



## APPLE M1 CHIP VS INTEL (X86)

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### ABSTRACT

Day by day CPU architecture is changing and reaching new metrics in terms of performance. With the launch of Apple M1 chips, the CPU segment saw a massive improvement in the terms of the performance, battery life, and heat management. It is quite unbelievable how Apple made a mobile chip so fast that it can beat some of the best desktop chips out there in terms of performance and power consumption. Cpu market is going to see improvement in terms of performance with the launch of Apple M1 as it set an industry standard for powerful SOC.

**KEY WORDS:** Apple M1, Intel

### I. INTRODUCTION

Apple was rumored to be working on its own processors since quite long in order to gain the very fine control it provides with its iPhone and iPad. At the same time, Intel was criticised recently for its inability to switch to newer die sizes available as gotten stuck on 14nm dies sizes for nearly years then also messing up with the move to the slower 10nm chips.

Things got difficult for Intel when in early 2019 Tim Cook told the media the reason behind declining Mac sales was Intel chips shortage. [4] A year later, Apple launched the new MacBook Air and MacBook Pro with its brand new M1 chips, which were Apple's custom ARM-based silicon. The launch of M1 has been a huge success and will be much better in the upcoming years.

### II. LITERATURE REVIEW

Here various scenarios were analyzed that could possibly lead to the differences between the two SOC's and which one is the better competitor to the other. Various benchmarks were performed which include CPU benchmark while rendering videos, performance metrics when using day-to-day apps like Chrome, firefox, and Microsoft office.

Apple's M1 processor introduced the mixed-CPU-core architecture to the mainstream laptops, and it is built on the

technologies that are used in smart phones for many years. Recently Intel also adopted this new high and low-tier CPU-architecture to its latest gen chips. This is a new era of processor technology that will evolve a lot and will take computational processing to new heights.

### III. WHAT IS A SYSTEM ON A CHIP (SOC)?

The typical individual may not grasp the difference between an SoC and a standard processor. Most industry insiders already know what M1 stands for: a system on chip, or SoC for short.

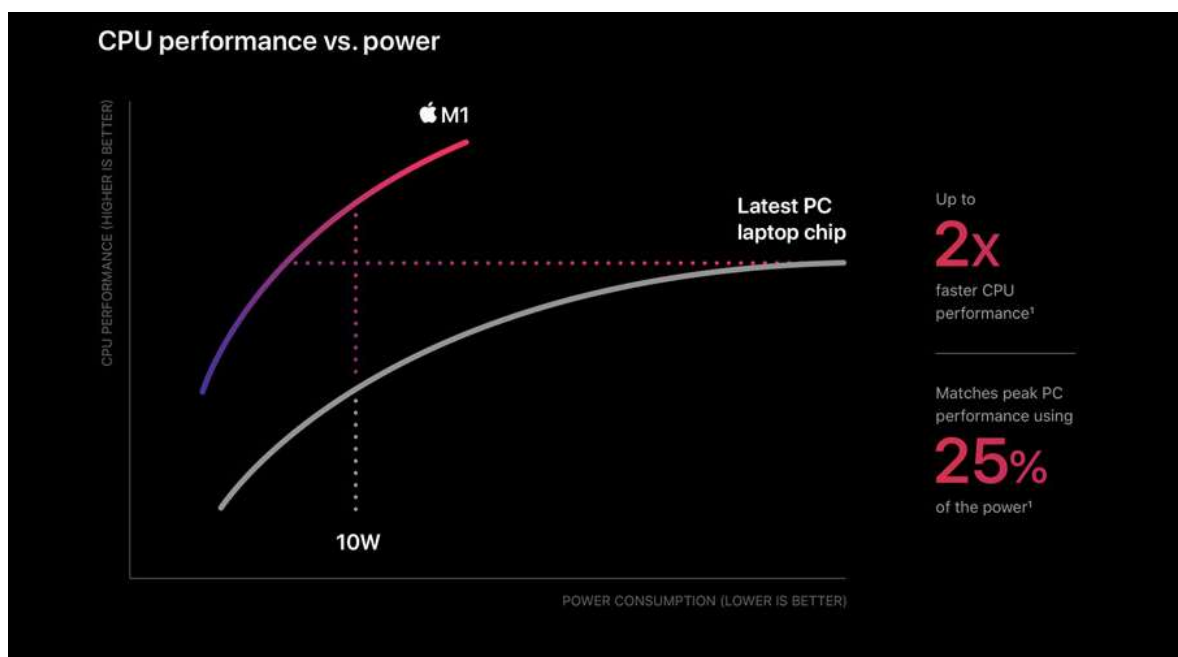
Simply described, an SoC is a single-chip integrated circuit that contains all of its components. The CPU, GPU, I/O ports and blocks, cache, memory, and memory are all included in this category. A SOC can effectively execute various tasks thanks to its small construction. As a result, it can perform a wide range of tasks, including signal processing, artificial intelligence, wireless communication, etc. Most desktop computers and laptops, on the other hand, do not need SoCs to process data or complete tasks. The motherboard, in most cases, will have a variety of components in various areas of the platform. Memory, storage, a central processing unit, and a graphics processing unit are all standard features and components of computers.



#### IV. THE PROS & THE CONS

Because there's so little area for hardware, all mobile CPUs are SoCs. However, the numerous components of SoCs are irreplaceable, which is a disadvantage. As a result, you won't be able to update any of the components that make the computer flexible and modular, such as memory or RAM.

Furthermore, SoCs are frequently unable to handle activities that need a high level of processing power or are exclusive to desktop CPUs. That is why the majority of computer makers continue to employ mobile CPUs.





## V. THE APPLE M1

[1] The Apple M1 processor chip has four enormous Firestorm processing cores for high-demand applications and four smaller Icestorm processor cores for efficiency. You've undoubtedly seen Android phones with comparable ARM chip architectures if this seems familiar. This layout has been around since 2014 and is known as ARM BIG-LITTLE by ARM. CPUs of the ARM architecture use Arch64 or ARM64 extenders. Similarly, integrated GPUs have been utilized in Intel and AMD CPUs for a long time. The Apple M1's GPU has eight cores and occupies only slightly more space on the chip than the processor's eight cores. ACCORDING TO APPLE, the GPU is said to be capable of 2.6 TFLOPS.

The Nvidia GeForce GTX 1050Ti from 2016 is capable of 2.1 TFLOPS in this regard. It's a desktop graphics card with 3.3 billion transistors and up to 75W of power, outperforming the integrated graphics in the MacBook Air, which is passively cooled. The main drawback is that eGPU support isn't available, and discrete graphics aren't available. On the Intel processor-powered 13-inch MacBook, Apple likewise doesn't provide a discrete GPU as an option. You'll still need the 16-inch MacBook Pro if you require a Radeon Pro on your new MacBook. The M1 chip's disadvantage is that, for the time being, it will only be available with 8GB and 16GB of RAM. Most customers won't mind having 8GB or 16GB of RAM on a MacBook Air or Mac Mini, but many MacBook Pro fans won't be thrilled with a 16GB machine that can't be upgraded.

It's true that we're used to soldered RAM in laptops, but this isn't one of them. Manufacturers can upgrade their product lines by swapping RAM chips with more excellent capacity chips, such as two 16GB RAM chips instead of two 8GB RAM chips, when RAM is soldered in. This method does not need any motherboard or component modifications. However, with the SoC's built-in RAM, this would necessitate double the amount of memory in the chip case, i.e., a redesigned M1 chip. As a result, Apple is unlikely to include 32GB RAM in the mid-2021 upgrade, as they will have to wait for the new Mseries CPUs, which might take up to 12-18 months.

## VI. APPLE M1 CHIP VS. INTEL: THE MAIN DIFFERENCES

### ● CPU Architecture

The M1 chip differs from Intel microprocessors in that it uses the ARM architecture. ARM processors are frequently designed to be lighter and more energy-efficient, making them ideal for smartphones and other mobile devices. They're also ideal for reducing overheating without requiring the usage of a fan.

However, while this kind of construction offers several benefits, it also has drawbacks. For example, ARM processors, such as the M1 chip, necessitate the development of whole new software. That is why mobile devices and PCs run on different operating systems. It's not only about the shape; processor compatibility is also important.

### ● Software, Desktop Apps, and Emulation

One of the critical reasons for the M1 chip's popularity in the IT sector is its software. What goes into designing and optimizing ARM-based CPUs for desktop use? It is a significant accomplishment. Because most items operate on emulation, they aren't as quick or simple to use. On the other hand, Newer Macs can run iOS programs thanks to the M1's portability. As a result, there is a greater degree of cross-compatibility, blurring the distinctions between mobile and desktop even more. Of course, with an Intel device, you won't be able to accomplish this level of cross-compatibility.

### ● Performance Comparison

On the surface, the M1 chip looks similar to Intel-based products. It is due to the fact that, regardless of the CPU, they both run the identical macOS operating system. It is significant since Apple uses Rosetta 2.0 to achieve near-perfect emulation. However, there is a noticeable difference in performance between the M1 chip and laptops with Intel CPUs. A better understanding of whether there is a distinct shift in performance in benchmarks, productivity, or other indicators.

### ● Productivity

Benchmarks are, after all, just numbers on a piece of paper. When comparing the M1 chip to the Intel chip, however, they correspond to actual performance to a degree. [2] A 4K movie may be converted to 1080p on the MacBook Air M1 in about 15 seconds. On the other hand, the XPS 13 can accomplish it in 18 minutes and 22 seconds, nearly twice as fast. Although quicker than the XPS, the Yoga could not compete, finishing in 14 minutes and 24 seconds.

On the other hand, Intel excels at some jobs that the M1 doesn't. According to Intel, Chrome performs quicker on the Intel Core i71185G7 CPU with 16GB RAM. It also outperforms the M1 regarding Microsoft Office and particular Office activities.

Of course, Intel has conducted its internal comparison, so proceed with caution. Meanwhile, the Apple M1 chip performed admirably in a variety of productivity tasks in various testing. The M1 still emulates desktop applications with Rosetta 2, so these findings might be just the beginning. As software companies improve their products on ARM microprocessors, it may become even quicker in the future. The compatibility with Thunderbolt 4 is perhaps Intel's most significant win. With a maximum throughput of 40 Gbps, the newer standard is excellent for connecting modern equipment. Utilizing the Thunderbolt 3 dock to add extra ports allows you to increase your connectivity without losing speed or efficiency.

### ● Rendering & Performance

That isn't to say that the dispute over the M1 versus Intel CPU is only about software. Adobe programs and other authoring software are available on both Windows and macOS. [2] Can the M1 compete with the Intel i9 or any of the company's other high-end processors? Fortunately, the M1 performs admirably, even outperforming particular Intel laptops. [6]



The M1 Mac Mini and HP Specter x360 through their paces using Blender (Intel i71165G7). According to the data, the Mac Mini renders a classroom in 925 seconds. On the other hand, the Intel-based HP Specter took 1690 seconds to complete the same job, much longer than the M1.4044. Finally. When exporting movies to Premiere Pro, Mac M1s often performs better. The application's rendering produces more frames per second than Intel's rendering. In terms of video editing, the M1 can easily exceed the i7s.

- **Battery life**

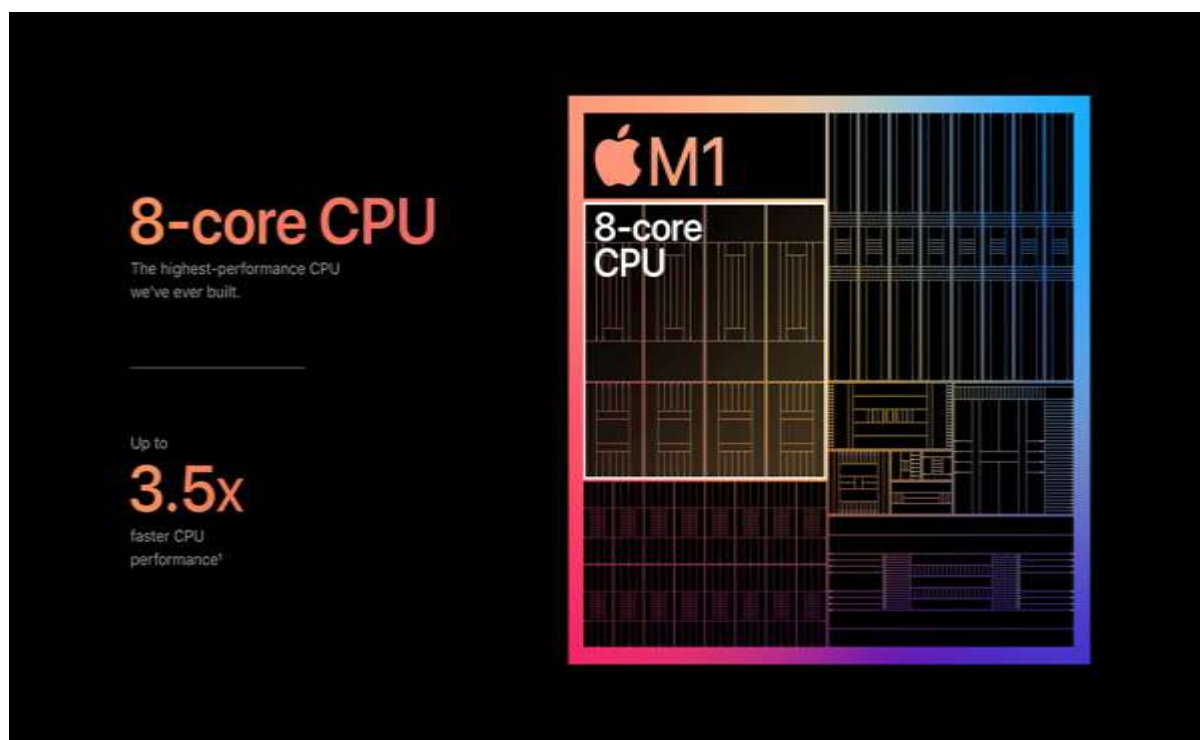
Of course, we can't discuss the M1 processor's performance without discussing its battery life. It is due to the fact that it is an ARM-based CPU, which is touted to be significantly more power-efficient than its rivals. Will the M1 be able to keep up with the pace? Yes, if we're comparing M1 vs. Intel chips. In terms of battery life, though, both the MacBook Pro and the Air excel. According to testing conducted by Laptopmag, the MacBook Pro can endure for around 16 hours and 32 minutes. At 14 hours 41 minutes, the atmosphere, on the other hand, has slowed a little.

Of course, these tests were conducted at 150 nits of brightness, which is probably too low in most scenarios. Intel claims to have conducted a test where screen was set to 250-nits on a MacBook Pro. The MacBook ran for about 10 hours and 12 minutes, which isn't awful by laptop standards. On the other hand, the battery lasted only 5-min more than that of the intel alternative Acer Swift 5. That isn't to say that the M1 isn't a power saver. It is still valid for these figures, primarily because Intel couldn't develop a better and more durable comparable than the Acer. The 1% advantage, on the other hand, isn't groundbreaking.

## VII. WHAT MAKES THE APPLE ML CHIP SO MUCH FASTER THAN THE COUNTERPART

Many current smartphones and tablets are capable of outperforming desktop PCs. However, one may argue that the explanation is due to software, as mobile operating systems aren't really complicated, and laptops aren't that popular. After all, [5] the M1 isn't the first ARM-based laptop CPU. Microsoft was the first to enter the market with the Surface Pro X with a Qualcomm processor. On the other hand, the simulation isn't relatively smooth - and that, maybe, is the key.

The M1 and Qualcomm chips in the Surface Pro X appear to be comparable on the surface. Plus, they're both SoCs and have 16GB of RAM (at least on certain Macs). [3] The simulation feature, however, is where they diverge. The secret sauce for running Intel programs on the Mac M1 is Rosetta 2, a finely tuned emulator. An emulator is also used in the Windows version of the M1. The experience is, however, exceedingly slow, sluggish, and restricted.





## VIII. CONCLUSION

As we can see, the Apple M1 chip seems to be a better option to Intel's latest Core i7 processor. With the standardized benchmark tests Apple m1 wins over Intel core i7 chips. Apple m1 offers great battery life because of low TDP and it is also cheaper to manufacture. But web developer can't take full advantage of m1 chips as most of the libraries tends to not work for the apple. As for the resale value the M1 chip beats Intel again. But considering the chip is relatively new, it can take a while for every software and service to support the apple m1. It also comes down to personal preference as windows user will prefer windows and the same for mac os users.

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