, but because of upcoming changes to the credit card system that will start next year, your business will probably need to upgrade soon. The cost of an NFC reader included with the new hardware will probably be much less than current NFC readers.

- **Competing systems**: There are at least three major companies that offer mobile wallet services and dozens of smaller ones. Some systems require NFC readers, while others use bar codes displayed on the screen. A few retailers offer their branded mobile wallets that deduct funds from gift cards.

- **Mobile hardware incompatibility**: Not all systems work with all mobile hardware. Many older and low-end smartphones lack NFC capabilities.

- **Rewards**: Some mobile wallets don’t give customers the same rewards as scanning their credit card would. For example, Google Wallet sets up a MasterCard debit account that charges the customer’s credit card on the back end. Suppose a customer has a branded rewards card that gives double points for shopping at the issuing retailer. They would not get a double reward since the card was charged by Google and not a retailer.

25. **What are the risks associated with M-Payment systems?**

- Inability to adapt to mobile payments can put a company at a competitive disadvantage.
- New processes create new security vulnerabilities. Over-the-air provisioning of payment credentials and applications, for example, potentially creates new attack vectors for eavesdroppers to steal and misuse customer data.
- Attackers can steal and misuse data, leading to painful disclosures, adverse publicity, and fines.
- Failure to understand exactly where and how sensitive account data is stored and transmitted can prevent organizations from clearly defining and implementing data protection solutions.
- Rising transaction volumes can lead to performance bottlenecks as inefficient processing limits capacity and degrades the customer experience.
- Overly cumbersome and costly security schemes can hinder an organization’s ability to adapt quickly to new opportunities or to scale its business processes to meet rising service demand.
PART – B
1. Explain in detail about the architecture of Mobile Operating system. [U]
3. Explain the following: [An]
   a) Android OS
   b) Windows Phone OS
   c) Apple IOS
   d) Blackberry OS
5. Explain about M-Commerce and its structure with neat sketch. [R]
6. Explain the various applications of M-Commerce. [R] May/June 2016
7. Discuss briefly about the various technologies involved in M-Payment system. [Ap]
8. Explain the working of M-Payment system with any example application. [An]

COURSE OUTCOME: An ability to understand and explain the features of various Mobile Operating Systems.
### COURSE OUTCOMES

**COURSE NAME**: IT6601 - MOBILE COMPUTING  
**YEAR/SEMESTER**: III / VI  
**YEAR OF STUDY**: 2016 –2017 EVEN (R – 2013)

On Completion of this course student will gain

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