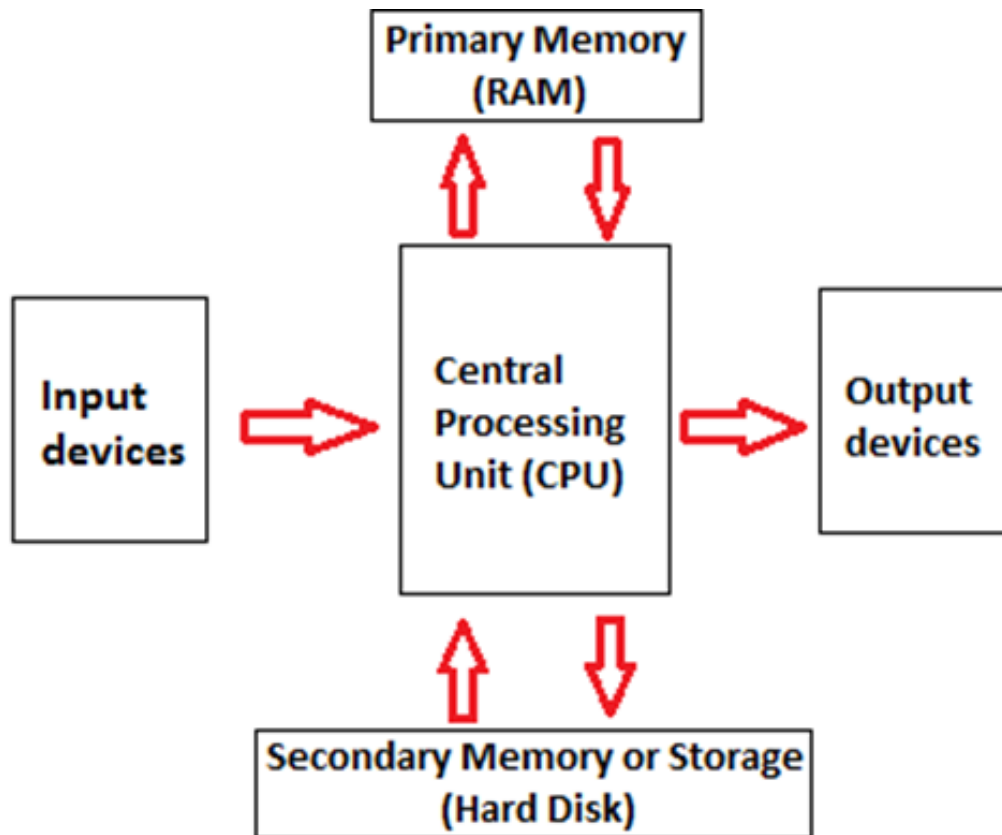


Computer Components and SoC Design

Overview of Computer Components



Overview of Computer Components



- Main Components of a Computer:
 - **CPU (Central Processing Unit):** Executes instructions and processes data.
 - **RAM (Random Access Memory):** Temporary storage for data and instructions currently in use.
 - **ROM (Read-Only Memory):** Permanent storage for essential system instructions.
 - **Storage Devices:** Long-term storage such as SSDs or HDDs.
 - **Peripherals:** External devices like keyboards, mice, and printers.
 - **Motherboard:** The main circuit board connecting all components.
 - **Power Supply:** Provides electrical power to all components.

CPU

- The CPU is the “brain” of the computer.
- It manages calculations, executes instructions, and controls data flow between memory and peripherals.
- **Importance:**
 - Executes instructions quickly and efficiently processes data.
 - Manages communication between memory and peripherals to ensure smooth operation.
- **Components:** ALU (Arithmetic Logic Unit), Control Unit, Cache.
- **Architecture:**
 - CMOS Technology: Reduces power consumption while keeping performance high.
 - VLSI Integration: Packs millions of transistors onto the chip to increase CPU power.

RAM (Random Access Memory)

- **RAM** is the computer's short-term memory.
- It temporarily stores data and instructions that the CPU needs to access quickly during operation.
- **Importance:**
 - Speeds up processing by providing the CPU with quick access to data.
 - Stores temporary data, which is erased when the computer is turned off
- **Characteristics:** Volatile memory, Multitasking
- **Architecture:**
 - CMOS Technology: RAM is constructed using CMOS transistors, which consume less power and offer faster read/write speeds.
 - VLSI Technology: Enables manufacturers to fit millions of memory cells on a single RAM chip, resulting in higher storage capacities.

ROM (Read Only Memory)

- **ROM** is the computer's long-term memory.
- It stores essential data and instructions required to start up the computer and perform basic operations.
- **Importance:**
 - Non-volatile: Data remains even when the computer is powered off.
 - Stores critical system instructions, such as the boot-up programs.
- **Architecture:**
 - CMOS Technology: Like RAM, ROM is built using CMOS to benefit from low power consumption.

Importance of Understanding Computer Components

- **Purpose of Each Component:**

- Understanding how each component works helps in troubleshooting, upgrading, and optimizing computer systems.
- Lays the foundation for grasping advanced subjects like System-on-Chip (SoC).

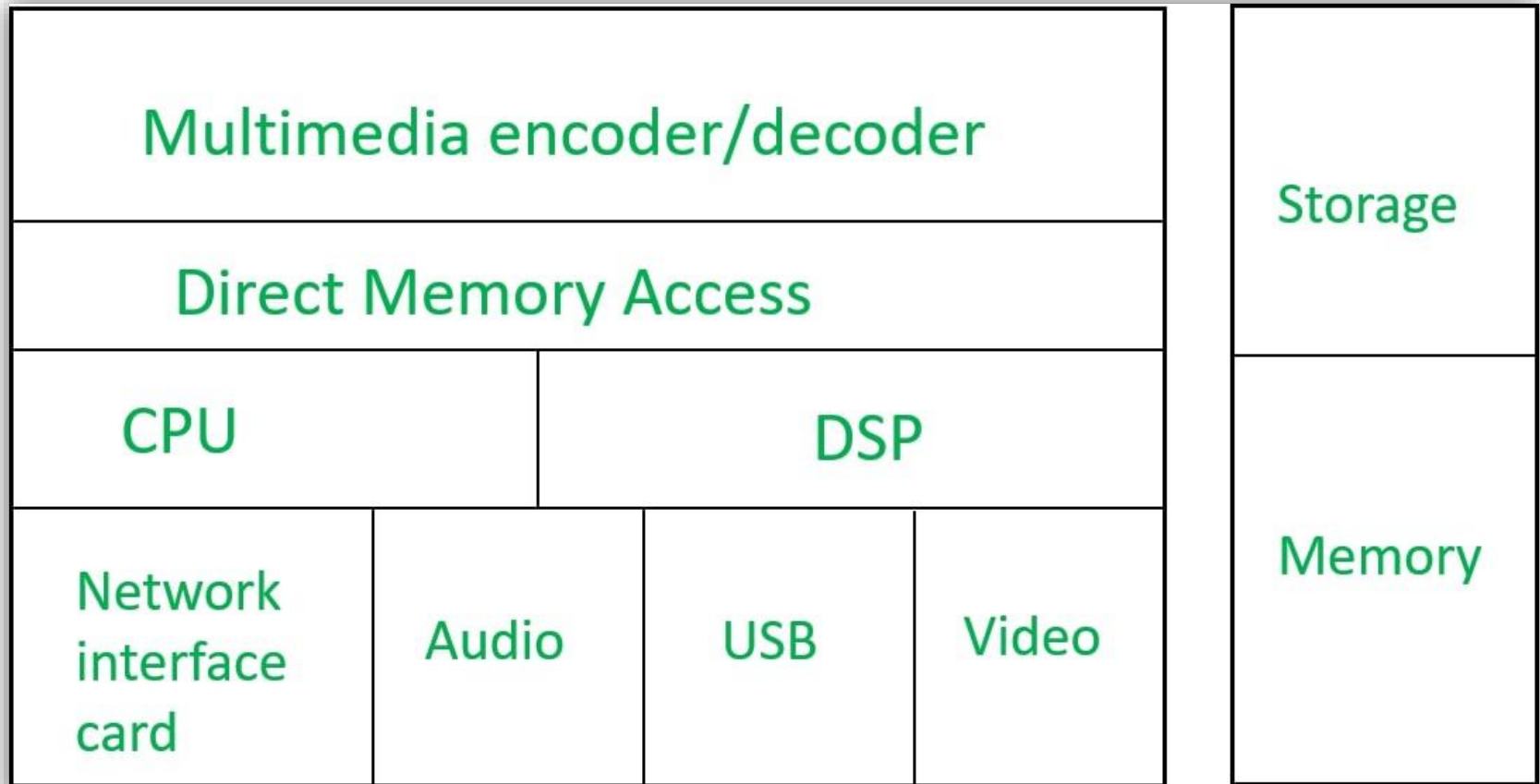
Understanding Systems and Chips

- What is a System?
 - A **system** is a group of interconnected components that work together to achieve a specific function.
 - Example: A computer system, includes hardware (CPU, RAM, storage), software (operating systems, applications), and peripherals (keyboard, mouse, printers).
- What is a Chip?
 - A **chip** (or integrated circuit) is a small piece of semiconductor material, typically silicon, on which a set of electronic circuits are integrated.
 - Example: The CPU (Central Processing Unit) is a chip that acts as the brain of the computer, executing instructions.

From Computer Components to System-on-Chip (SoC)

- **What is a System-on-Chip (SoC)?**
 - SoC integrates multiple essential computer components into a single chip.
 - Combines CPU, RAM, ROM, and peripherals into one compact chip.
 - Offers efficiency in terms of power consumption, size, and performance.
 - **Components of SoC:** CPU, GPU, RAM, ROM, Peripherals

SoC Architecture



Advantages of SoC

- It is small in size and includes many features and functions.
- It consumes low power.
- SoC is flexible in terms of size, and power factor.
- It is built on a single chip.
- It is cost-effective.
- It is produced in a large quantity.

Disadvantages of SoC

- Time-consuming designing process. Usually, a designing process of SoC takes six to twelve months.
- If any component of the SoC is not functioning properly then it cannot be replaced in that case an entire SoC has to be replaced.
- Visibility of SoC is limited.

Benefits of SoC

- **Why SoC Design is Beneficial:**

- Enhanced performance due to faster data transfer.
- Space-saving design enables smaller devices.
- Reduced power consumption extends battery life.
- Used in smartphones, tablets, and IoT devices.

Uses of SoC

- Used in smartphones, smartwatches, tablets, and computers.
- Internet of Things applications such as home automation.
- Embedded systems applications especially where the microcontroller is used.

Applications of SoC



Smartphones and Tablets: SoCs integrate key components for better performance and power efficiency in mobile devices (e.g., Qualcomm Snapdragon, Apple A-series).



Embedded Systems (IoT Devices): Used in smart home devices and industrial machinery, SoCs offer real-time processing and low power consumption (e.g., ARM Cortex-M).



Wearable Technology: Powers smartwatches and fitness trackers, providing compact and energy-efficient solutions (e.g., Qualcomm Snapdragon Wear).



Automotive Systems (ADAS): Supports advanced driver-assistance and infotainment systems in vehicles, offering real-time processing (e.g., Nvidia DRIVE).



Gaming Consoles: High-performance SoCs handle gaming and media in consoles like the PlayStation 5 and Xbox Series X (e.g., AMD custom SoCs).