

# Introduction to Mobile Computing

## Introduction to Mobile Computing – Study Notes

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### 1. What Is Mobile Computing?

| Aspect                 | Description                                                                                                                                                                                                          |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Definition</b>      | The ability to access network resources, run applications, and exchange data while moving freely, using portable devices (smartphones, tablets, wearables, laptops).                                                 |
| <b>Key Goal</b>        | Provide seamless, real-time connectivity and services regardless of location.                                                                                                                                        |
| <b>Core Components</b> | <ul style="list-style-type: none"><li>• Mobile devices</li><li>• Wireless communication networks</li><li>• Mobile operating systems &amp; middleware</li><li>• Backend services &amp; cloud infrastructure</li></ul> |

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### 2. Characteristics of Mobile Computing

| Characteristic              | Explanation                                                           |
|-----------------------------|-----------------------------------------------------------------------|
| <b>Portability</b>          | Small, lightweight devices that can be carried anywhere.              |
| <b>Ubiquity</b>             | Users can connect anytime, anywhere within network coverage.          |
| <b>Location Awareness</b>   | GPS, Wi-Fi, cellular triangulation enable context-sensitive services. |
| <b>Ad Hoc Connectivity</b>  | Devices can form temporary networks (e.g., Bluetooth, Wi-Fi Direct).  |
| <b>Resource Constraints</b> | Limited battery, CPU, memory, and storage compared with desktops.     |
| <b>Heterogeneity</b>        | Variety of hardware platforms, OSes, and network technologies.        |

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### 3. Mobile Device Architecture

#### 1. Hardware Layer

- Processor (ARM, x86)
- Memory (RAM, flash storage)
- Sensors (accelerometer, gyroscope, magnetometer, proximity, ambient light)

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- Radio interfaces (cellular, Wi-Fi, Bluetooth, NFC, GPS)

## 2. Operating System (OS)

- Manages resources, provides APIs for hardware access.
- Popular OSES: Android, iOS, iPadOS, HarmonyOS, Windows Mobile (legacy).

## 3. Middleware

- Provides services such as data synchronization, security, location management, and messaging.

## 4. Application Layer

- End-user apps (native, web, hybrid) that deliver functionality.

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## 4. Wireless Communication Technologies

| Technology                   | Frequency / Range                | Typical Data Rate       | Typical Use Cases                    |
|------------------------------|----------------------------------|-------------------------|--------------------------------------|
| Cellular (3G/4G/5G)          | Sub-GHz to mmWave (up to 100GHz) | 1Mbps – >10Gbps (5G)    | Voice, video streaming, IoT backhaul |
| Wi-Fi (802.11 a/b/g/n/ac/ax) | 2.4GHz / 5GHz / 6GHz             | Up to 10Gbps (Wi-Fi 6E) | Indoor broadband, hotspot            |
| Bluetooth (LE)               | 2.4GHz                           | Up to 2Mbps (LE)        | Wearables, peripheral devices        |
| NFC                          | 13.56MHz                         | ~424kbps                | Contactless payments, pairing        |
| Satellite                    | L-band, Ku-band, Ka-band         | 100kbps – 100Mbps       | Remote area connectivity             |
| LoRa / Sigfox                | Sub-GHz (e.g., 868MHz)           | ~250kbps                | Low-power wide-area IoT              |

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## 5. Mobile Operating Systems & Development

| OS      | Programming Languages     | Primary SDK    | Distribution Model |
|---------|---------------------------|----------------|--------------------|
| Android | Java, Kotlin, C/C++ (NDK) | Android Studio | Open source (A     |