

Computer Subsystems

Northbridge

The northbridge is a subsystem situated close to the CPU designed around integrating RAM and AGP (memory and graphics expansion). While northbridges and AGP have been replaced by logic on the CPU die and PCIe respectively, the general process of having a northern system for RAM and graphics (and, more recently, general expansion) slots that is fast and simple (Computerhope, 2019).

The reason that northbridges were integrated into the CPU is to reduce motherboard complexity and cost, instead having a more complex CPU that fits the “System on a Chip” design philosophy better, which revolves around removing complexity and allowing for increased performance (Techopedia, 2020).

Southbridge

Southbridges are subsystems which integrate various forms of I/O, including USB, SATA, Ethernet, PCI and video/sound cards. This chip is usually further away from the CPU as I/O requires less speed and therefore proximity to the CPU. While some I/O, such as those that rely interrupts, uses the Super I/O chip, the majority of the I/O instead travelling through the regular southbridge chip (Computerhope, 2019).

Southbridges have also been replaced in modern hardware, with motherboard chipsets being more generalised while performing similar functions. Some functions, like PCI (now PCIe) have been integrated into the CPU, combined with the northbridge functionality for AGP, while slower I/O and interrupts are still handled by the chipset. Intel has the PCH platform for their chipsets (Intel, 2012) while AMD has various chipset names such as B450 and X570 (AMD, 2020).

Modern Motherboard



Modern B450 Chipset Motherboard

- AM4 socket (CPU and ‘Northbridge’)
- DDR4 RAM sockets
- B450 chip (‘Southbridge’)
- SATA, USB, Audio headers
- Expansion Slots (PCIe)
- Motherboard I/O

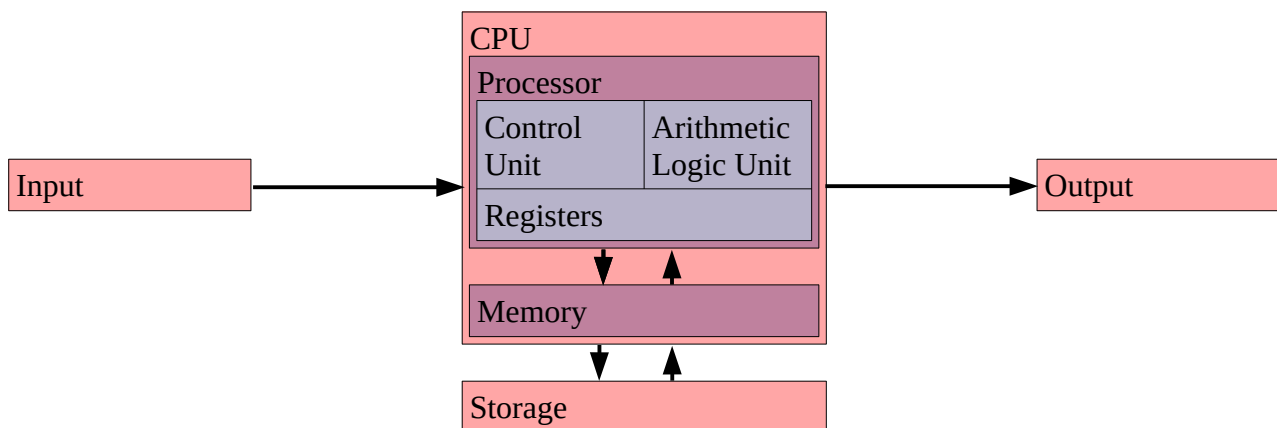
The CPU has the modern equivalent of a northbridge on the die which communicates with the RAM and the PCIe lanes, with a direct connection to the motherboard chipset (in this case, a B450 chip). This chipset handles I/O and any other slower communication on the motherboard, replacing the southbridge and some functions of the northbridge (Techopedia.com, 2020).

Motherboard: ASUS ROG STRIX B450-F GAMING ATX (Asus, 2018)

CPU Purpose

The CPU is the core processing system for a computer, handling general tasks relating to programs and the operating system. While a CPU may be supported by a coprocessor like a GPU, usually they handle all the calculations in a given machine. CPUs rely on data comprised of instructions and data which comes from inputs and storage, and performs calculations which are sent to the outputs. Outputs include displays, storage and networks (Melendez, 2015).

CPU Architecture



Von Neumann Architecture is a CPU architecture that involves a CPU with multiple features, including the Arithmetic Logic Unit, Control Unit, Memory, Input/Output (Computerhope.com, 2017). These features serve to present or utilise data, whether for decoding and execution or for storage, relating to the Fetch Decode Execute cycle. The CPU has and utilises different forms of storage, with registers inside each processor, cache memory on the CPU itself, and storage such as RAM and ROM (Techopedia.com, 2019).

The Arithmetic Logic Unit, or ALU, contains silicon used to perform binary operations like logical operations and arithmetic operations, along with bit-shifting (Techopedia.com, 2019). These operations output data back into registers including the accumulator, which allows the ALU to be used for mathematical operations.

The control unit deals with some internal registers including the Program Counter, Instruction Register and the Address Register. Along with these, the control unit also fetches and decodes instructions, using the program counter to find which address is being referenced, and the other two registers to store the instructions and addresses required for execution. This process is called the machine cycle (Computerhope.com, 2017).

Bibliography

ComputerHope (2019). *What is a Northbridge?* [online] Computerhope.com. Available at: <https://www.computerhope.com/jargon/n/northbri.htm> [Accessed 30 Jan. 2020].

Techopedia.com. (2020). *What is a System on a Chip (SoC)?* - Definition from Techopedia. [online] Available at: <https://www.techopedia.com/definition/702/system-on-a-chip-soc> [Accessed 30 Jan. 2020].

ComputerHope (2019). *What is Southbridge?* [online] Computerhope.com. Available at: <https://www.computerhope.com/jargon/s/southbrid.htm> [Accessed 30 Jan. 2020].

Intel (2012). Intel® 7 Series / C216 Chipset Family Platform Controller Hub (PCH). [online] Available at: <https://www.intel.com/content/dam/www/public/us/en/documents/datasheets/7-series-chipset-pch-datasheet.pdf> [Accessed 30 Jan. 2020].

AMD. (2020). AMD Socket AM4 Platform. [online] Available at: <https://www.amd.com/en/products/chipsets-motherboards-desktop> [Accessed 30 Jan. 2020].

Techopedia.com. (2020). *What is Chipset?* - Definition from Techopedia. [online] Available at: <https://www.techopedia.com/definition/2172/chipset> [Accessed 30 Jan. 2020].

Asus. (2018). ASUS ROG STRIX B450-F GAMING AMD B450 ATX Gaming Motherboard Socket AM4, USB 3.1. [online] Available at: <https://uk.store.asus.com/asus-rog-strix-b450-f-gaming-amd-b450-socket-am4.html> [Accessed 30 Jan. 2020].

Melendez, S. (2015). *What Are the Different Types of Microprocessors?* [online] Techwalla. Available at: <https://www.techwalla.com/articles/what-are-the-different-types-of-microprocessors> [Accessed 6 Feb. 2020].

Computerhope.com (2017). *What is Von Neumann Architecture?* [online] Computerhope.com. Available at: <https://www.computerhope.com/jargon/v/vonneuma.htm> [Accessed 6 Feb. 2020].

Techopedia.com. (2019). *What is Von Neumann Architecture?* - Definition from Techopedia. [online] Available at: <https://www.techopedia.com/definition/32480/von-neumann-architecture> [Accessed 20 Nov. 2019].

Techopedia.com. (2019). *What is Arithmetic Logic Unit (ALU)?* - Definition from Techopedia. [online] Available at: <https://www.techopedia.com/definition/2849/arithmetic-logic-unit-alu> [Accessed 6 Feb. 2020].

[4] <https://www.techopedia.com/definition/2849/arithmetic-logic-unit-alu>

Computerhope.com (2017). *What is a Control Unit?* [online] Computerhope.com. Available at: <https://www.computerhope.com/jargon/c/contunit.htm> [Accessed 6 Feb. 2020].