Mobile Communication & Computing Notes

1. Mobile Communication

Mobile Communication allows wireless transmission of voice and data, enabling users to move while staying connected.

1. Provides wireless access over large areas.
2. Supports voice, video, SMS, and data services.
3. Works via cellular network infrastructure.
4. Enables mobility and portability of users.

2. Mobile Computing

Mobile Computing enables users to process and communicate data using portable devices through wireless networks anytime, anywhere.

1. Combines communication and computing.
2. Devices: smartphones, laptops, PDAs, tablets.
3. Uses wireless technologies (Wi-Fi, GSM, Bluetooth).
4. Ensures ubiquitous and location-independent access.

3. Paradigms of Mobile Computing

1. Mobile Communication
2. Mobile Hardware
3. Mobile Software

4. Promises / Novel Applications

1. Ubiquitous connectivity (always online).
2. Mobile commerce (m-payment, banking).
3. Telemedicine (remote health monitoring).
4. Mobile learning, smart homes, location-based services.
5. IoT integration with real-time data exchange.

5. Impediments (Challenges)

1. Limited bandwidth and data rates.
2. Frequent disconnections and handovers.
3. Battery and power constraints.
4. Security and privacy risks.
5. Heterogeneous network compatibility issues.

6. GSM (Global System for Mobile Communication)

GSM is a 2G digital cellular network standard providing voice and data communication.

1. Services: Bearer, Teleservices, Supplementary.
2. Architecture: MS, BSS, NSS, OSS.
3. Radio Interface: TDMA, 200 kHz spacing.
4. Protocols: LAPDm, network, and physical layers.

5. Localization, Calling, and Handover supported.
6. Security via SIM authentication and encryption.
7. New Data Services: SMS, CSD, GPRS.

7. GPRS (General Packet Radio Service)

1. Packet-switched data service (2.5G).
2. Always-on connectivity, up to 171.2 kbps.
3. Uses SGSN and GGSN for Internet access.
4. Enables mobile Internet, MMS, and email.

8. Wireless Medium Access Control (MAC)

Wireless MAC controls how multiple devices share the wireless medium efficiently, avoiding collisions and ensuring fairness.

1. Coordinates channel access among nodes.
2. Avoids interference and collisions.
3. Maintains QoS and fairness.
4. Supports mobility and dynamic topology.

9. Motivation for Specialized MAC

1. Hidden Terminal Problem – nodes unable to detect each other cause collisions (solved by RTS/CTS).
2. Exposed Terminal Problem – unnecessary blocking of transmission (solved by carrier sensing).
3. Near-Far Problem – unequal power causes unfair access (solved by power control).

10. Multiple Access Techniques

1. SDMA – spatial separation (used in MIMO, beamforming).
2. FDMA – frequency division, each user has unique band (used in 1G).
3. TDMA – time slots for users (used in GSM).
4. CDMA – all share same channel using codes (used in 3G).

11. Wireless LAN (IEEE 802.11)

1. Based on CSMA/CA with RTS/CTS.
2. Components: Station, Access Point, BSS, ESS.
3. Versions: 802.11b/g/n/ac/ax with speeds from 11 Mbps to 9.6 Gbps.
4. Supports encryption (WEP, WPA, WPA2).
5. Advantages: flexible, portable, easy setup.
6. Disadvantages: limited range, interference, security risks.