

PORTFOLIO # 5: A Comparative Study into Different types of Mother boards

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Group 4 -MW(1:30 - 3:30)

Introduction

What is a Motherboard?

A motherboard is the main printed circuit board in a computer, acting as the central backbone that interconnects all other components (CPU, memory, storage, expansion cards, etc.) and distributes power among them. It defines the system's overall size and shape via a form factor, which standardizes its dimensions, mounting points, and power/interface connectors. Form factors ensure that motherboards and cases from different vendors and generations remain compatible.

Different Types of Motherboards

AT (Advanced Technology): The AT motherboard was among the earliest standards, designed for the first IBM-compatible PCs. It featured a simple layout with limited built-in components and relied heavily on expansion cards. It lacked user-friendly features like plug-and-play configuration and had poor airflow management. What makes AT distinct is its legacy design, which laid the groundwork for all later motherboards but is now obsolete due to incompatibility with modern hardware.

LPX (Low Profile eXtension): LPX motherboards were created for slim desktop systems, using a riser card to mount expansion slots horizontally, saving vertical space. They also integrated most peripheral connectors directly onto the board, reducing the need for add-on cards. LPX's uniqueness lies in its space-saving design, although it suffered from poor airflow and non-standard compatibility across brands.

Standard ATX (Advanced Technology eXtended): Standard ATX is the most widely adopted motherboard type, combining high expandability, stability, and performance. What sets it apart is its versatility, it supports multiple GPUs, overclocking, and a wide range of components, making it the go-to for both gaming and general-purpose builds.

Micro-ATX: Micro-ATX retained the ATX design's features but reduced expansion capability to make systems more affordable and compact. It is distinct for maintaining the same socket and chipset support as ATX, while providing fewer PCIe slots. It's ideal for budget and mid-range builds, balancing performance and space efficiency.

Mini-ATX: Mini-ATX boards were a transitional design between Micro-ATX and Mini-ITX, offering minimal expansion but maintaining compatibility with standard hardware. Their distinction lies in being cost-effective and simplified, meant for basic computing needs and small PCs.

Mini-ITX: Mini-ITX is known for its compact and power-efficient layout, used in small-form-factor PCs. It integrates most features directly onto the board (LAN, audio, USB, etc.) and often has only one

expansion slot. Its key distinction is its energy efficiency and minimalism, suitable for compact or portable computers.

Extended-ATX (EATX): EATX motherboards are designed for high-performance systems and servers. They support more memory slots, additional PCIe lanes, and sometimes dual CPU sockets. What makes EATX unique is its focus on maximum power delivery and expandability, catering to professional users like gamers, engineers, and workstation builders who require top-tier performance.

BTX (Balanced Technology eXtended): BTX was developed to improve heat dissipation and airflow efficiency compared to ATX. It placed the CPU and memory closer to airflow paths for better cooling. Unlike ATX, the BTX design was mirrored, which changed the internal layout of PC cases. However, despite its thermal advantages, it failed to replace ATX due to low manufacturer adoption.

Form Factor	Build	CPU Slots	Memory Slots	Chipsets	BIOS	PCI slots	SATA	Builtin Features
AT	Old design; bulky and less power-efficient required manual configuration	1 slot	1 - 2 slots	Basic controller chips	Legacy BIOS	ISA slots	None (IDE only)	Minimal ports
ATX	Improved layout and cooling; standard for modern PCs	1 socket (Intel LGA / AMD AM4 compatible)	2–4 slots	Northbridge/Southbridge or modern Intel/AMD platform hubs	UEFI BIOS	Up to 7 PCIe slots	SATA + M.2 supported	Integrated USB, LAN, Audio
BTX	Reversed layout for better airflow; improved heat control	1 socket (Intel)	2–4 slots	Intel chipsets (integrated controller hub)	UEFI BIOS	4–7 PCIe slots	SATA supported	Integrated LAN, Audio
EATX	Larger high-performance version; supports multi-CPU setups	1–2 sockets (Intel Xeon / AMD)	Up to 8 slots	Server-grade or high-performance chipsets (e.g., Intel X-series, AMD TRX40)	UEFI BIOS	7–8 PCIe slots	SATA + M.2 supported	Dual LAN, USB 3.2, RGB, advanced cooling control

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LPX	Compact, low-profile board using riser cards for expansion	1 socket	1–2 slots	Integrated controller chipset	Legacy BIOS	3–5 (riser-based)	None (IDE only)	Built-in VGA, Audio
Micro-ATX	Smaller ATX version; good balance of size and expandability	1 socket (Intel/AMD)	Up to 4 slots	Mid-range chipsets (e.g., Intel B660 / AMD B550)	UEFI BIOS	Up to 4 PCIe slots	SATA supported	Integrated Audio, LAN
Mini-ATX	Simplified cost-effective design, limited expandability	1 slot	1–2 slots	Compact chipset with limited lanes	UEFI BIOS	1–2 PCIe slots	SATA supported	Basic I/O ports
Mini-ITX	Ultra-compact and power-efficient for small PCs	1 socket	2 slots	Low-power chipsets (e.g., Intel H610 / AMD A520)	UEFI BIOS	1 PCIe x16 slot	SATA + M.2 supported	Full I/O, Audio, LAN
Pico-BTX	Smallest BTX form; efficient airflow and compact layout	1 socket	1–2 slots	BTX-specific compact chipset	UEFI BIOS	1 PCIe slot	Limited SATA support	Minimal I/O ports
Standard ATX	Common form factor; balance of power, size, and features	1 socket (Intel/AMD)	2–4 slots	Consumer chipsets (e.g., Intel Z790 / AMD X670)	UEFI BIOS	Up to 7 PCIe slots	SATA + M.2 supported	Full USB, LAN, Audio, RGB

Definitions:

1.Build

The build of a motherboard refers to its physical design, structure, and layout, including its size, materials used, and arrangement of components. It determines how well the motherboard fits in a computer case, how efficiently it manages heat, and how components like RAM, CPU, and storage are connected. Different builds are designed for different purposes from compact systems to high-performance workstations.

2.CPU Slots (CPU Socket)

A CPU slot, or more commonly a CPU socket, is the connector on the motherboard that holds and connects the central processing unit (CPU) to the system. It ensures electrical contact between the processor and the motherboard's circuitry. Each socket type supports specific processors, making compatibility a crucial factor.

3. Memory Slots (RAM Slots)

Memory slots, also known as DIMM (Dual Inline Memory Module) slots, are the connectors on the motherboard where RAM modules are installed. They determine how much memory a system can support and at what speed. Most standard motherboards have two to four memory slots, while high-end ones can have up to eight, allowing for greater multitasking and performance.

4.Chipsets

The chipset is the motherboard's communication hub that manages data flow between the CPU, RAM, storage devices, and peripheral components. It determines which features the motherboard supports, such as overclocking, number of PCIe lanes, USB versions, and storage interfaces. In modern systems, the chipset works closely with the CPU to ensure stable and efficient operation. Examples include Intel's Z790 and AMD's B650 chipsets.

5. BIOS (Basic Input/Output System)

The BIOS is firmware stored on the motherboard that initializes hardware components during startup and loads the operating system. It provides a user interface for configuring system settings such as boot order, CPU performance, and memory timing. Modern motherboards often use UEFI (Unified Extensible Firmware Interface), which is the successor to traditional BIOS, offering faster boot times and a more user-friendly interface.

6. PCI Slots (Peripheral Component Interconnect)

PCI slots, or more modern PCIe (PCI Express) slots, are expansion interfaces that allow users to install additional hardware such as graphics cards, sound cards, Wi-Fi adapters, or capture cards. They vary in size and speed — PCIe x1, x4, x8, and x16 — depending on the device's bandwidth requirements. The number of PCIe slots differs depending on the motherboard's form factor and chipset.

7. SATA (Serial Advanced Technology Attachment)

SATA ports are connectors that link storage devices like hard drives, solid-state drives (SSDs), and optical drives to the motherboard. SATA replaced the older IDE interface, providing faster data transfer speeds (up to 6 Gbps for SATA III). Many modern boards also include M.2 slots, which connect NVMe SSDs for even faster performance.

8. Built-in Features

Built-in features refer to the integrated hardware components that come pre-installed on a motherboard. These can include onboard audio chips, Ethernet (LAN) ports, Wi-Fi modules, Bluetooth, and USB controllers. Higher-end motherboards may also include RGB lighting control, diagnostic LEDs, and integrated cooling support. These features reduce the need for extra expansion cards, making the system more compact and efficient.

Conclusion

Motherboards play an integral role in determining a computer's performance, efficiency, and upgrade potential. The evolution from AT to modern ATX and Mini-ITX boards reflects technological advancements aimed at improving component compatibility, thermal management, and overall system integration.

The AT and BTX models were crucial during early computing development but are now considered obsolete due to design limitations and incompatibility with current hardware standards. In contrast, ATX and its derivatives, Micro-ATX, Mini-ITX, and Extended ATX, have become the industry standards due to their flexibility, scalability, and balance between size and functionality. These motherboards support advanced chipsets, faster PCIe and SATA interfaces, and efficient power delivery systems that enhance both stability and performance.

For users and system builders, choosing the right motherboard type depends on application requirements. For instance, Mini-ITX suits compact, energy-efficient systems, while E-ATX is ideal for high-end gaming, workstation, and server configurations requiring multiple GPUs and large memory capacities. The chipset also plays a key role, as it determines CPU compatibility, storage capabilities, and connectivity features.

In essence, understanding motherboard classifications is not only about identifying form factors, it is also about recognizing how architecture, chipset integration, and expansion support contribute to a system's long-term performance and adaptability. Selecting the appropriate motherboard ensures efficient operation, optimal upgrade paths, and enhanced user experience across various computing environments.

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