

"What is Computer Architecture?"

Dina Sharabi

Computer architecture gives us the answer to the following question: "what are computers made of, and what makes them functional?" It explains how different components within a computer interact to execute the computer's purpose. Generally, every computer has a CPU, RAM, storage, input/output devices, all connected through the motherboard. Smartphones are not much different: they also contain the same parts, except in smaller and more power-efficient versions.

We can view the Central Processing Unit (CPU) as the brain of the computer. In computers, it has an arithmetic logic unit (ALU), which performs calculations, and a control unit, which ensures that instructions run in the correct order. Phones also have CPUs, but theirs are built to balance performance with battery life. In some modern phones we can find multiple 'cores', designed for either heavy or light tasks, which helps save power whenever possible.

Random-Access Memory (RAM) and storage (hard drives or SSDs) can be compared to humans' short-term and long-term memory. RAM works in a fast but temporary manner, storing quick-access data for the CPU. It makes multitasking smooth and efficient, allowing switching between apps and tasks without delays. However, since the data in RAM is temporary, all stored information will be lost once the computer is turned off. For better performance, we should pay attention to the RAM capacity - the larger the capacity, the more data the computer can handle at once.

Storage, on the other hand, is the equivalent of long-term memory. Data is kept permanently in the storage, and this data can be files, apps, operating systems... There are two main types of storage: Hard Disk Drives (HDDs) and Solid State Drive (SSDs). Both have their advantages and disadvantages. HDDs use spinning magnetic disks to read and write data. They offer large capacity at a lower cost, but are slower than SSDs. SSDs use flash memory, making them much faster, though usually more expensive. The choice between HDDs and SSDs depends on whether the user values capacity or speed more. Smartphones also use RAM and storage, but in smaller amounts. This storage is often soldered onto the board and can't be replaced like in most computers.

Input/Output devices enable the computer and its user to interact. Input devices provide data and commands to the computer (e.g. keyboards, mice, microphones). Output devices return feedback and information to the user (e.g. monitors, speakers). Some devices serve both input and output device functions, such as touch screens. These components improve user experience and make tasks like audio playback, gaming, document printing possible.

A Graphic Processing Unit (GPU) is a specialised processor that accelerates graphics rendering. It takes care of the visuals, and is important for video editing, gaming, or any application that requires high-resolution graphics. By offloading intensive graphical tasks from the CPU, it enhances system performance, enabling smoother visuals and more efficient processing. GPUs are also essential for scientific computing, machine learning, and cryptocurrency mining, since these actions demand a large amount of data to be handled simultaneously. In computers, a GPU can be integrated into the motherboard, or exist as a separate card. In smartphones, however, it is built into the same chip as the CPU.

Of course, all these components need power to function, which brings us to the Power Supply Unit (PSU). The PSU converts alternating current from wall outlets into direct current needed by computer components. It distributes power to the motherboard, CPU, GPU, storage devices, and peripherals through connectors. If the PSU fails, the system may become unstable, crash, or suffer hardware damage. Phones, by contrast, rely on compact rechargeable batteries.

The motherboard is the main circuit board that connects and allows communication between all components. The communications happen through the buses, and a clock keeps processes in sync. The motherboard contains everything that has been microchipped, and links them together for functionality as a whole. It contains a chipset, which manages the flow of data between processors, memory, and peripherals. It also has slots and ports for the user to attach external devices (e.g. USB ports, audio jacks, network interfaces). All smartphones and most modern computers already include Wi-Fi and Bluetooth, reducing the need for additional expansion cards.

Since hardware generates heat, cooling systems are critical. These systems maintain the optimal operating temperatures, prevent overheating, and extend a computer's lifespan. Cooling can contain the following parts: fans, heat sinks, sometimes liquid cooling solutions. They also require regular maintenance, like cleaning dust from fans, and ensuring proper airflow. Smartphones generally rely on passive cooling, spreading heat through their thin metal frames.

Now that we understand the components of our devices, we can see that even if it's a desktop, or a phone, the pieces are all the same, simply adapted for respective needs and priorities.