

Lecture 24: Mobile Handset Architecture

Mobile Device

DI05011011: Mobile Communication

Agenda for Today

- 1. Overview of a Mobile Handset
- 2. General Block Diagram
- 3. The Antenna Section
- 4. The RF (Radio Frequency) Section
- 5. The Baseband Processor
- 6. Power Management and User Interface
- 7. Summary

1. Overview of a Mobile Handset

- A mobile handset is a highly complex, miniaturized two-way radio.
- It must simultaneously transmit and receive (Full Duplex).
- It contains computers (processors) more powerful than early desktop PCs.
- Requires extreme power efficiency to run on a small battery.

2. General Block Diagram

- The core architecture is divided into three main sections:
- **1. Radio Frequency (RF) Section:** Handles transmission and reception of analog radio waves.
- **2. Baseband Section:** Handles digital signal processing, coding, and modulation.
- **3. Application/UI Section:** Handles the OS, display, camera, and user inputs.

3. The Antenna Section

- The interface between the handset and the electromagnetic environment.
- Modern phones use internal antennas (e.g., PIFA - Planar Inverted-F Antenna).
- Must support multiple frequency bands (GSM, LTE, Wi-Fi, Bluetooth).
- Includes an **Antenna Switch** or **Duplexer** to separate transmit (Tx) and receive (Rx) signals.

4. The RF (Radio Frequency) Section

- **Receiver Path (Rx):**

- - Receives weak signal from the antenna.
- - Passes through an LNA (Low Noise Amplifier).
- - Down-converts the high-frequency radio signal to a lower intermediate frequency (IF) or directly to baseband.

- **Transmitter Path (Tx):**

- - Up-converts baseband signal to high radio frequencies.
- - Passes through a PA (Power Amplifier) before hitting the antenna.

The Role of the Power Amplifier (PA)

- The PA is located just before the transmitting antenna.
- It amplifies the signal to the required power level commanded by the base station.
- Draws heavy current from the battery.
- Generates significant heat, requiring careful thermal management in the handset design.

5. The Baseband Processor

- The 'brain' of the radio communications.
- A specialized DSP (Digital Signal Processor).
- **Functions:**
 - - Analog-to-Digital (ADC) and Digital-to-Analog (DAC) conversion.
 - - Speech coding/decoding (Vocoders).
 - - Channel coding (adding error correction bits).
 - - Encryption and Decryption.

Signal Flow: Transmitting Voice

- 1. Microphone captures sound (Analog audio).
- 2. Baseband ADC converts audio to Digital data.
- 3. Baseband compresses data and adds error correction.
- 4. Baseband passes digital data to RF Section.
- 5. RF Section up-converts data to a 1900MHz analog radio wave.
- 6. PA boosts the signal.
- 7. Antenna radiates the wave to the cell tower.

6. Power Management Unit (PMU)

- The unsung hero of the mobile handset.
- Takes the raw voltage from the battery and converts it into precisely regulated voltages for different chips.
- The RF PA might need 3.4V, the baseband processor might need 1.2V, and the screen might need 5V.
- Manages sleep modes to conserve battery when the phone is idle.

- A mobile handset consists of an Antenna, RF Section, Baseband Section, and Power Management.
- The **RF Section** handles high-frequency analog radio waves (amplification, up/down conversion).
- The **Baseband Section** handles digital signal processing (coding, encryption, modulation logic).
- The **PMU** ensures all these components receive the correct power efficiently.

- In the next lecture, we will dive deeper into power management:
- **1. Charging Control Section:** How does a phone safely charge?
- **2. Battery Types:** Lithium-Ion vs. Lithium-Polymer.
- **3. Battery Management Systems (BMS).**