**INTEL SPEED ON COMUTER COMPLIMENT**

**by**

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**BEING A SEMINAR PAPER**

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**Abstract**

*Intel’s processors are based on the Penryn manufacturing process the company introduced last year, but otherwise there are few similarities with the Core 2 Duo, Core 2 Quad, and Core 2 Extreme lines. Hyper-Threading has also been reintroduced the line, so each core process two threads simultaneously making eight-core processing a reality. And in case that not enough multiprocessing for the technology can support as eight physical cores meaning that 16-core processing. Intel's old strategy for producing microprocessors was to simply increase the core clock speeds, instruction sets and cache sizes a few ticks every year. Every time this happened the power draw and heat levels would increase as well, until eventually Intel hit a brick wall with the Pentium 4. They are 64-bit processors in computer architecture, 64-bit integers, memory addresses or other data units are those that are at most 64 bits wide. The Core i7 is a completely new architecture which is much faster and more efficient than the Core 2 Duo.*

**INTRODUCTION**

A Microprocessor is an electronic device that does the function of a computer’s central processing unit (CPU) on a single Integrated Circuit (IC) or at most a few integrated circuits. A microprocessor is a programmable device that accepts data in digital form and processes it according to the instructions stored in its memory unit and it provides the result as output. Microprocessors also have an internal memory and they can be used for multiple purposes (Koufaty & Upton, 2014).

Intel introduced its first 4-bit microprocessor the Intel 4004 in 1971 and its 8-bit microprocessor Intel 8008 in 1972.32-bit hardware and software is often referred to as x86 or x86-32. 64-bit hardware and software is often referred to as x64 or x86-64. 32-bit system utilizes data in 32-bit pieces while a 64-bit system utilizes data in 64-bit pieces. As the number of bits increase there are two important benefits. More bits means data can be processed in larger chunks which means data can be processed more accurately and quickly. More bits means that our processor can point to or address to a larger number of locations in physical memory. 32-bit systems were once desired because they could address up to 4 Gb (Gigabyte) of memory in one go, which simply means that a 32-bit system can support at most 4Gb of RAM or Memory (Roy, 2008).

The Intel Penryn microarchitecture, which included the Core 2 family of processors, was the first mainstream Intel microarchitecture based on the 45nm fabrication process. This allowed Intel to create higher-performance processors that consumed similar or less power than previous-generation processors. The Intel Nehalem micro architecture that encompasses the Core i7 class of processors uses a 45nm fabrication process for different processors in the Core i7 family. Besides using the power consumption benefits of 45nm, Intel made some dramatic changes in the Nehalem microarchitecture to offer new features and capabilities in the Core i7 family of processors. This white paper explores the details on some key features and their impact on test, measurement, and control applications (Cass, 2010).

According to Patterson (2010), Intel core i3, i5, and i7 naming scheme for their CPUs for quite a while now, but what these labels mean tends to slowly change over time as new features are introduced or older ones get replaced. On top of this, the naming scheme between desktop and mobile CPUs is often different as well. In this article, we will go over what differentiates i3, i5, and i7 processors for both mobile and desktop Haswell CPUs. The biggest thing you need to know in regards to the i3, i5 and i7 naming scheme is that it is primarily a way for Intel to separate their CPUs into three performance tiers:

1. Intel Core i7: High-end
2. Intel Core i5: Mainstream
3. Intel Core i3: Entry-level

There are a few differences in features (notably Hyperthreading, cache size and number of cores), but as we will show later in this article there is actually very little that differentiates an i5 CPU from an i7 CPU. The biggest thing that this naming scheme gives you is a starting place when choosing a CPU. If you use your computer for basic tasks like surfing the web, then an i3 CPU is likely a great choice. If you use your computer for a variety of tasks that require a bit more power (including gaming), than an i5 CPU might be a better choice. If you run multiple applications that require a lot of CPU power, then an i7 CPU is probably right for you (Ramanathan, 2006).



Figure1: The [Intel Core i7 920](http://www.pcstats.com/articleview.cfm?articleID=2582) processor

**FEATURES OF INTEL PROCESSORS**

**A. New Platform Architecture**

An Intel microarchitecture for a single processor system included three discrete components a CPU, a Graphics and Memory Controller Hub (GMCH), also known as the north bridge and an I/O Controller Hub (ICH), also known as the south bridge. The GMCH and ICH combined are referred to the chipset. The older Penryn architecture, the front-side bus (FSB) was the interface for exchanging data between the CPU and the north bridge. If the CPU had to read or write data into system memory or over the PCI Express bus, then the data to traverse over the external FSB (Schaller, 1997).

**B. Higher-Performance Multiprocessor Systems with QPI**

Not only was the memory controller moved to the CPU for Nehalem processors, Intel also introduced a distributed shared memory architecture using Intel Quick Path Interconnect (QPI). QPI is the new point-to-point interconnects for connecting a CPU to either a chipset or another CPU. It provides up to 25.6 GB/s of total bidirectional data throughput per link. Intel’s decision to move the memory controller in the CPU and introduce the new QPI data bus an impact for single-processor systems. However, this impact is much more significant for multiprocessor systems (Brooks & Bose, 2000).

**C. CPU Performance Boost via Intel Turbo Boost Technology**

About five years ago, Intel and AMD introduced multicore CPUs. Since then a lot of applications and development environments have been upgraded to take advantage of multiple processing elements in a system. However, because the software investment required re-architecting applications, there are still a significant number of applications that are single threaded. Before the multicore CPUs, these applications saw performance gains by executing on new CPUs that simply offered higher clock frequencies. With multicore CPUs, this trend was broken as newer CPUs offered more discrete processing cores rather than higher clock frequencies (Ami, 2019).

To provide a performance boost for lightly threaded applications and to also optimize the processor power consumption, Intel introduced a new feature called Intel Turbo Boost. Intel Turbo Boost is an innovative feature that automatically allows active processor cores to run faster than the base operating frequency when certain conditions are met. Intel Turbo Boost is activated when the OS requests the highest processor performance state. Turbo Boost is Intel's terminology for overclocking CPUs, allowing them to run faster than their base clock speed. Both Core i7 and i5 processors support Turbo Boost (Ami, 2019).

**D. Improved Cache Latency with Smart L3 Cache**

Cache is a block of high-speed memory for temporary data storage located on the same silicon die as the CPU. If a single processing core, in a multicore CPU, requires specific data while executing an instruction set, it first searches for the data in its local caches (L1 and L2). If the data is not available, also known as a cache-miss, it then accesses the larger L3 cache. Exclusive L3 cache, if that attempt is unsuccessful, then the core performs cache snooping searches the local caches of other cores – to check whether they have data that it needs. Attempt also results in a cache-miss it then accesses the slower system RAM for that information. The latency of reading and writing from the cache is much lower than that from the system RAM, therefore a smarter and larger cache greatly helps in improving processor performance (Ami, 2019).

**E. Optimized Multithreaded Performance through Hyper-Threading**

Intel introduced Hyper-Threading Technology on its processors in 2002. Hyper-threading exposes a single physical processing core as two logical cores to allow them to share resources between execution threads and therefore increase the system efficiency (see Figure 5). Because of the lack of OSs that could clearly differentiate between logical and physical processing cores, Intel removed this feature when it introduced multicore CPUs. With the release of OSs such as Windows Vista and Windows 7, which are fully aware of the differences between logical and physical core, Intel brought back the hyper-threading feature in the Core i7 family of processors (Koufaty & Upton, 2014).

Hyper-Threading Technology benefits from larger caches and increased memory bandwidth of the Core i7 processors, delivering greater throughput and responsiveness for multithreaded applications. Intel Hyper-Threading increases CPU performance for multithreaded tasks and is helpful for multitasking when several applications are running simultaneously. As discussed above, all Core i7 processors and mobile i5 processors support hyper-threading (Ramanathan, 2006).

**Improved Virtualization Performance**

Virtualization is a technology that enables running multiple OSs side-by-side on the same processing hardware. In the test, measurement, and control space, engineers and scientists have used this technology to consolidate discrete computing nodes into a single system. With the Nehalem mircoarchitecture, Intel has added new features such as hardware-assisted page-table management and directed I/O in the Core i7 processors and its chipsets that allow software to further improve their performance in virtualized environments. These improvements coupled with increases in memory bandwidth and processing performance allow engineers and scientists to build more capable and complex virtualized systems for test, measurement and control. Intel core i5 and i7 specifications are in two ways (Ami, 2019).

**H. Remote Management of Networked Systems with Intel Active Management Technology (AMT)**

AMT provides system administrators the ability to remotely monitor, maintain, and update systems. Intel AMT is part of the Intel Management Engine, which is built into the chipset of a Nehalem-based system. This feature allows administrators to boot systems from a remote media, track hardware and software assets, and perform remote troubleshooting and recovery. Engineers can use this feature for managing deployed automated test or control systems that need high uptime. Test, measurement, and control applications are able to use AMT to perform remote data collection and monitor application status. When an application or system failure occurs, AMT enables the user to remotely diagnose the problem and access debug screens. This allows for the problem to be resolved sooner and no longer requires interaction with the actual system. When software updates are required, AMT allows for these to be done remotely, ensuring that the system is updated as quickly as possible since downtime can be very costly. AMT is able to provide many remote management benefits for PXI systems. For customers using the NI PXIe-8133, National Instruments offers a NI Labs download that enables AMT capabilities on this embedded controller (Cass, 2010).

**ADVANTAGES OF INTEL PROCESSORS**

**The Advantages of Intel Processors**

While Intel's main competitor AMD (Advanced Micro Devices) offers aggressively priced, high-quality components, there are a few reasons why an Intel CPU may be better for your particular needs.

**Power Consumption**

For netbooks, Intel's Atom CPU uses very little electricity--as little as 5 watts. A comparable AMD CPU may use two to three times as much wattage, which has a noticeable effect on a netbook's battery power.

**Heat Generation**

While AMD and Intel regularly trade places depending on what performance benchmark you're using, Intel CPUs do have a reputation for generating less heat, which is in part thanks to lower wattage requirements, like their netbook parts. In a compact environment like a mini-computer, Intel may be a better choice.

**Compatibility**

As Intel CPUs are more common in the market, a wider range of motherboards are available. This means you can choose from a wider variety of features, and it's easier to find a lower price than a comparable AMD-compatible motherboard.

**Integrated Memory Controllers**

This technology allows a CPU to coordinate the activity of all of its cores, and it improves how instructions are temporarily stored and retrieved. Intel's movement to QuickPath Interconnect put it on equal memory footing with AMD, and Intel's powerful Core i7 processors coupled with this technology allow a higher performance ceiling.

**Fabrication Capacity**

Intel operates 15 CPU fabrication plants across the world, while AMD spun off its small handful of plants into a separate organization that is substantially owned by a third party. Intel's larger production capacity allows them to bring a larger amount of CPUs to market in a shorter amount of time, making you more likely to be able to find the CPU you want.

The Core i7 is Intel's current most powerful processor, most have clock speeds or GHz just below the absolute best Core 2 Duo processor or higher than the Core 2 Duo and unlike the best Core 2 Duo processors have larger cache (the larger the cache, the faster the processor can work), 4 physical processing cores instead of 2 and with hyper-threading 4 cores plus 4 virtual cores so almost like having 8 cores in one computer.

**DISADVANTAGES OF INTEL i7 PROCESSORS**

# Disadvantages of an Intel Processor

Non-Intel CPUs may be more cost effective for manufacturers.

One of the major producers of computer chips for personal computers is California-based Intel Corporation. Intel has been a household name for decades, powering some of the most advanced computers with its Pentium, Core and Xeon chips. However, there are disadvantages to using certain Intel chips that computer manufacturers and buyers must consider.

## Price

One disadvantage of Intel processors is the price. As a highly recognizable brand name, Intel's products often sell for more than comparable counterparts from lesser-known microprocessor makers. In addition, new Intel processors may demand a price premium, falling to more competitive levels only once the company has introduced an even newer chip. This can drive up the cost of new computers and make older models with Intel chips less attractive to budget-oriented buyers.

## Availability

Just as Intel processors may demand a price premium, new models may be difficult to acquire in large quantities. This is especially true of processors intended for use in popular consumer desktop and notebook computers, with many different computer manufacturers competing for the same limited stock of processors. As a manufacturer, relying on Intel processors may delay the release of new models to the public.

## Power Consumption

While Intel does produce a line of processors for notebook computers that draw relatively little power, other models intended for desktop computers use a significant amount of electricity. Coupled with the power needs for fans or a liquid cooling system pump, this can cause a computer using Intel chips to consume a large amount of electricity, increasing the operating cost and contributing to strain on the electric grid.

## Heat

Another issue with some Intel processors, such as the Core 2 Duo, is heat. Some of Intel's more powerful multicore processors produce a great amount of heat, requiring multiple fans for cooling. Besides the aforementioned energy usage, heat can decrease the durability of the processor or make a notebook computer uncomfortably hot to the touch.

# Conclusion

The Core i7 family of intel processors based on the Intel Nehalem microarchitecture offers many new and improved features that benefit a wide variety of applications including test, measurement and control. This processor is ideal for computer 3D games, multitasking and multi-threading applications. The main thing to remember is that intel core i7 CPUs are at the high end of the product line, i5 CPUs are in the middle, and i3 CPUs are entry level. While there are a few things that the i3/i5/i7 naming scheme tells you, it is really no substitution for actually looking at the specifications of individual CPUs.

**RECOMMENDATIONS**

1. This paper recommends that the intel processor be used where performance and speed is required.
2. This paper also recommends that intel processors gives you a decent starting place to look for a CPU based on what you will be using your computer for, but you will likely need to look at the individual specs for multiple CPUs to determine which is actually the right fit for you.

# References

Ami, H. (2019). A Study of the Usability of Multicore Threading Tools, *International Journal of Software Engineering and Its Applications,* 4(3), 21-31.

Brooks, D. & Bose, P. (2000). Power-aware microarchitecture: design and modeling challenges for next-generation microprocessors. *Journal of Electrical Electronics Engineering,* 20(6), 26-44.

Cass, S. (2010). Multicore Processors Create Software Headaches. *Journal of Technology Review,* 113(3), 74-75.

Koufaty, J. & Upton, M. (2014). Hyper-Threading Technology Architecture and Microarchitecture. *Intel Technology Journal*, 6(1), 02-14.

Patterson, D. (2010). Power reduction techniques for microprocessor systems. *ACM Journal of Computing Surveys*, 37(3), 195–237.

Ramanathan, R. (2006). Intel multi-core processors: Making the move to quad-core and beyond. *Journal of Technology Review*, 4(31), 45-55.

Roy, A. (2008). Multi-core processors: A new way forward and challenges. Journal of Microelectronics 3(1), 454.

Schaller, R. (1997). Moore's law: past, present and future. *Journal of Electrical Electronics Engineering,* 34(6), 52-59.