MICROPROCESSORS & MICROCONTROLLERS

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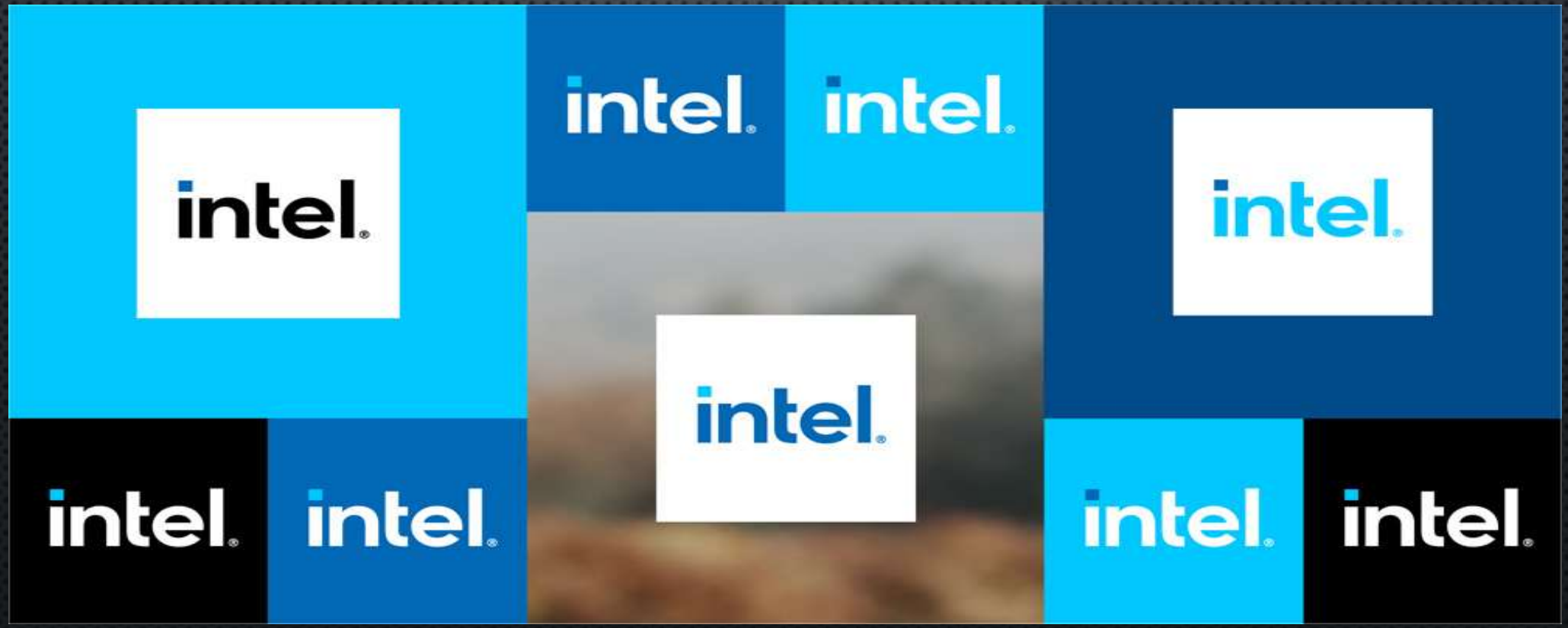
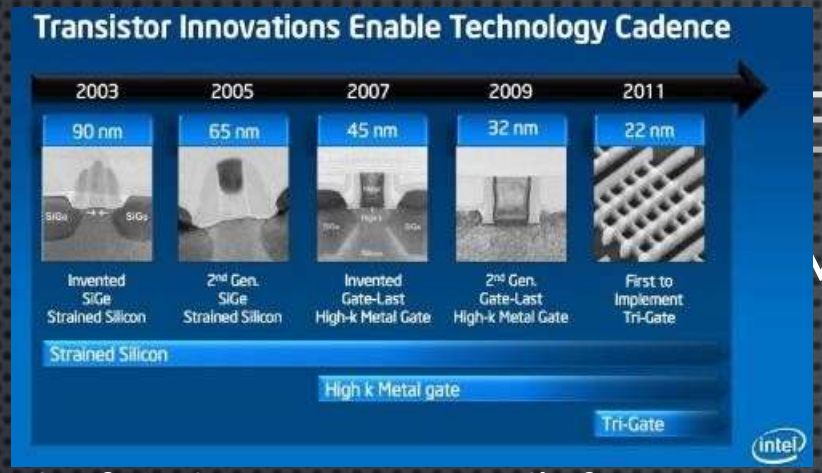




EVOLUTION OF MICROPROCESSOR

The four-bit 4004 was Intel's first microprocessor that was offered for sale in 1971. It was made to operate in tandem with the 4001 ROM, 4002 RAM, and 4003 Shift Register microchips. While the 4004 itself carried out calculations, those additional parts were essential for the processor to work. The 4004 was not designed to be utilised inside of computers; instead, it was mostly employed in calculators and other comparable devices. It could clock at a maximum of 740 kHz. The 8086 was Intel's first 16-bit CPU, which significantly improved performance in comparison to preceding models. In addition to being faster than the less expensive 8088, it also used a longer, six-byte prefetch queue and a 16-bit external data bus.. Since the debut of the 8086, practically all of the processors made by AMD or Intel have been based on the x86 ISA, which was initially used by the 8086, making it the first x86 processor.In 1984, Intel developed their first RISC CPU. It was created as a safe embedded solution rather than as a direct rival to the company's x86 processors. Its internal architecture was a 32-bit superscalar using Berkeley RISC design principles. The 80386 was Intel's first 32-bit x86 CPU, which was introduced in 1985. This processor's 32-bit address bus, which enabled it to accommodate up to 4GB of system memory, was one of its main advantages. RAM restrictions frequently impair the performance of earlier x86 and rival processors, even though this was significantly more RAM than anyone was utilising at the time.The Pentium was the first Intel x86 processor to be released in 1993 that didn't use the 80x86 numbering scheme. The L1 cache size on Intel's Pentium processors was also enhanced.

The processor "race" between Intel and AMD was declared over in 2006 due to impossibility. New goals include multi-core and energy efficiency. For these jobs, the outdated NetBurst architecture (Pentium 4, Pentium D) was inadequate. Fortunately, Intel took the lead in developing Pentium M laptop chips, whose architecture served as the foundation for the Core 2 Duo series of desktop processors.

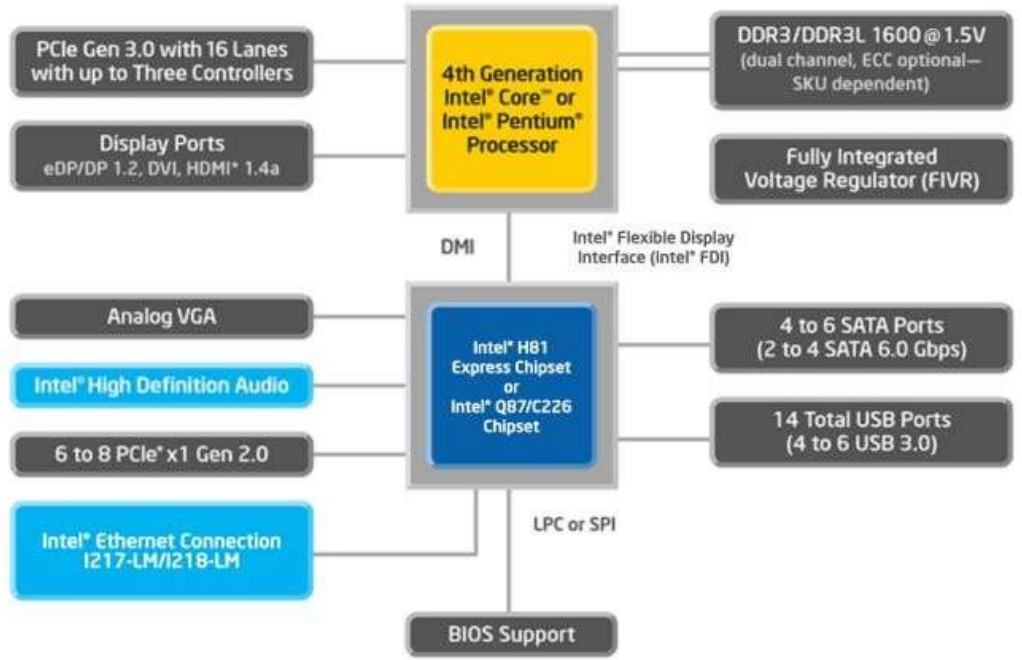
For a brief period, Core 2 Duo and Quad were the primary processors. A brand-new chip family that is still in use today was announced by Intel in 2008 under the name Core i7. The family of chips was called Bloomfield, and the architecture was called Nehalem. These were the first Intel processors with a genuine quad-core architecture and support for Hyper-Threading, which split each physical core into two virtual streams. And whereas one virtual core's performance on the Pentium 4 was roughly 40 percent of that of a real core, it increased to 70 percent on the Core i7.

The actual "Golden age" of Intel began in the year 2011. New processors, named Core 2nd Gen or Sandy Bridge (finally, the name of the architecture and processor family has been unified), were already a third more powerful than Westmere.

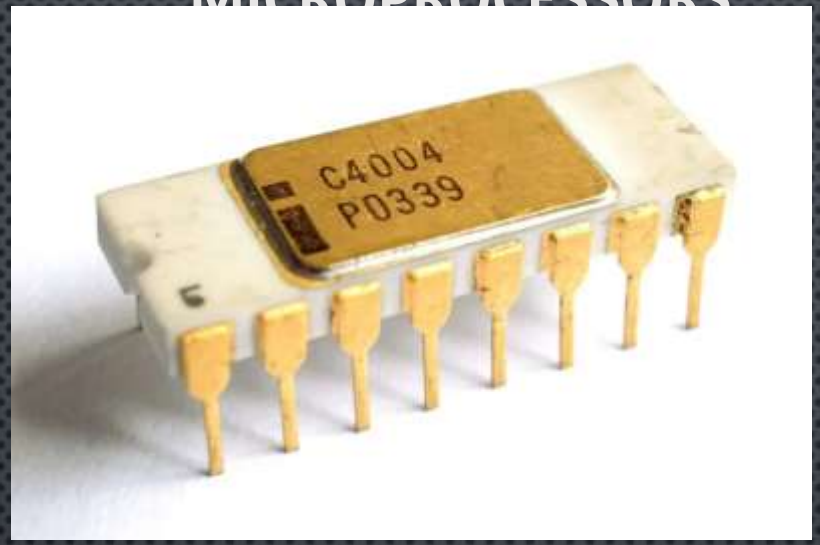
BASIC ARCHITECTURE OF INTEL PROCESSORS

Some abbreviations used in the diagrams below:

BIOS	Basic Input/Output System; a boot ROM
DDR3	Double Data-Rate v3; a popular DRAM interface standard
DMI	Direct Memory Interface; a video graphics standard
FIVR	Fully Integrated Voltage Regulator
LPC	Low Pin Count; a simple interface to slower I/O devices
PCH	Platform Controller Hub; a companion chip
PCI	Peripheral Component Interconnect; a popular expansion bus
PCIe*	PCI Express*; an upgraded PCI standard
SATA	Serial ATA; a popular disk-interface standard
SPI	Serial Peripheral Interface; simple interface to slower devices



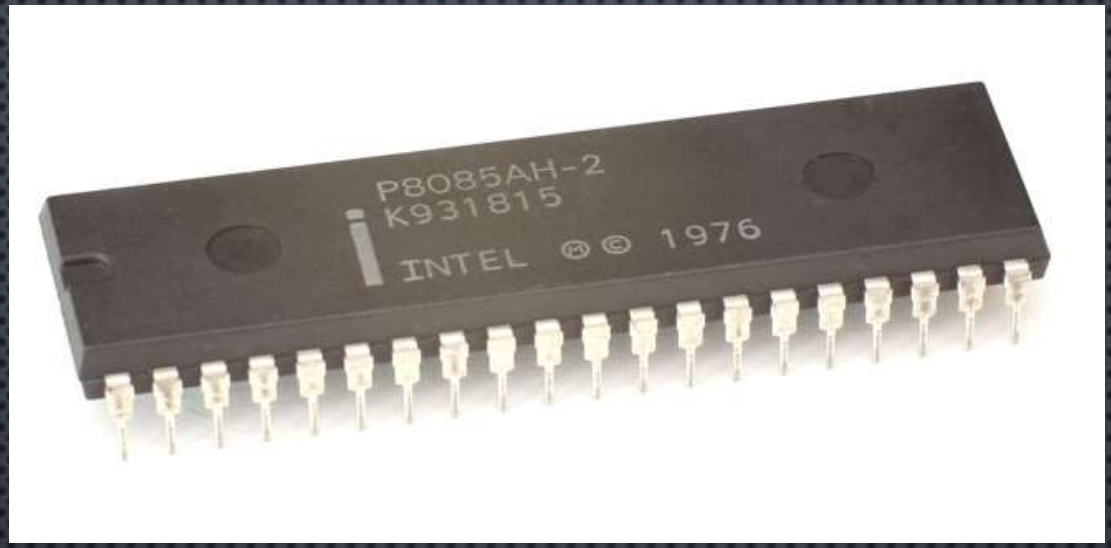
4- BIT MICROPROCESSORS



The largest operand width in a 4-bit microprocessor or computer architecture will be 4 bits, or a nibble. Additionally, these designs or microprocessors will often have a register file that matches, with registers that are 4 bits wide and addresses that are 4–8 bits wide.

Early in the 1970s, the majority of the first microprocessors used 4-bit word sizes. The first commercial microprocessor, the Intel 4004, and the 4040 both have 4-bit words but 8-bit instructions.The Intel 4004, which came in a 16-pin ceramic dual in-line packaging, contained about 2,300 transistors. It could carry out about 92,000 instructions per second on a 12 mm2 device using silicon-gate enhancement load pMOS technology with a 10 m process. The 4004 had separate storage for programmes and data. The 4004 however, with its requirement to reduce pin count, uses a single multiplexed 4-bit bus for the transfer of 12-bit addresses, 8-bit instructions, and 4-bit data bits as opposed to Harvard architectural devices that use separate buses.

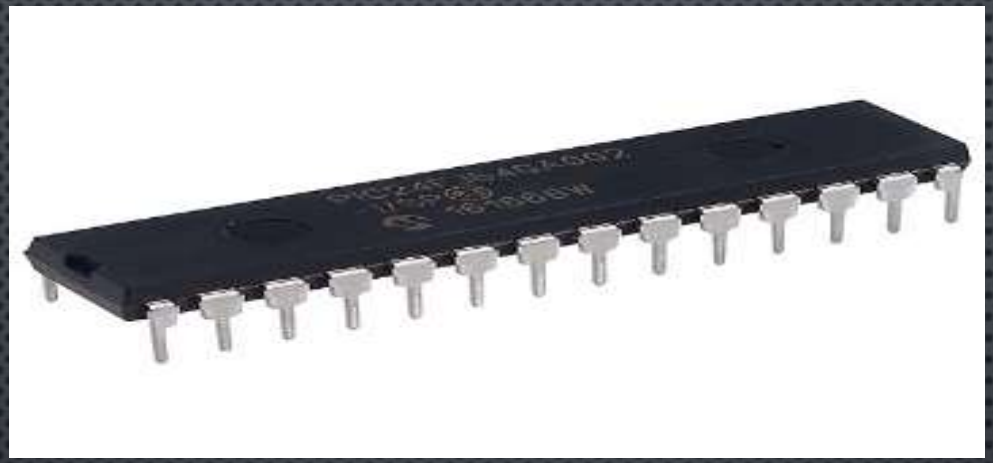
8- BIT MICROPROCESSORS



8-bit integers, memory addresses, and other data units are those that are 8 bits (1 octet or 1 byte) wide in computer architecture. Additionally, architectures for 8-bit CPUs and ALUs are those that rely on registers, address buses, or data buses that are that big. A generation of microcomputers known as 8-bit typically used 8-bit microprocessors. Generally speaking, an 8-bit CPU corresponds to an 8-bit data or information bus.

Federico Faggin and his Intel team created a microprocessor that Computer Terminals Corporation made for operating a CRT display. Datapoint was the name given to this chip later. In order to function properly, a chip must be fast, and Datapoint judged that this chip did not meet this condition. The 8008, created by Intel in 1972, was the first 8-bit general-purpose microprocessor. In the renowned Mark-8 computer kit, the Intel 8008 was employed. As soon as Intel recognised the potential of this product, it unveiled the upgraded 8008. In 1974, the corresponding architecture became known as the 8080 microprocessor. The microprocessor industry was essentially founded with the Intel 8080.

16- BIT MICROPROCESSORS



The 16-bit microprocessor 8086 (16-bit bus) was released by Intel in 1978, while the 8088 was released by Intel in 1979. (8-bit bus). 29,000 transistors made up it. IBM chose the Intel 8088 for its personal computer in the year 1981. (IBM-PC). The 16-bit microprocessor 80286 with 1,34,000 transistors was released by Intel in 1982 to be used as the CPU in advanced technology personal computers (PC-AT). It was known as Intel 286 and was the first Intel CPU capable of running all software created for Intel 8088, its predecessor.

A 16-bit programme is any software created for MS- DOS, OS/2 1.x, or early versions of Microsoft Windows, which were first supported by 16-bit Intel 8088 and Intel 80286 microprocessors, in the context of IBM PC compatible and Wintel platforms. These applications went beyond what was possible with only 16-bit addresses by using a 20-bit or 24-bit segment or selector-offset address representation. The complexity of writing 16-bit applications increased because programmes holding more than 216 bytes (65,536 bytes) of data and instructions needed specific instructions to move between their 64-kilobyte segments.

32- BIT MICROPROCESSORS

IA-32, often known as i386 or "Intel Architecture, 32-bit," is the 32-bit implementation of the x86 instruction set architecture. It was created by Intel and was initially used in the 80386 microprocessor in 1985. The name "IA-32" can be used as a metonym to refer to any x86 versions that enable 32-bit computation because IA-32 was the first version of x86 to do so. The availability of 32-bit general-purpose processor registers (like EAX and EBX), 32-bit integer arithmetic and logical operations, 32-bit offsets within a segment in protected mode, and the conversion of segmented addresses to 32-bit linear addresses are the main characteristics that distinguish IA-32 from other architectures. The designers used the chance to make more advancements.Significant enhancements include the ability to handle 32-bit integers, broader addressing modes, more segment registers, etc. The 8087, a floating-point coprocessor, is an optional component for the 8086, 8088, 80186, and 80188. The 8087 adds eight 80-bit wide registers, numbered from st(0) to st(7), each of which can store numerical data in one of seven formats: 32-, 64-, or 80-bit floating point, 16-, 32-, or 64-bit (binary) integer, and 80-bit packed decimal integer. The 8087 appears to the programmer as a component of the CPU.

64- BIT MICROPROCESSORS

A 64-bit CPU architecture can be used for a single data element in a format or for several data elements that need to be processed or sent in concurrently. 64-bit is often referred to as WOW64 and x64. It is a term used in computer architecture to describe the amount of bits that might potentially change 64 bits of data each clock cycle. The x86 architecture, which stands for 64-bit processor architecture and enables computers to process data and memory addresses represented by 64 bits, is typically contrasted with it.a huge increase in RAM. Computers can load and operate big, complicated software programmes that employ enormous data sets because they have access to so much accessible memory space, which is all loaded and running in the computer's memory.better data movement performance. The secret to a processor's performance is moving and processing more data more quickly. Because processors use 64 bits for both addressing and data, they can carry twice as much data per clock cycle than 32-bit processors..

32-bit Processor	64-bit Processor
They can support memory maximum of 3-4GB.	They can support memory which is more than 4 GB.
A computer with the 32-bit processor cannot have a 64-bit version of an operating system installed.	A computer which has 64-bit processor can have a 64-bit version of an operating system or it can have a 32-bit version of an operating system.
In 32-bit processor, software programs which have a lot of calculations operate slower.	In 64-bit processor, the software program which has a lot of calculations can operate effectively, efficiently and faster than the other.
32-bit processors don't come in different versions.	64-bit processors can come in different versions like dual core, quad core, six core, eight core etc.

Intel Pentium Processor

A family of x86-compatible microprocessors known as Intel Pentium CPUs was first released by Intel Corporation in 1993. One of the most widely utilised and successful CPU families in history, Pentium CPUs are frequently found in desktop and laptop computers.High performance, dependability, and compatibility with a variety of hardware and applications are all attributes of Pentium CPUs. The x86 architecture served as the foundation for the original Pentium processors, which operated at 60 or 66 MHz. The Pentium series has grown over time to include numerous models, each with their own unique set of features and capabilities.The capacity of Pentium processors to process several instructions simultaneously in parallel is one of their fundamental characteristics. Due to its capacity for several simultaneous activities, the CPU is the best option for demanding and multi-tasking applications.The employment of sophisticated branch prediction algorithms by Pentium processors, which enhance CPU speed by lowering pipeline stalls and increasing instruction fetch rates, is another key characteristic of these processors.The Pentium processors are also renowned for their dependability and great performance. To ensure that Pentium processors operate at their peak efficiency, Intel has included a number of technologies, including as improved power management features, error correcting technologies, and support for virtualization.The Pentium CPUs are well-known for their performance and dependability, as well as for being extremely compatible with a variety of hardware and software. One of the most common x86 architectures in use today is that of the Pentium processors, and it is supported by a huge selection of software programmes, operating systems, and peripheral devices.In order to accommodate new technologies and features like multi-core processing, 64-bit computing, and hyper-threading, Pentium processors have also changed through time. Because of these developments, Pentium processors are now able to meet rising processing needs while yet maintaining great performance and dependability.

Intel i3 Processor

A line of entry-level processors called Intel Core i3 was launched by Intel Corporation in 2010. These CPUs, which are frequently found in entry-level desktop and laptop computers, are created for users who require a dependable and effective CPU for daily operations like web browsing, using office programmes, and playing light games.The Core i3 processors have a dual-core design and are based on Intel's Core microarchitecture, which enables them to manage two threads or processes at once. They are therefore ideally suited for multitasking and light workloads, which enhances the computer's general performance and responsiveness.The Core i3 CPUs' usage of Intel Hyper-Threading technology, which enables each core to manage two threads simultaneously, is one of their distinguishing characteristics. This basically doubles the number of processing threads, which helps multi-threaded applications run and respond more quickly.The usage of Intel Turbo Boost technology, which enables the CPU to momentarily increase its clock speed to boost performance when necessary, is another crucial aspect of Core i3 CPUs. As a result, even while running demanding apps, the Core i3 CPUs can give rapid and responsive performance.The Core i3 CPUs are also renowned for their energy efficiency and are made to use less power and generate less heat than processors with higher performance levels. They are therefore perfect for usage in small, portable devices as well as long-lasting desktop and laptop computers.The Core i3 CPUs offer excellent performance and energy economy in addition to being highly interoperable with a variety of hardware and software. One of the most popular x86 architectures in the world, it is supported by a broad variety of software programmes, operating systems, and peripheral devices, including those utilised by the Core i3 CPUs.

Intel i5 Processor

In 2009, Intel Corporation unveiled their line of mid-range processors, the Intel Core i5. For jobs like video editing, gaming, and multitasking, these CPUs are appropriate for people who need a mix between performance and efficiency. The Intel Core microarchitecture serves as the foundation for the Core i5 CPUs, which come in dual- or quad-core configurations. The CPU can manage numerous processes and threads at once thanks to its design, which enhances performance and responsiveness.The usage of Intel Turbo Boost technology, which momentarily raises the CPU's clock speed to improve performance when necessary, is one of the key characteristics of Core i5 CPUs. Additionally, the Core i5 CPUs make use of Intel Hyper-Threading, which enables each core to manage two threads at once, effectively doubling the number of processing threads and enhancing the computer's performance and responsiveness.The Core i5 processors are built to be more energy-efficient than high-end processors, using less power and producing less heat. They are therefore perfect for usage in a variety of gadgets, including desktop and laptop computers and all-in-one systems.Due to the Core i5 processors' use of the x86 architecture, which is extensively supported by a variety of software programmes, operating systems, and peripheral devices, they are also extremely compatible with a broad range of hardware and software.

Intel i7 Processor

A series of Intel CPUs known as Core i7 spans eight generations of Intel chipsets. They have four or six cores, and their base frequency range from 2.6 to 3.7 GHz. New generations of the i7 CPU have been released since the first ones were introduced in November 2008 (2020).The i7 CPU is available in a range of configurations for personal computers. Some desktop computers with high-performance i7 CPUs, like the i7-8700K, are unlocked for overclocking. For desktop computers, laptops, and mobile devices, high-efficiency i7 CPUs (which maximise energy conservation at the cost of some performance) are produced. One of the first Core i-series CPUs manufactured with Intel's new Nehalem microarchitecture technology is the Core i7. The Nehalem microarchitecture from Intel has several advantages over earlier processor architectures.The new Nehalem architecture from Intel has two threads running on each CPU core and an integrated memory controller. Our in-depth benchmark tests demonstrate how well the new quad-core processors function in real-world situations.Nehalem chips offer a number of other features in addition to the AMD-inspired concepts. For instance, the P4's well-known Hyperthreading design can be improved by allowing the four processing cores to run on two threads simultaneously. Four additional logic units are also available in addition to the four actual arithmetic and logic units.The Core i7 CPUs, which go on sale officially on November 17th, offer three DDR3/1066 channels, in contrast to the AMD similar chips, which only enable dual-channel DDR2/1066 memory. In contrast to the AMD chips' maximum memory bandwidth of 16GB/s, the chips' theoretical memory bandwidth is 25.5GB/s. The QPI interface's speed distinguishes distinct Nehalem CPUs from one another.

COMPARISON BETWEEN PENTIUM, I3, I5 & I7 PROCESSORS

The different CPU lines from Intel Corporation—Intel Pentium, i3, i5, and i7—are each created to meet a certain customer demand.Pentium CPUs from Intel are entry-level processors with limited functionality that are suited for simple computing tasks like word processing and web browsing. They normally only support Intel Turbo Boost and do not support Hyper-Threading. They have two cores.Mid-range Intel Core i3 processors are suited for everyday computing workloads. They have two cores and support Intel Hyper-Threading technology but not Intel Turbo Boost.Mid-range to high-end Intel Core i5 processors are built for demanding computer applications like video editing and gaming. They utilise Intel Turbo Boost technology and have either two or quad cores.High-end Intel Core i7 processors are built for demanding computer activities and high-performance software. They support Intel Turbo Boost and Hyper-Threading technologies and have four or six cores.The Intel Core i7 CPU typically has the fastest clock speed, followed by the Intel Core i5, the Intel Core i3, and then the Intel Pentium processors.The Intel Core i7 processors are the fastest in terms of performance, followed by the Intel Core i5, the Intel Core i3, and then the Intel Pentium processors.The Intel Core i3 CPUs typically have the highest energy efficiency, followed by the Intel Core i5 processors, Intel Core i7 processors, and then Intel Pentium processors.

THANK YOU