

A Modern AI PC Design

Introducing the future of Windows and Copilot+ PC with the new Surface Laptop and Snapdragon X Elite.

Ryan Shrout



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Introduction

It is the culmination of more than four years of research and development

A Vision for AI on the PC

Since the launch of the first Surface back in 2012, Microsoft's devices group has been working towards a vision. This theoretical end state is one where there is a merger between hardware and software, not at the expense of other system OEMs or partners, but as a beacon and directional guidance for the entire industry. We have seen 10+ years of iteration, with some significant changes and advancements in design and integration, and some other years of modest and iterative change.

In 2024, it's clear that Microsoft is beginning to turn the page to a very different kind of Windows operating system and with it comes the need for a different kind of computing hardware. It calls this new class of computer the "Copilot+ PC" and it is the culmination of more than four years of research and development, coming together as a combination of new operating system fundamentals and hardware requirements to enable a new class of consumer experience.

Surface Supports the Vision

The new Surface Laptop, and the new Surface Pro, based on the Qualcomm Snapdragon X Elite SoC, is Microsoft's attempt to get all the pieces together and ready for the shift that AI is bringing to the personal computer. In practical terms this translates into an elevated level of performance, one that is complemented by power efficiency rather than burdened. It also means a new emphasis on a third player in the computing IP space: the Neural Processing Unit (NPU).

The NPU is now a first-class citizen to both the CPU and the GPU in PCs. And the NPU that is part of the X Elite platform from Qualcomm is the most power efficient and performant on the market today.

What We Cover

This paper will highlight the performance and advanced capabilities of the new Surface Laptop, the 15" model. It is not a deep dive into the drastic changes to the Windows operating system that are coming later this year; that will be an investigation for another time.



The New Surface Systems

The new Surface devices looks like many other laptops on the market, and you'd be hard pressed to notice a difference between it and the Surface Laptop 5 that has been shipping for nearly two years. But under the hood are some big changes.



Hardware Specs

- Qualcomm Snapdragon X Elite and X Plus processor
- Up to 12 high performance cores
- 45 TOPS NPU
- Tablet, 13" and 15" laptop designs
- 16-32GB system memory
- 256GB-1TB PCIe storage
- Wi-Fi 7 / Bluetooth 5.2

There are multiple Copilot+ PC Surface devices that are launching today, including the 15" laptop that is used for this study, but also a 13" laptop form factor and a 13" tablet & kickstand design that has become a staple of the Surface lineup.

The heart of the new Surface Laptop is the Qualcomm Snapdragon X Elite processor, a brand-new offering from the San Diego silicon company that was announced back in October of 2023. It features a 12-core Oryon architecture CPU, a powerful Adreno integrated GPU, and a Hexagon NPU.

The Oryon CPU architecture turns out to be one of the X Elite and new Surface Laptop

secret weapons, offering performance at or above any other PC processors on the market. The cores are organized as three blocks of four cores each and run at 3.8 GHz, two of which are capable of boosting up to 4.2 GHz for additional performance in lightly threaded workloads.

The GPU offers up to 4.6 TFLOPS of peak performance that can be utilized for graphics and gaming workloads but also for any AI and content creation functions that might utilize a GPU-first design.

The Hexagon NPU is incredibly fast, providing up to 45 TOPS (tera operations per second) of AI throughput, a noticeable 4x increase over

anything else available in-market today. And it does this while running at very lower power consumption, a characteristic that Microsoft believes is critical for the acceptance of AI functionality in PCs.

Our system under test includes 16GB of memory, the minimum to be considered a Copilot+ PC, and a 1TB integrated solid state drive for storage.

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The New Surface Systems

Design

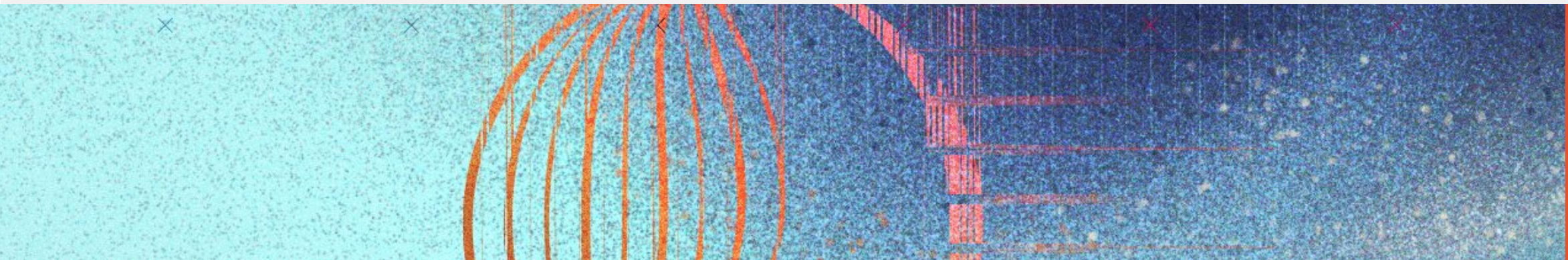
Our focus today is on performance and functionality, but it is worth noting that the design of the new Surface Laptop is superb, built with an aluminum body, and presents itself as a premium, high-quality laptop that would be a match or best any other laptop on the market.

Screen

Like all the Microsoft Surface computers, this Surface Laptop has a gorgeous screen that supports multi-touch. The 15" high resolution 2496x1664 screen looks amazing watching video content but also while getting productivity work done in bright office spaces.

Connectivity

It has two USB4 Type-C ports on the left-hand side of the device, a USB Type-A on the left, a Surface dock connector on the right that supports both power input and data connectivity, and an SD memory card reader. Microsoft chose to integrate the Qualcomm Fast Connect 7800 chip that adds support for Wi-Fi 7 and Bluetooth.



The Oryon CPU architecture turns out to be one of the X Elite and new Surface Laptop secret weapons

Competitive Landscape

To best understand the performance landscape that the new Snapdragon X Elite processor and new Surface Laptop are competing in 2024, we selected a handful of other devices to measure and compare.



First, it made the most sense to look at the previous generation Surface Laptop 5 using the highest end CPU configuration at the time, the Intel 12th Gen Core i7 processor. This provides us with a clear generation-to-generation uplift data set.

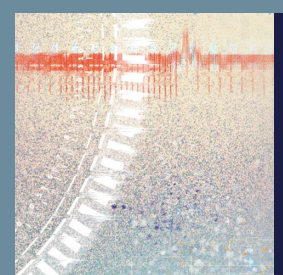
Next, we wanted to include the latest and most relevant Windows competitive solutions, and those today are based on Intel's Core Ultra

processors, previously codenamed Meteor Lake. For that we used the MSI Prestige 16 EVO AI laptop that includes the Intel Core Ultra 7 155H with integrated Arc graphics.

Finally, the Apple MacBook Air powered by the M3 processor is often considered one of, if not the, best and most premium PC on the market. Given that status and that the M3 chip is based on a similar

Arm architecture as the Snapdragon X Elite, this gives us a great comparative data set. (Obviously there are going to be some applications and workloads that are not available cross-OS, so we'll point out those areas where they occur.)

*In 15" configuration and alike memory and storage configurations.



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Competitive Landscape

This paper is focused on performance and platform capabilities, but a consideration around price is also warranted. The new Surface Laptop configured with the Snapdragon X Elite X1E-80-100, 16GB of memory and 1TB of storage will run you \$1699. For comparison, the Apple 15" MacBook Air with 16GB of memory and 1TB of storage costs \$1899 as we write this. Systems based on the Intel

Core Ultra 7 processor family can vary in pricing drastically depending on OEM, screen configurations and more, but the unit we tested for this paper with 16GB of memory and 512GB of storage is selling today for \$1499.

It's fair to say that the new Microsoft Surface Laptop is a premium machine, both in terms of price and design,

compared to much of the Windows laptop ecosystem. One of the questions we hope to answer with today's testing is if that price delta is warranted for consumers.

The new Surface Laptop is \$200 cheaper than the MacBook Air*

Full system specifications and testing details are included at the end of this report in the appendix.



Physical System Analysis

Physical and technical characteristics analysis.

Thermal Performance Under Load

Thermal performance testing for this report was conducted using the FLIR C5 Thermal Imaging Camera. Temperatures were measured in a 72°F ambient room using a 10-minute run of Cinebench 2024 to saturate the cooling solutions.

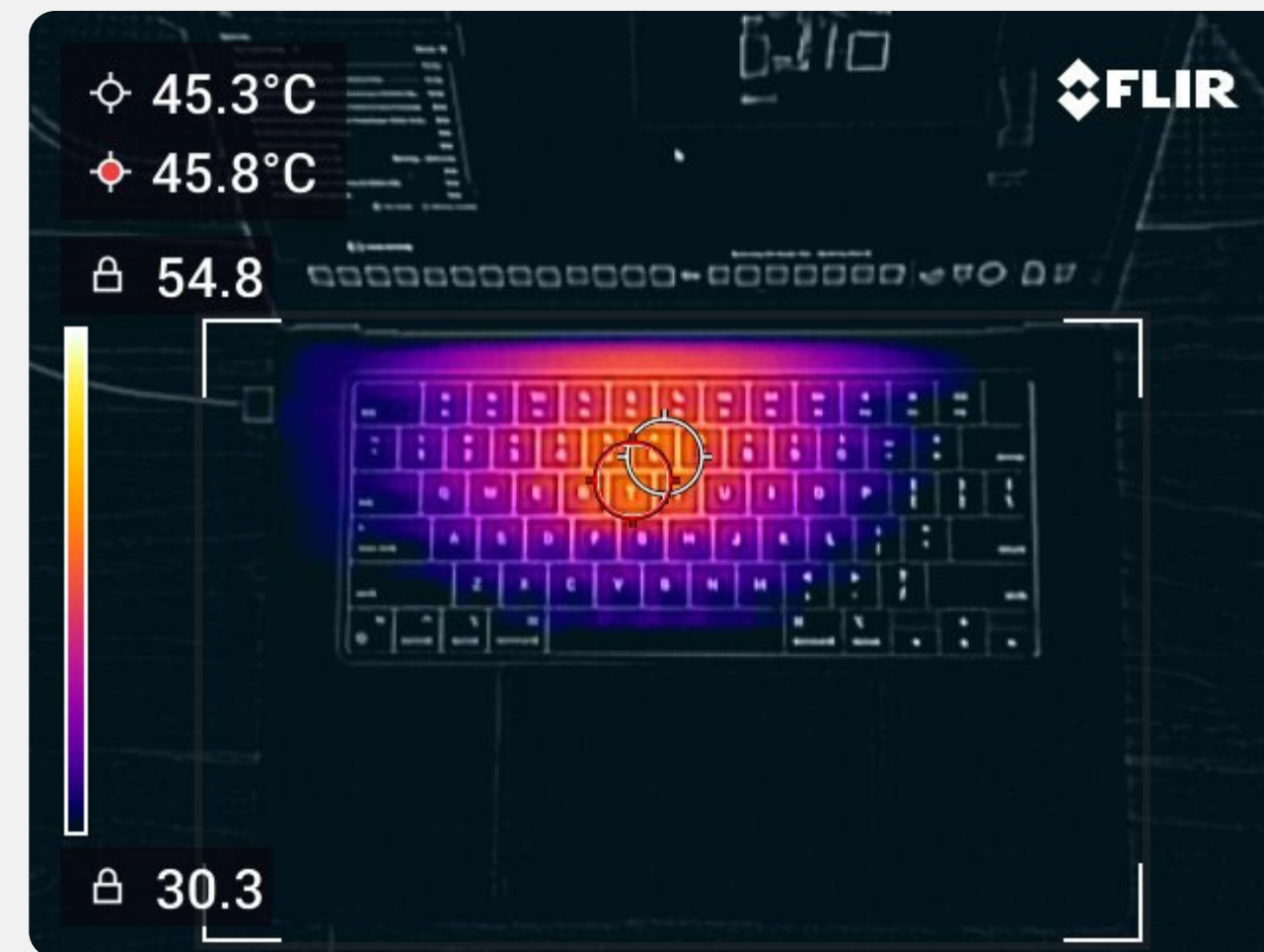
Thermal Performance (Cinebench 2024 Multi-thread)



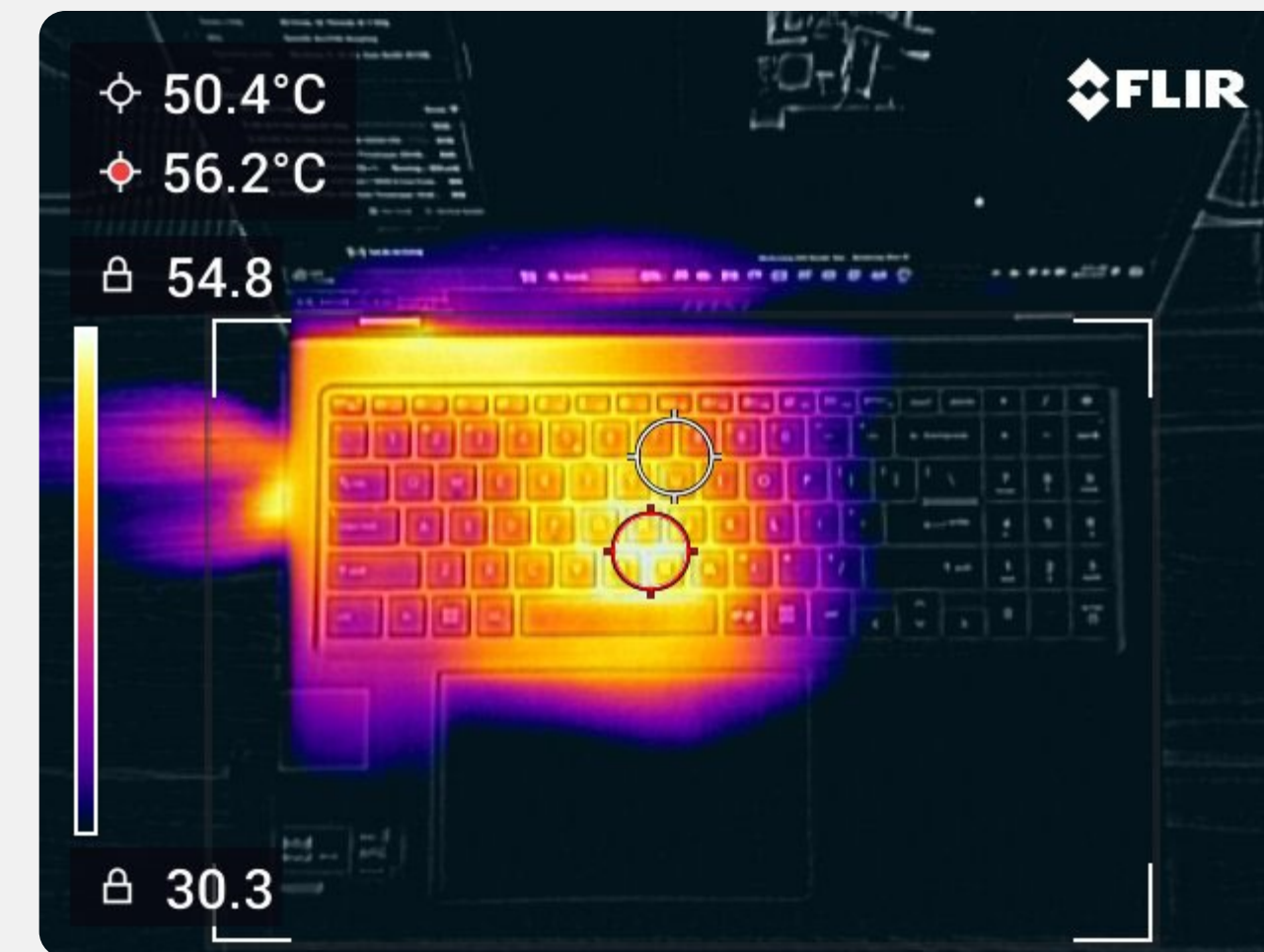
The New Surface Laptop (Snapdragon X Elite)



Surface Laptop 5 (Intel 12th Gen Core i7)



Apple MacBook Air (Apple M3)



MSI Prestige 16 EVO AI (Intel Core Ultra 7 155H)

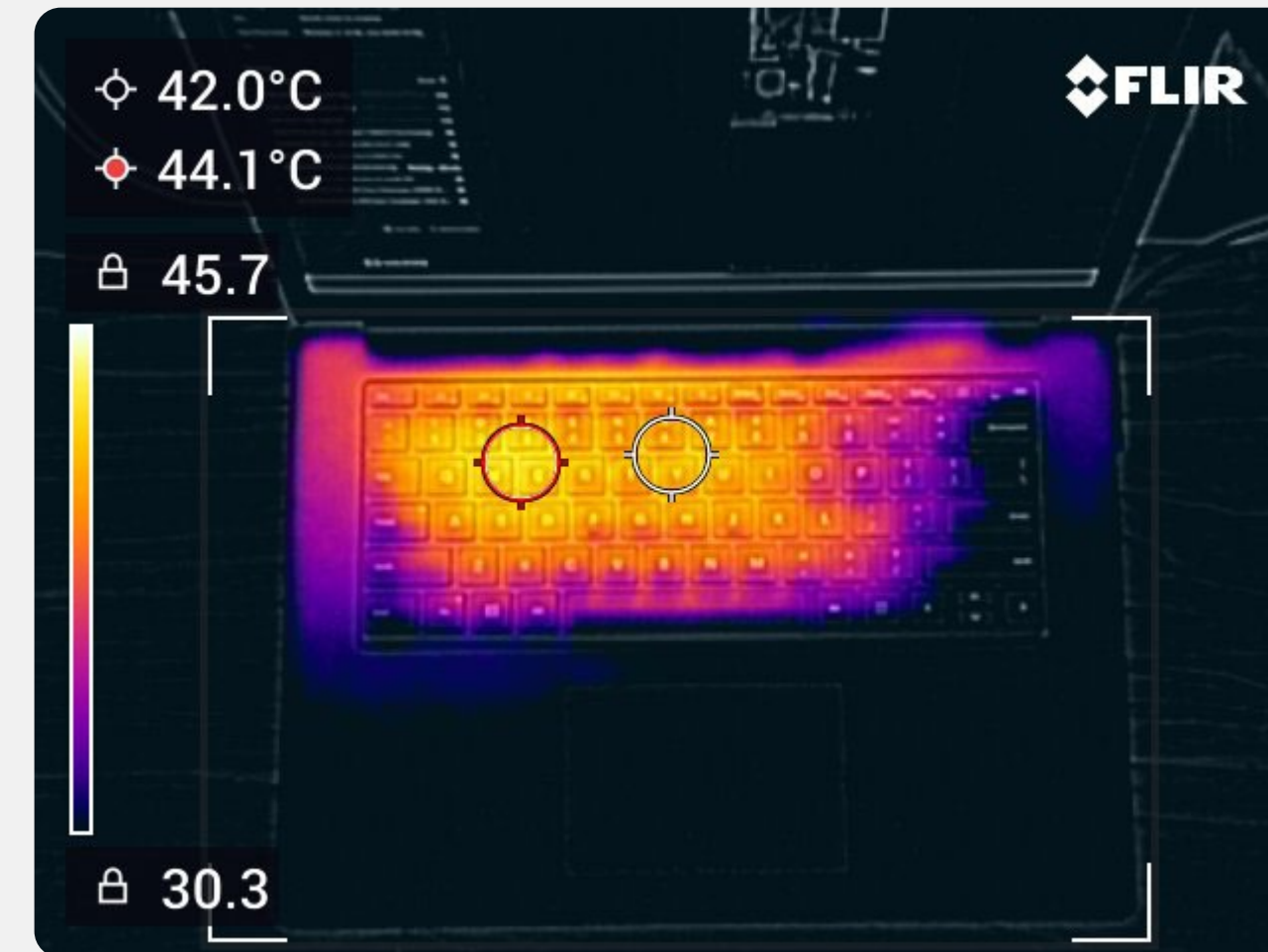
In what we can generally consider a worst case scenario, under a fully loaded system for 10 minutes to saturate the cooling solution, the new Surface Laptop with the Snapdragon X Elite performs well in our testing. The hottest temperatures (50.3C) are seen at the hinge between the screen and the keyboard, away from the hands of the user. The Surface Laptop 5 using the Intel Core i7 CPU is slightly cooler at 47C but the heat is centralized more over the left hand side of the keyboard.

The Intel Core Ultra 7 155H powered by system from MSI proved to be the hottest (and as you'll see in the next section, the loudest), getting up to 56.2C right dead center in the device. You can see the exhaust fans working to expel the heat out the left-hand side. Of course, there is a wide range of system designs using the Intel Meteor Lake CPUs so this result is only representative of one particular integration. The MacBook Air is the coolest system but sacrifices performance.

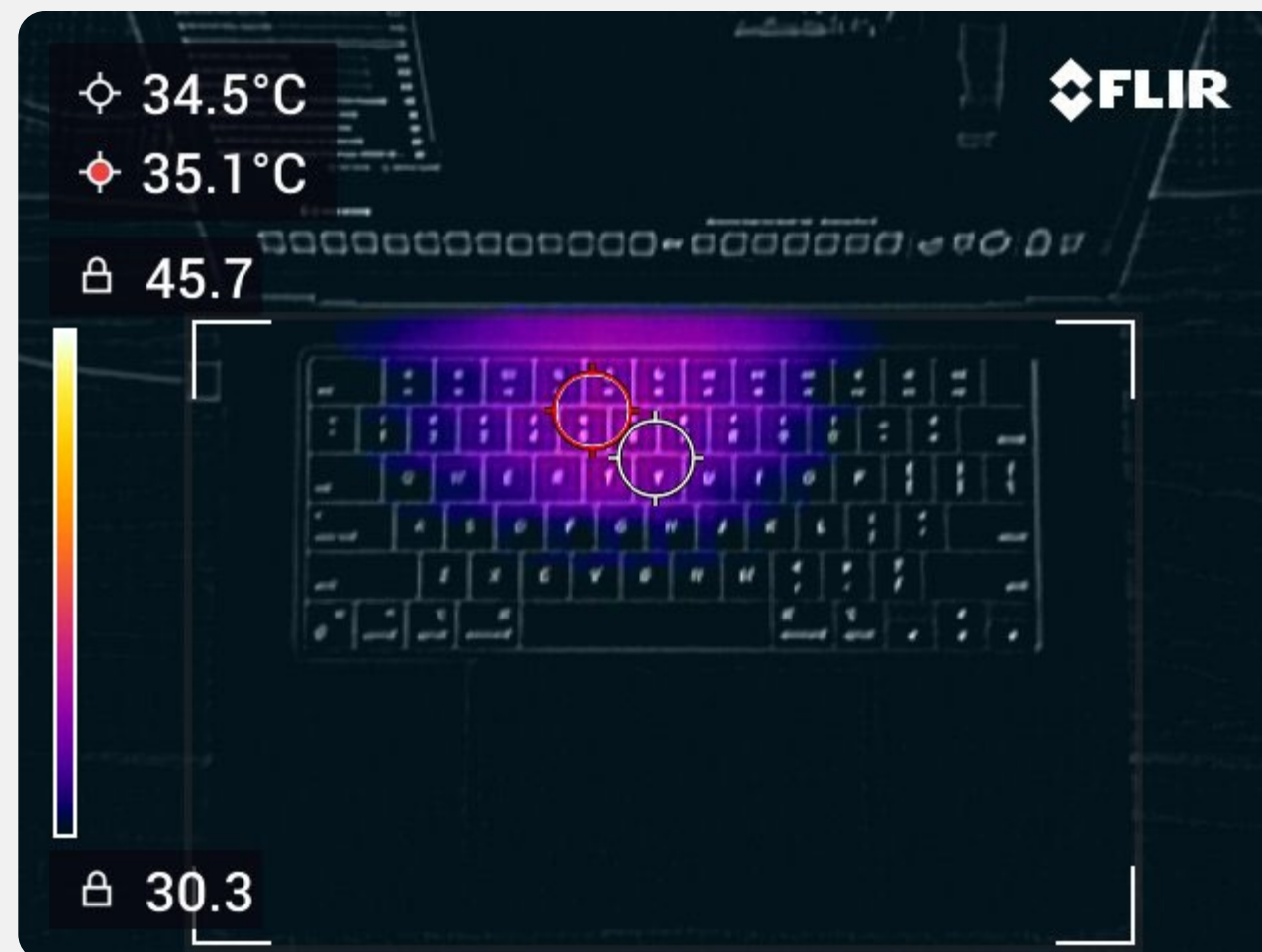
Thermal Performance (Cinebench 2024 Single Thread)



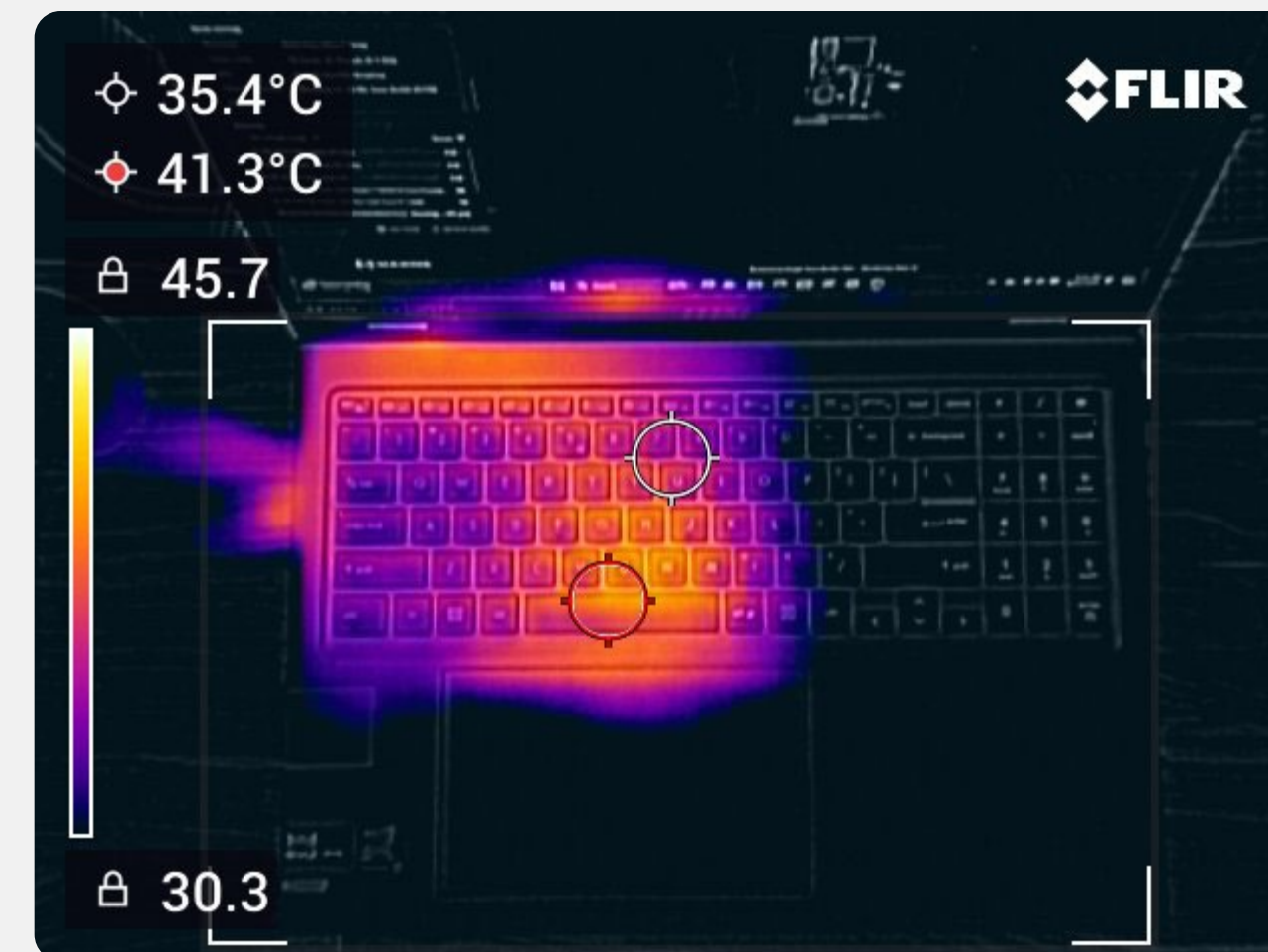
The New Surface Laptop (Snapdragon X Elite)



Surface Laptop 5 (Intel 12th Gen Core i7)



Apple MacBook Air (Apple M3)



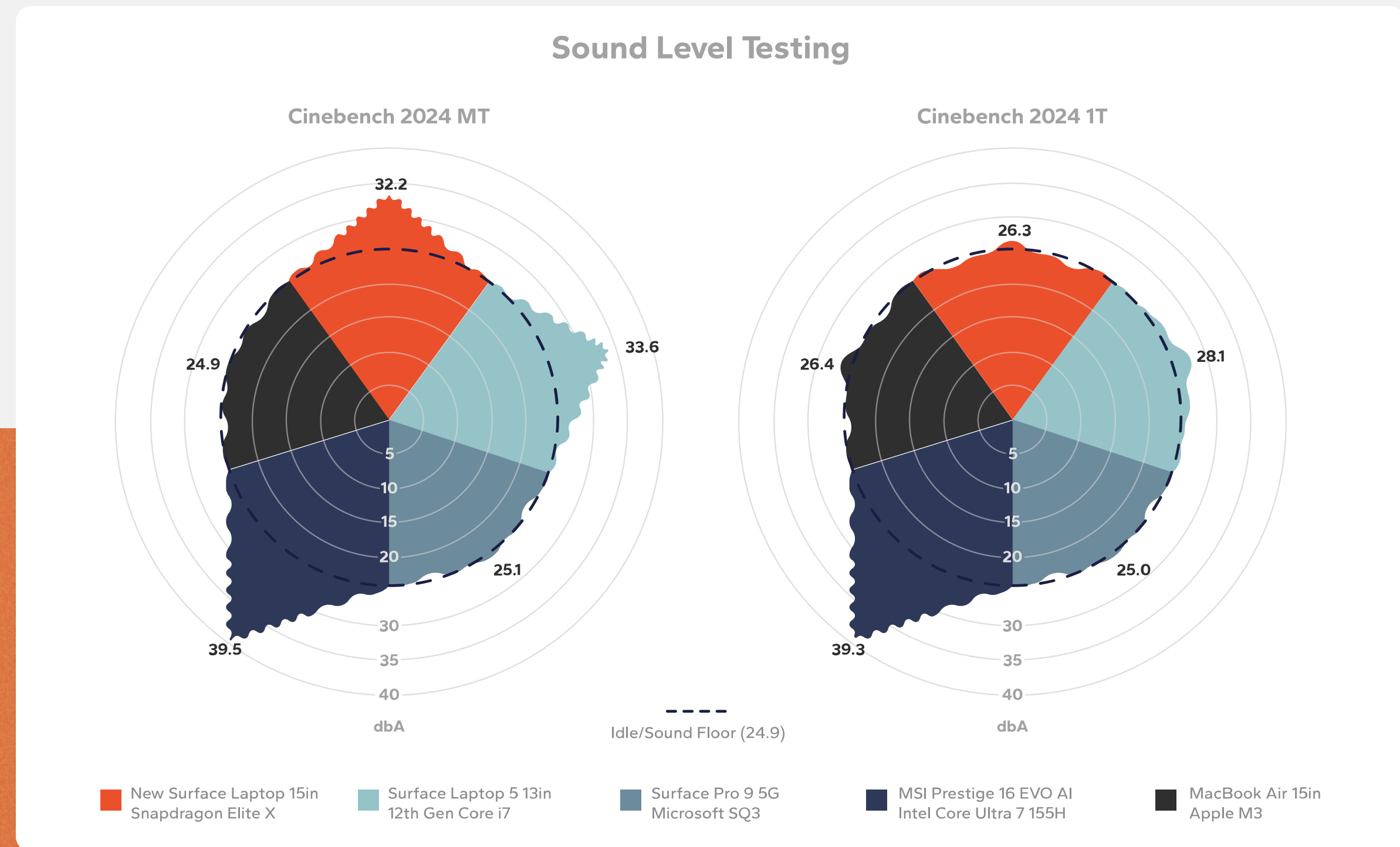
MSI Prestige 16 EVO AI (Intel Core Ultra 7 155H)

Testing the thermals in a more standard workload environment paints the new X Elite SoC in a great light, with the system only hitting 37.4C. In contrast, the 12th Gen Core i7 Laptop 5 system still gets to 44.1C. The MSI-built Core Ultra platform is cool at just 41C but does so at the expense of noise (as noted on the next page).

Physical System Analysis

Sound and Fan Noise

Secondary to the thermal performance of any notebook design is the resulting fan speeds and noise that can be traded off for temperature. We measured noise of these laptops in a quiet, but standard working environment from a distance of 18 inches.



Both the new Surface Laptop and the Laptop 5 showed similar sound levels in our testing under the heavy, consistent workload, coming in at just over 33 dbA. The MSI Intel Core Ultra system fans were running noticeably louder, hitting 39.5 dbA in our measurement. The SQ3-based Surface Pro 9 5G and MacBook Air are fanless, and thus, don't measure above our office sound floor.

In more standard workloads, where the system is loading only a single thread, the new Surface Laptop and the X Elite CPU are incredibly quiet, just above the noise floor at 26.3 dbA. The previous generation Laptop 5 is a bit louder, crossing the 28 dbA level. The MSI system with the Intel Core Ultra is just as loud in this testing as when fully loaded, despite being 15C cooler in our thermal imaging.

Battery Life

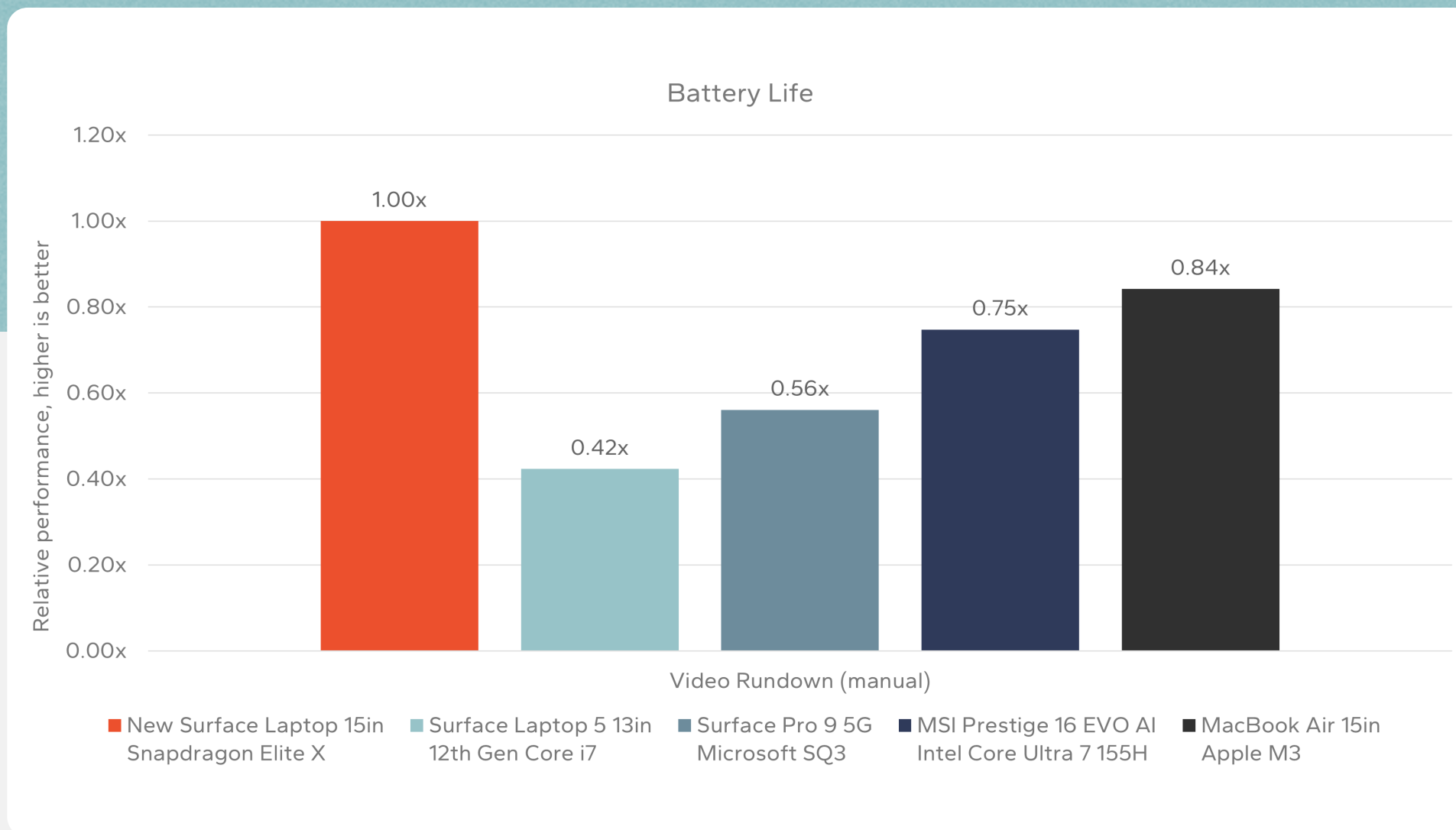
Understanding real-world battery life scenarios.

Local Video Playback

Our in-house local video playback battery life test evaluates the machines in like-for-like configurations including 150 nit screen brightness, wireless connectivity disabled, and looped H.264 video content.

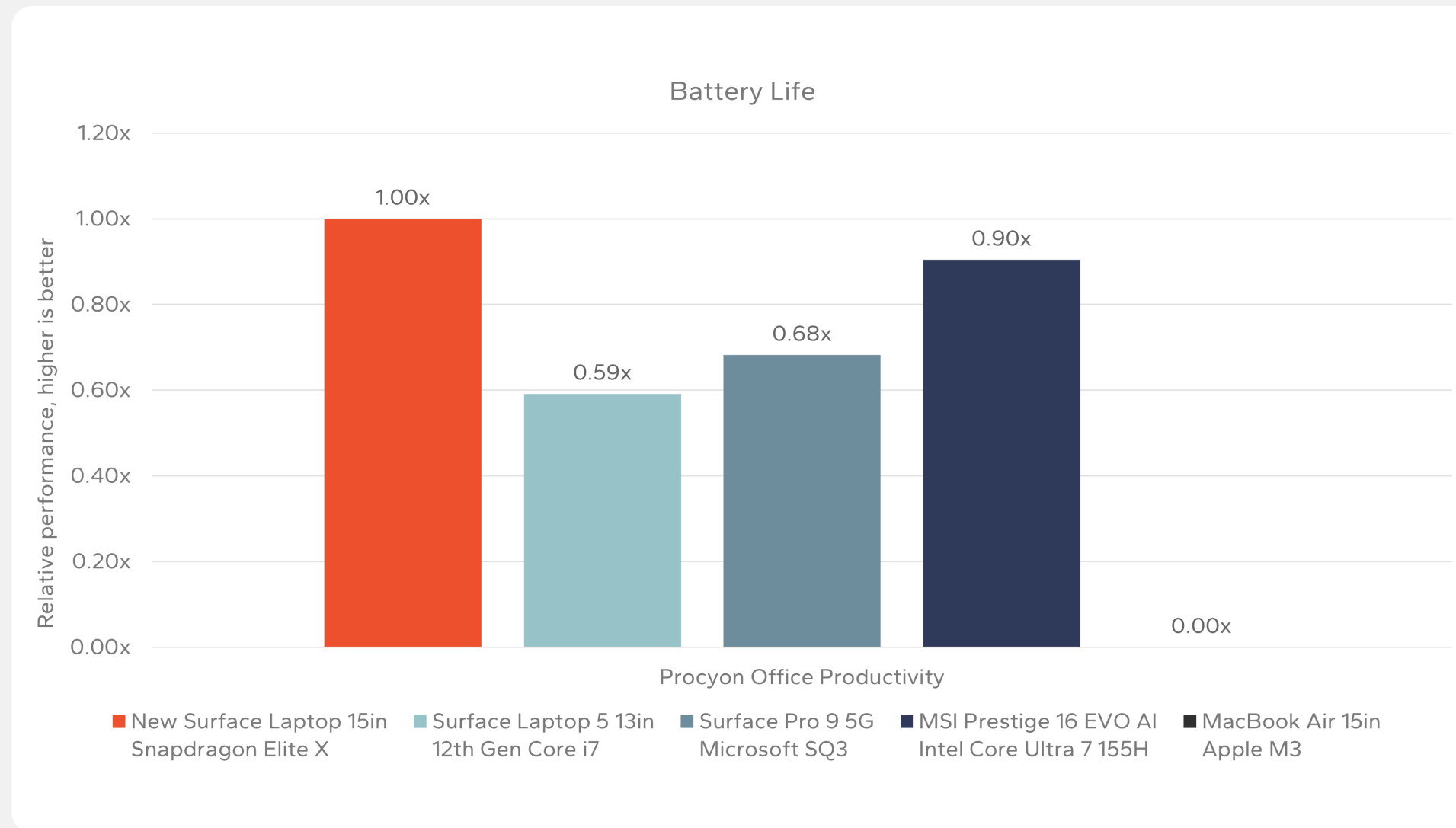
Our results on this show that the new Surface Laptop powered by the Snapdragon X Elite has the longest battery life of any system we have tested. Usable video playback time is more than double that of the previous generation Surface Laptop 5 and significantly exceeds the battery performance of the Intel Core Ultra system. The MacBook Air offers about 16% less video playback time than the new Surface Laptop..

The new Surface Laptop has over 21 hours of video playback on a single charge



Battery Life

Procyon Battery Life



In this battery life test the new Surface Laptop is able to operate in a productivity environment more than 30% longer than both the previous generation Surface Laptop 5 and the system based on the new Intel Core Ultra 7 processor. The MacBook Air powered by the M3 offers equivalent battery life.

The Procyon Productivity battery test is a performance-qualified battery life test, meaning it measures performance with each loop of its productivity test suite to look for performance variations. We will be reporting performance in isolation later in this report.

Battery Life Thoughts

The new Snapdragon X Elite is performing as promised in our battery life testing, matching or beating the 15-in MacBook Air in our results and offering significantly more usable time on DC power than the previous generation Surface Laptop using the 12th Core i7 and the MSI hardware with the Intel Core Ultra.

Battery life has always been one of the major advantages of the Windows on Arm platform, but now it is doing it without sacrificing performance, as you'll see in our results in this research.

Anecdotally, the connected standby time on the new new Surface Laptop is fantastic, showing a drop of just 1% of its battery in a standard 8-9 hour overnight closed-lid scenario. Combining this characteristic with extended battery life we see during our usage testing and the result is a platform that is built for all-day and all-weekend battery life.

Performance Bounding

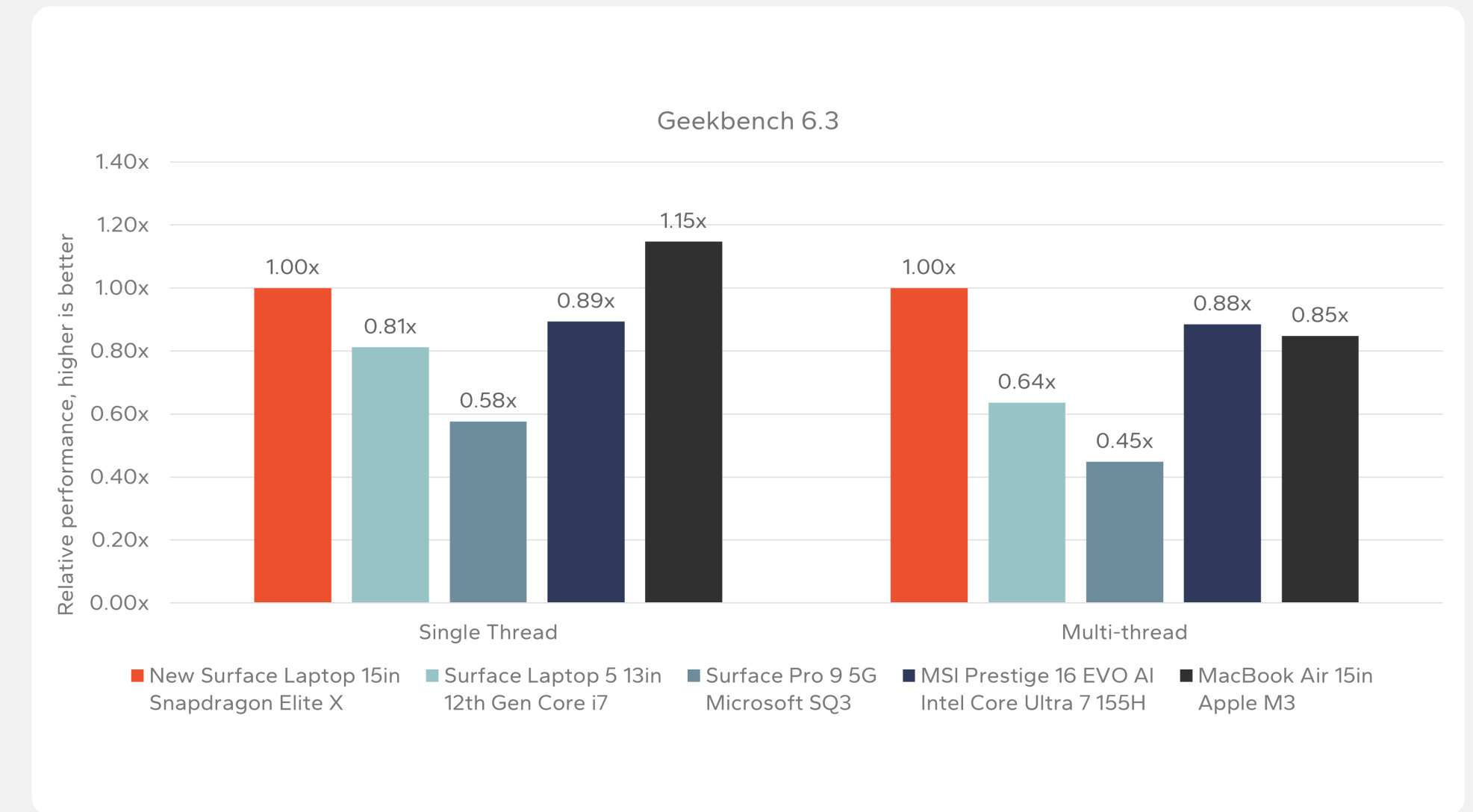
Peak and sustained synthetic performance comparisons.

The new Surface Laptop is up to 2x the multi-threaded performance of the previous generation Surface Laptop

Geekbench 6.3

Geekbench 6 is self-described as a benchmark that measures a “system’s performance with the press of a button” and allows for device comparisons between everything from mobile to desktop. It is comprised of a collection of workloads that stress the CPU and GPU, through tests that the developer considers “real world” in that they represent workloads from augmented reality to object detection to file compression and much more.

While Geekbench isn’t an exact measurement of a specific real world application, Signal65 likes to use Geekbench as a general purpose performance indicator for bursty, broad-coverage workloads.



The single threaded results of Geekbench 6 indicate that the Snapdragon X Elite used in the new Surface Laptop is almost 20% faster than the previous generation Surface Laptop and still 10-15% faster than the Intel Core Ultra 7 powered machine. Surface Pro 9 5G with the Qualcomm-powered SQ3 SoC is barely offering half the single threaded performance of the new X Elite. The MacBook Air 15-in and M3 processor performs very well here, leading the X Elite by 10%.

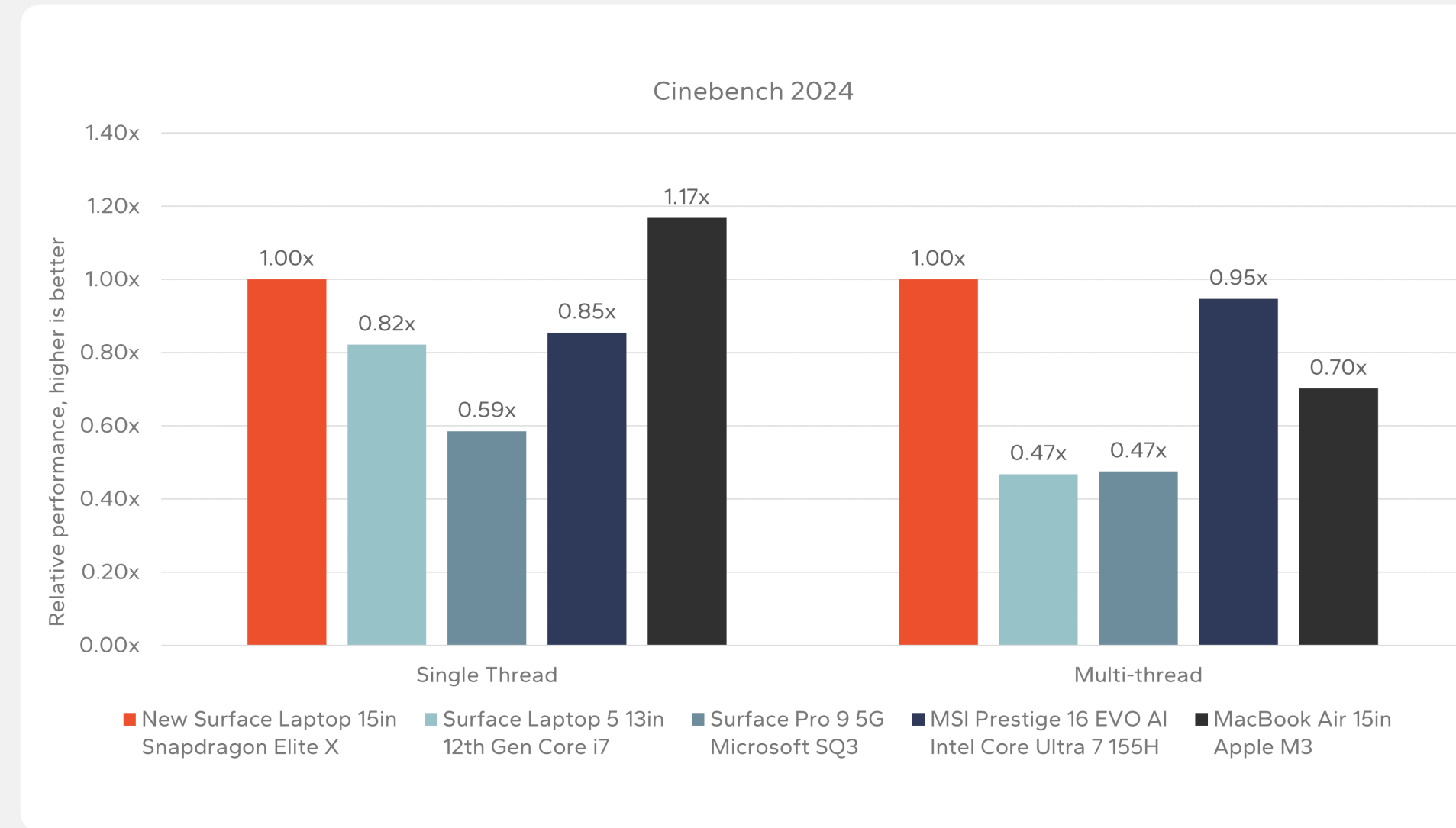
In the multi-threaded results that stress all the cores in each design as much as possible in these scenarios, the new Surface Laptop is the outright winner, outperforming the 12th Gen Core i7 in the Laptop 5 by 35% and overcomes the Apple M3 chip by around 15%.

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Performance Bounding

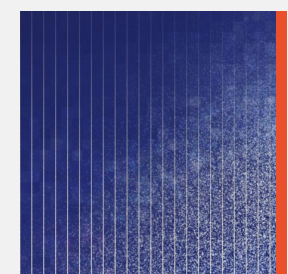
Cinebench 2024

Cinebench has been a consistent benchmark used in engineering analysis and reviews across the industry for years. It is based on the Maxon Cinema 4D rendering engine and runs in both single threaded and multi-threaded configurations in an attempt to measure maximum, sustained performance of a processor. We use the phrase “sustained performance” since it can be run for 10-30 minute intervals and will saturate the cooling capability of a laptop or desktop machine to measure performance that a system can maintain over a longer period of time.



The results in Cinebench show us that the single threaded performance of the Snapdragon X Elite chip in the new Surface Laptop is roughly 20% faster than the Surface Laptop 5 and its 12th Gen Core i7 CPU, but that the M3 chip in the MacBook Air is about 15% faster. The multi-threaded results tilt the favor towards the X Elite, where it offers more than double the performance of the previous generation Surface Laptop and is more than 30% faster than the Apple M3. Even the larger 16-in Intel Core Ultra system with the 155H can't catch the new Surface Laptop. A very impressive result.

Snapdragon X Elite is up to 30% faster in sustained, all-core performance than the Apple M3



Performance Bounding

We call this section “performance bounding” because both of the test suites included are meant to represent the peak or sustained performance of the platform and architectures. The collection of Geekbench sub-tests might each be representative of some application, but the collective result and score is really more of a “best case” or representative situation to a power user across a range of workloads. And while most users might not be using the Cinema 4D engine for 3D rendering, the single and multi-threaded results help to demonstrate the performance capabilities of the devices in question should you have a workload similarly demanding.

The results in this case indicate that the new Surface Laptop powered by the Qualcomm Snapdragon X Elite processor is a powerful and market shifting combination. Against both the previous generation 12th Gen Core i7 platform and the new Core Ultra 7 155H CPU, the X Elite is generally faster in both single and multi-threaded testing, making the case for it being an amazing option for both lightly threaded, burst workloads and sustained, high impact applications.

And against the Apple M3, considered the leading silicon option in this segment, the Snapdragon X Elite finds itself within 10% of the performance in pure single-threaded results but 15-30% faster in multi-threaded ones.

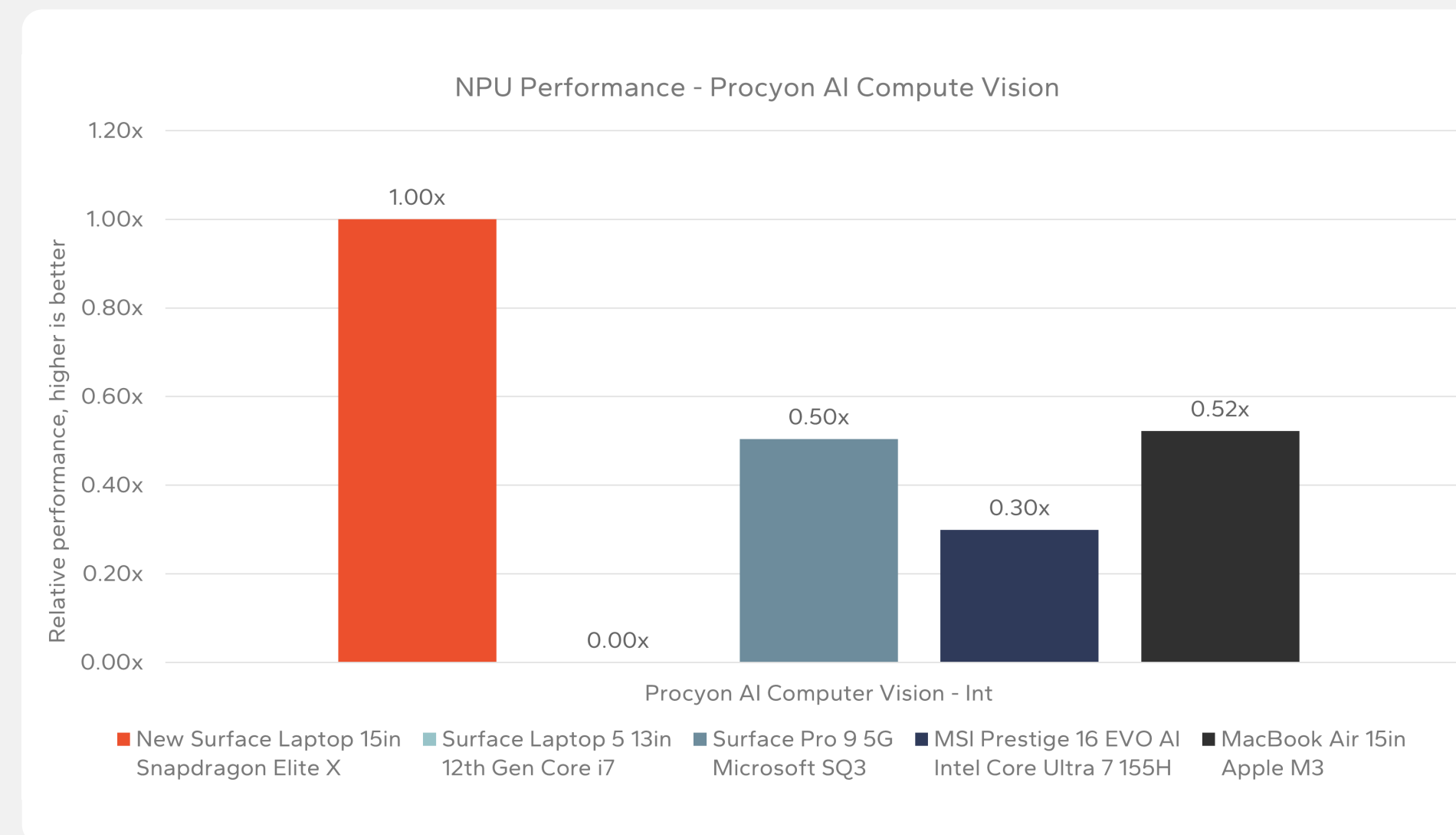
Modern AI Performance

AI throughput and performance.

Procyon AI Computer Vision

From UL, "Procyon AI Computer Vision Benchmark gives insights into how AI inference engines perform on your Windows PC or Apple Mac. The benchmark features several AI inference engines from different vendors, with benchmark scores reflecting the performance of on-device inferencing operations."

This test includes testing of models MobileNet V3, Inception V4, YOLO V3, DeepLab V3, Real-ESRGAN, and ResNet 50. These models achieve a range of image recognition, classification, and upscaling functions and it supports both integer and floating-point precisions, where supported by the hardware and development stacks per platform.



Easily the biggest hurdle for AI performance analysis today is finding ways to compare architectures and platforms where support for different precisions and software APIs varies widely. The Procyon AI benchmark shows us that when we are able to compare across the common integer precision data on these systems, the NPU on the Snapdragon X Elite in the new Surface Laptop is completely unrivaled in performance. Rated at 45 TOPS, it is more than 3x faster than the NPU on the Intel Core Ultra 7 155H and twice the speed of the neural processor on the Apple M3 chip.

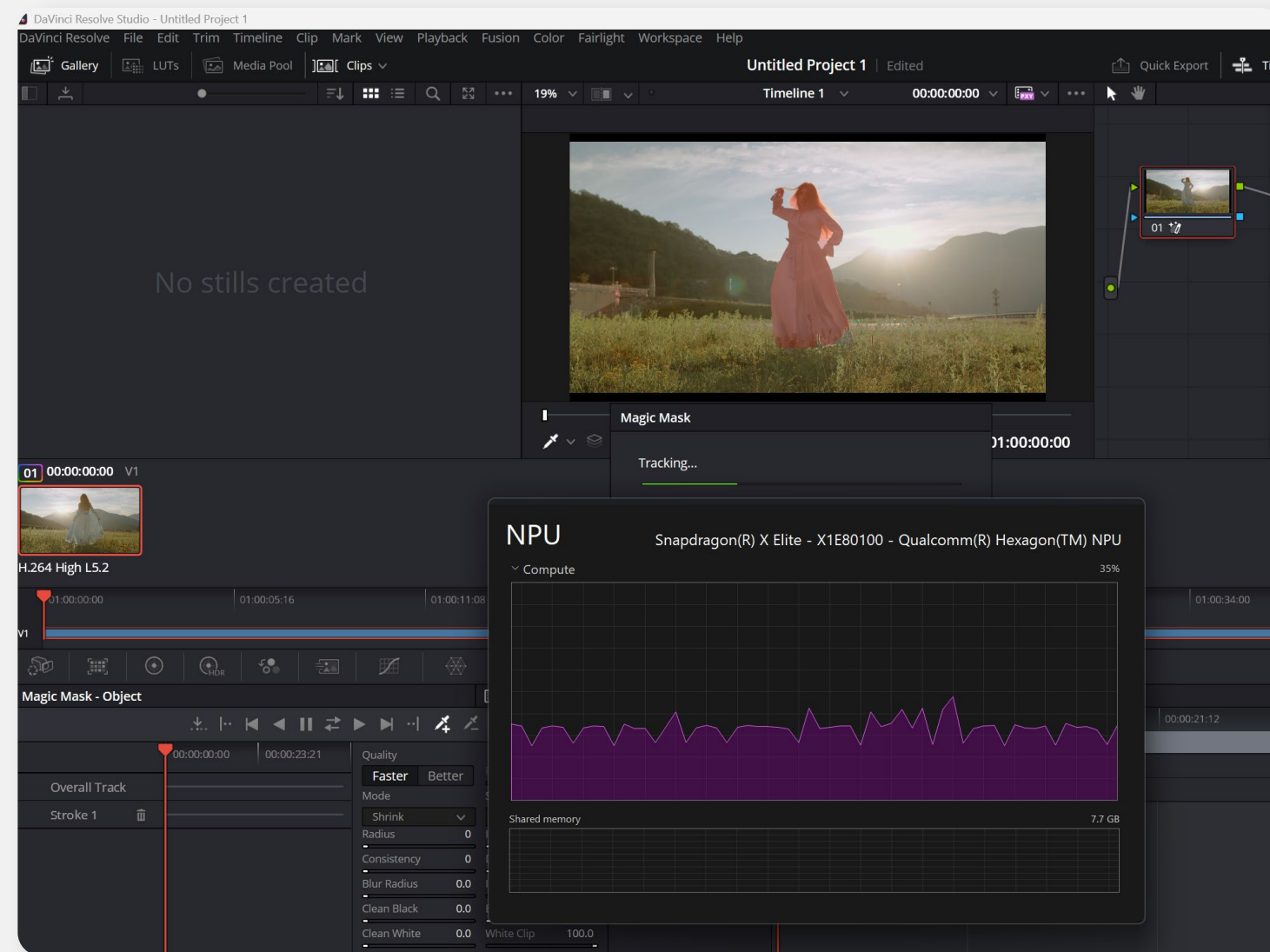
The new Surface Laptop has 2x more NPU performance than Apple M3

A MODERN AI PC DESIGN

Modern AI Performance

DaVinci Resolve AI Functions: Magic Mask, Smart Reframe

Blackmagic Design has been a leading developer in the content creation field and is integrating various AI functions throughout its software. In DaVinci Resolve, the Magic Mask feature uses AI inference to identify and track an object through a video clip using only very rough indicators from the content creator. This speeds up the development of new creative that must remove, overlay, or adjust complex, fast-moving masked content.



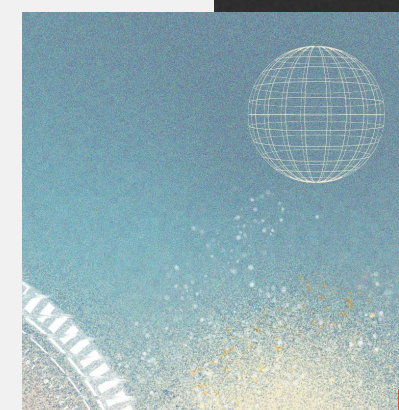
Though this is an early preview build of a new version of Resolve that supports the Qualcomm Snapdragon X Elite processor, we were able to utilize Magic Mask effectively, and at impressive speed, thanks to the Hexagon NPU. You can see in the screenshot above that the masking feature is utilizing the NPU, as will other integrated AI features like Smart Reframe. Signal65 will have more testing on this update to Resolve soon.

Modern AI Performance Thoughts

This section of our report covering the performance and compatibility of AI software for the PC is one that we expect to grow and change quite a bit over the next 12 months. Tools like the Procyon AI benchmarks help us understand the capabilities of the NPUs and AI compute for each platform, but the real-world implications of this AI PC revolution are just getting started. Microsoft has been clear for its vision that AI will drastically change the way we use our computers, the way we interact with software, and how we get things done.

The DaVinci Resolve preview is another example of how applications will evolve and improve workflows to make us faster, more creative, and more productive.

As it stands today, the Snapdragon X Elite platform used in the new Surface Laptop is the highest performance NPU available in a consumer processor and our benchmarks show the potential it provides. Other computing options like Intel Lunar Lake and AMD Strix Point will have an impact later in the year, but the end result will be more AI performance and more AI experiences for PC users.



Media Processing

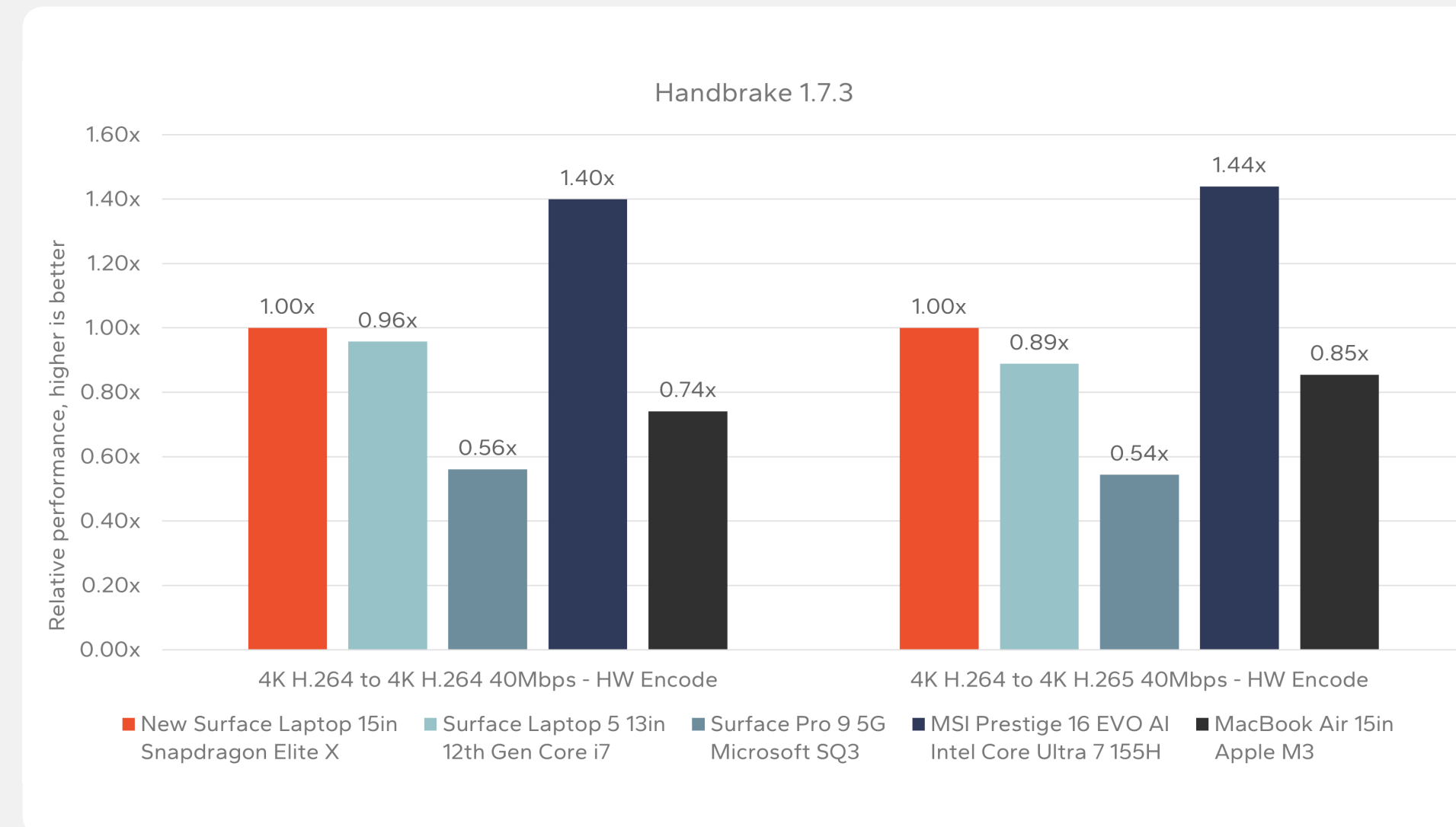
Measuring transcoding performance.

Up to 25% faster encoding than the Apple M3

Handbrake 1.7.3

Handbrake has been a staple of media testing for a decade or more as it is both a powerful tool that is based on the industry standard ffmpeg application but also in its ability to support leading edge architectures and features.

Intel has some of the best media processing and acceleration capabilities across the entire industry in its CPUs as part of the Quick Sync integration, and our Handbrake results indicate that is still the case. The new Surface Laptop with the Snapdragon X Elite performs great in our transcoding operations, beating out the MacBook Air and the M3 by 15-25% depending on the conversion and moving slightly ahead of the previous generation Surface Laptop 5. The Core Ultra 7 155H and its media engine though are a solid 40% ahead of the next best option.

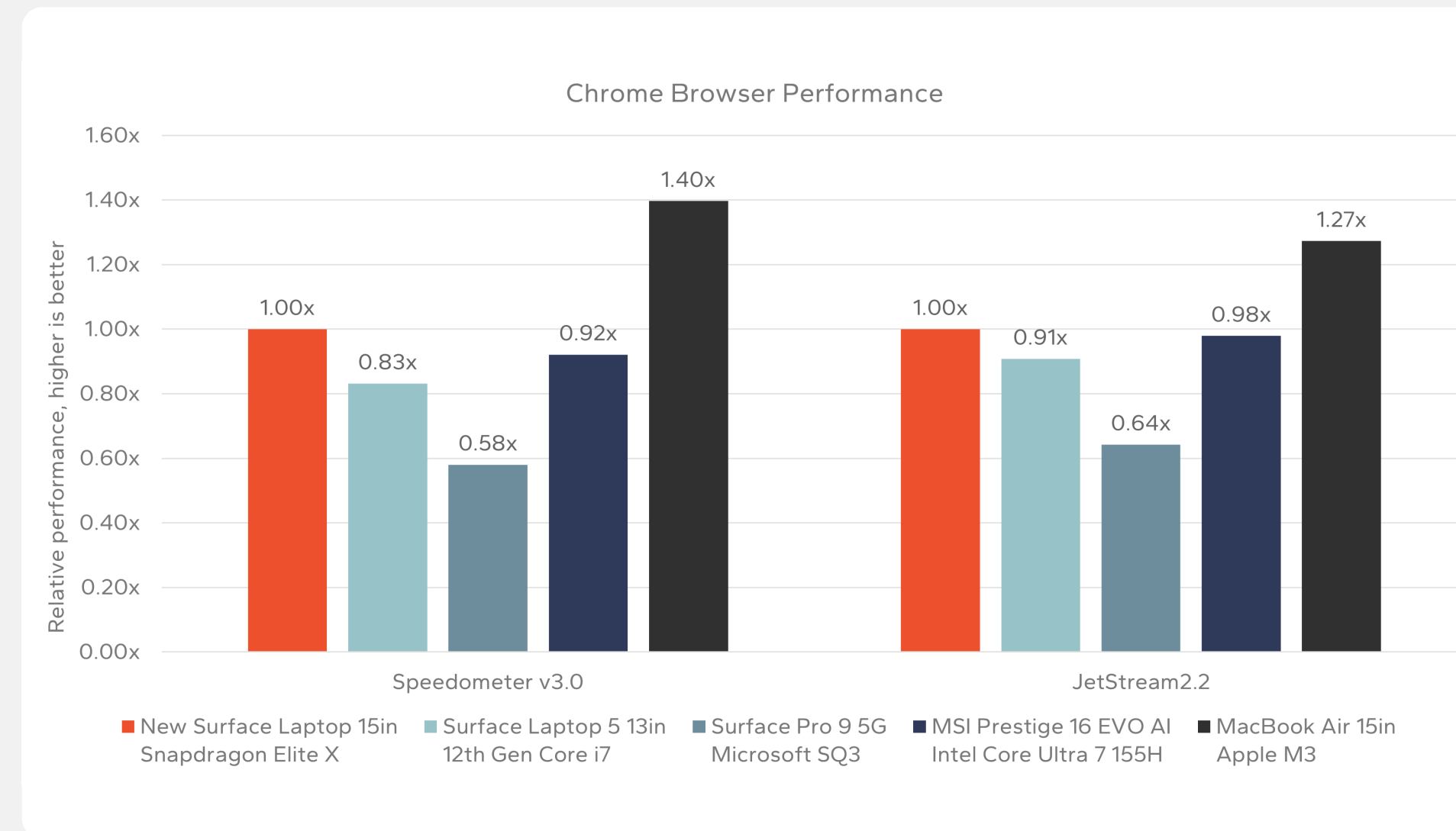


Modern Web Performance

Everyday performance in modern web applications and browsers.

Google Chrome

Using the latest version of the Chrome browser, now available natively for Windows on Arm, we are running each platform through standard browser performance tests like Speedometer v3 and JetStream v2.2. These tests look at a range of capabilities from JavaScript to Web Assembly and workloads like rendering charts and editing rich text.



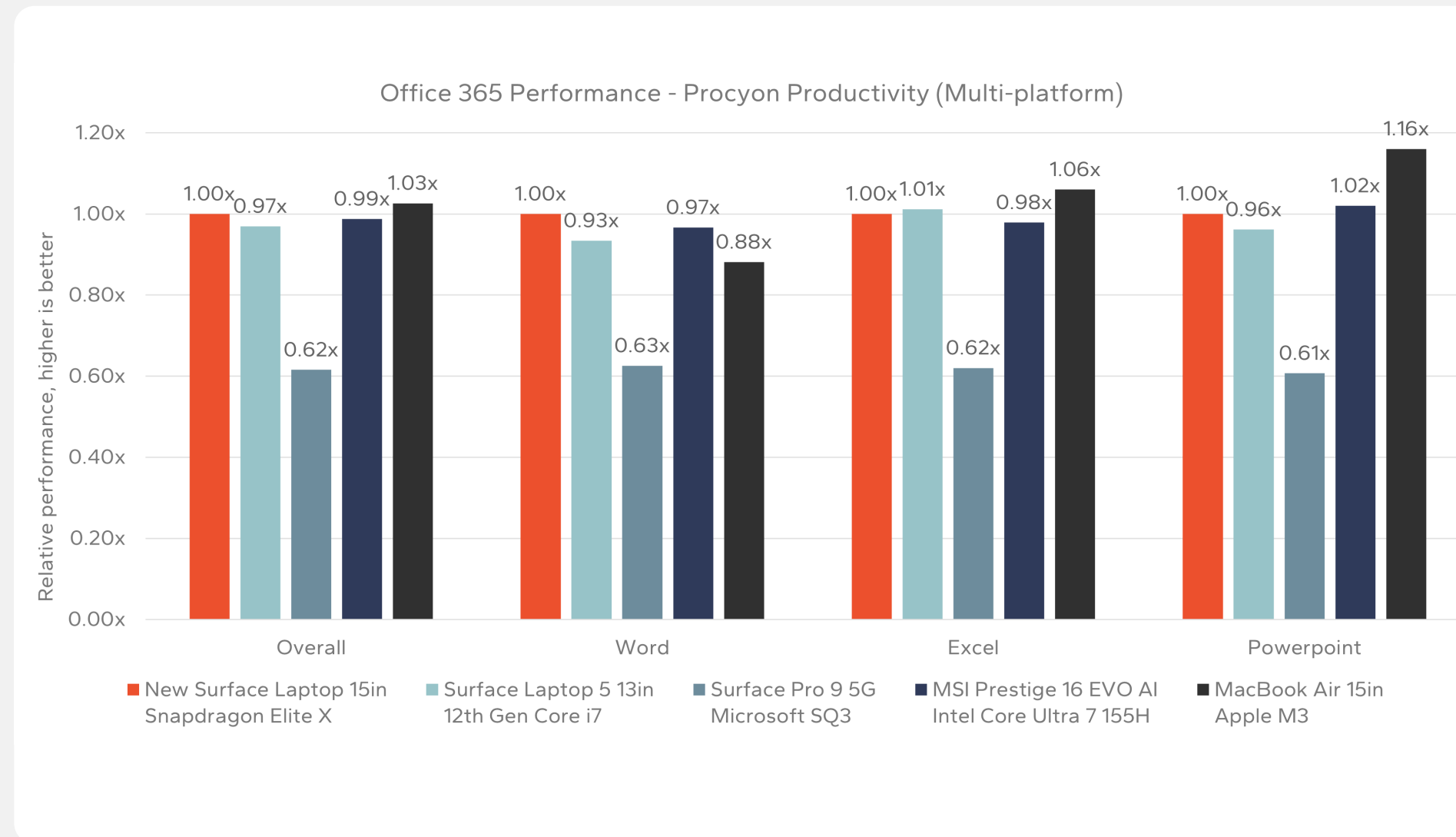
While the efficiency and speed of Chrome running on Mac doesn't appear to be in question based on these scores, from a Windows perspective, the new Surface Laptop with the Snapdragon X Elite SoC leads that pack. Thanks to that recent release of the native version of Chrome for the Arm64 architecture, the most popular web browser now is a first-class citizen in the app ecosystem, and the performance results speak for themselves.

There is no more sacrifice in performance or efficiency if you depend on the Chrome browser as your primary interface to the web.

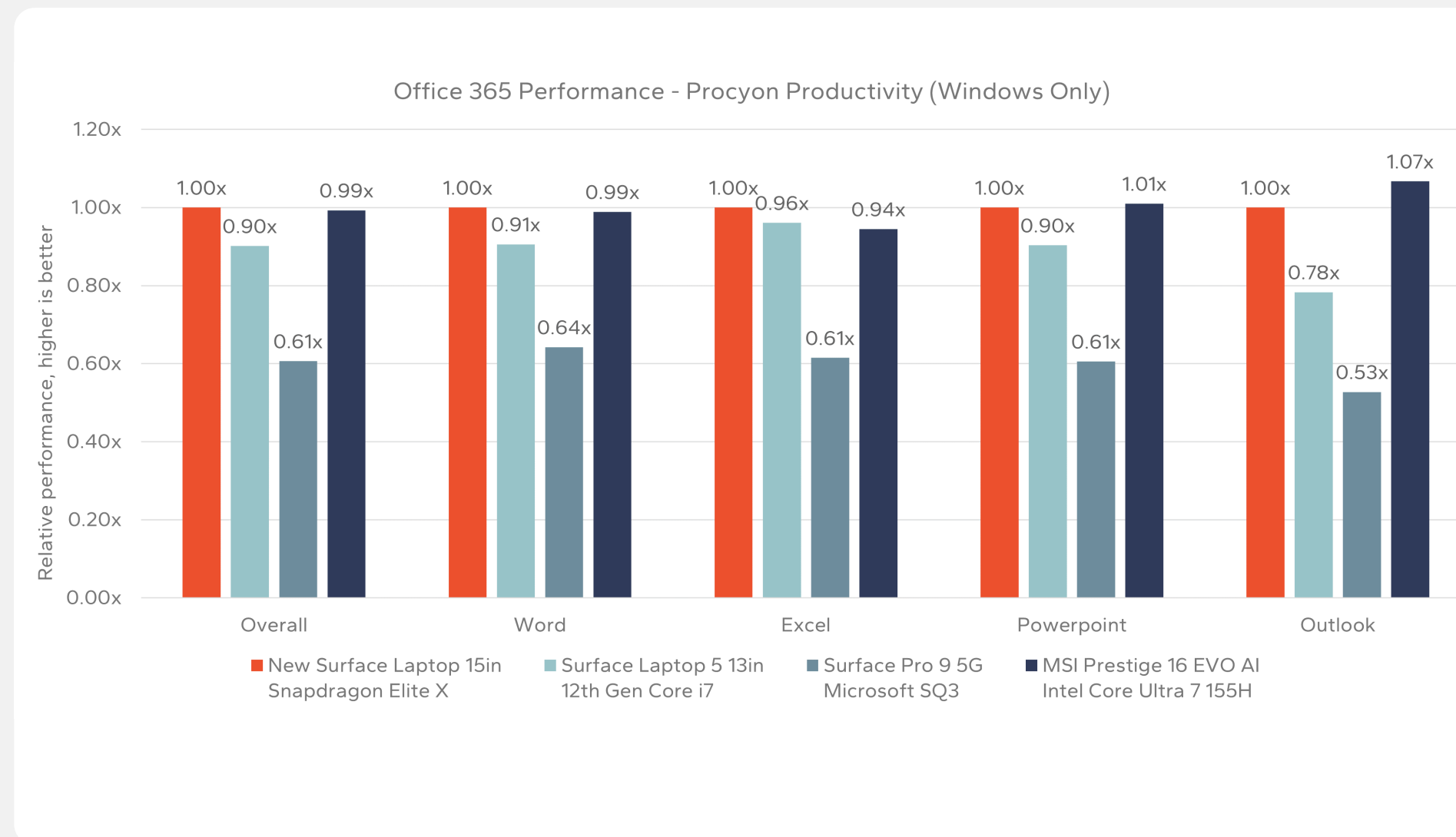
Productivity

Office and advanced productivity performance testing.

The Procyon Productivity test uses Microsoft Office 365 applications to evaluate performance using real-world workloads and scenarios. There are two versions of this test, one that is multi-platform that can be run on Windows and Mac devices, and one that is Windows only (due to a difference of Microsoft Outlook integration). Scores for both versions are different and reported separately.



Performance of Office 365 across this set of tests is fairly uniform on systems ranging from the new Intel Core Ultra to the 12th Gen Core i7 based Surface Laptop 5 and of course the new Surface Laptop powered by the Snapdragon X Elite. Only the SQ3 stands out, but offers a supporting data point to the narrative that moving to a system powered by the X Elite isn't sacrificing your ability to be productive.

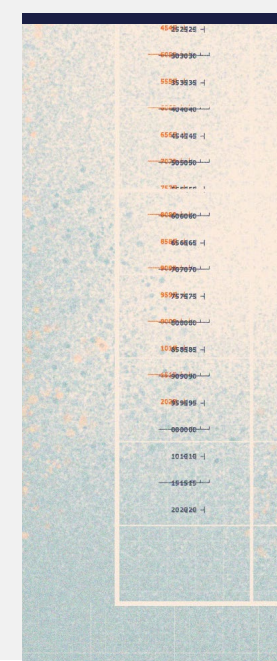


This second version of the test only compares the Windows laptops but adds performance analysis in the Outlook email and calendar application. The new Surface Laptop and the Snapdragon X Elite have the best performance of any of the systems in this comparison and this time is 10% faster than the previous generation Surface device thanks to the impact of the Outlook subtest.

Productivity Thoughts

Productivity performance is an area that many would consider to be a “solved problem” in the world of computing. Applications like Word and PowerPoint aren’t typically thought of as performance drains on your machine, though Excel can be bottlenecked by single threaded throughput if you have a lot of complex macros or formulas.

But in previous generations of Windows on Arm systems there have been concerns about baseline performance and the need to emulate some of these applications on slower CPUs. That is no longer the case. Office 365 runs natively on Arm-based processors now and the results on the Snapdragon X Elite demonstrate that not only is it “fine” performance but that it is exceeding the previous generation Surface Laptop and putting in a great battle against Intel’s latest offerings.

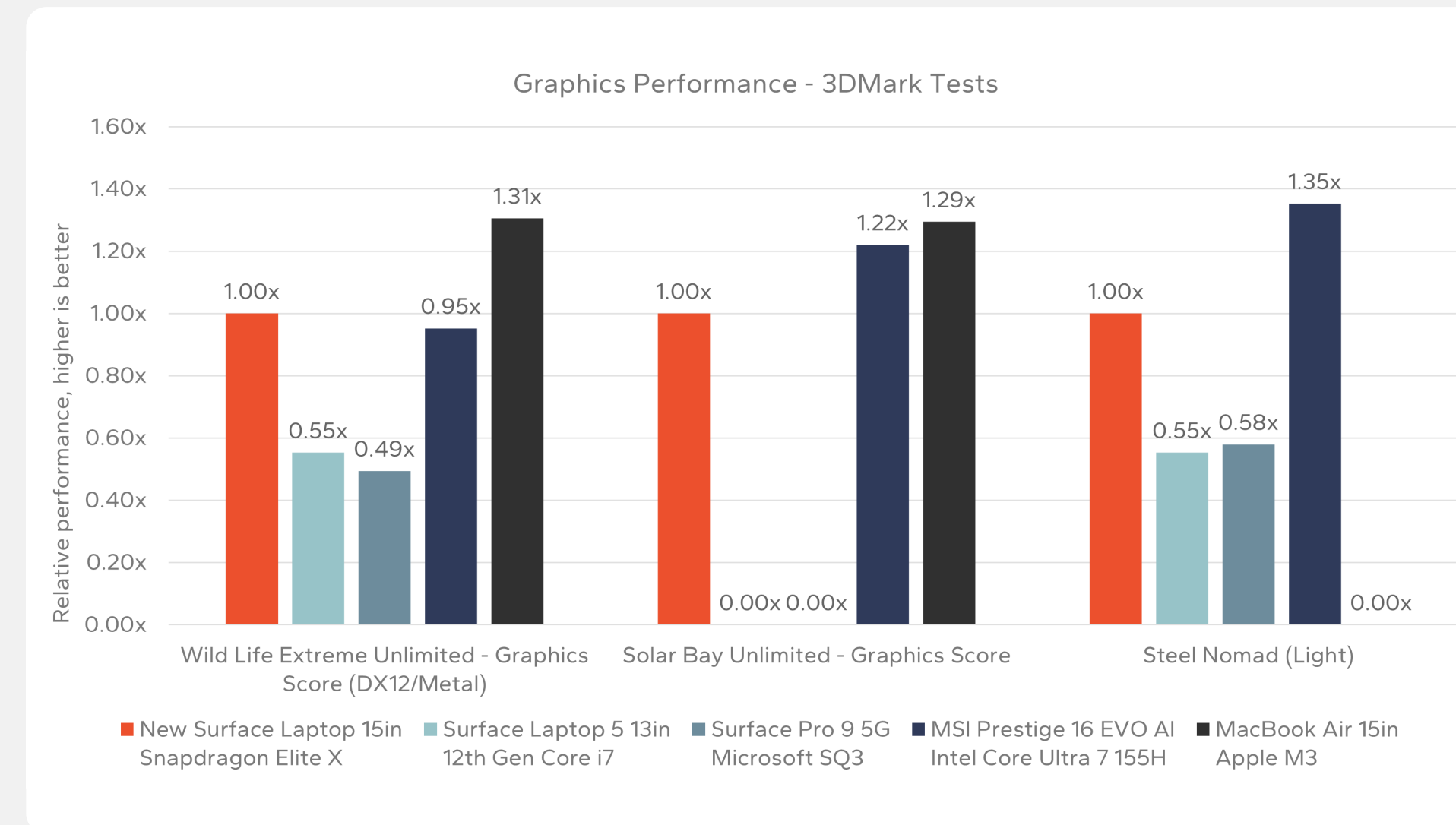


Graphics Performance

GPU performance analysis in synthetic and real-world testing.

3DMark

UL Benchmark's 3DMark family of tests is one of the longest tenured set of benchmarks in the world and the developers have continued to innovate and build leading-edge tests to evaluate performance appropriately across a range of hardware, APIs, and graphics features.



Because of the different supported features and platforms on all three of these 3DMark tests, understanding the results can be a bit confusing. In the Wild Life Extreme test, which is the oldest of the three shown here but still supports modern APIs like DX12 and Metal, the Snapdragon X Elite on the new Surface Laptop is roughly 2x the performance of the 12th Gen Core i7 and SQ3 Surface devices, and is 5% ahead of the latest Intel Core Ultra processor with integrated Arc graphics. The GPU on the Apple M3 is showing some muscle here, resulting in a 30% performance lead.

The Solar Bay benchmark is a ray tracing specific test and any graphics system that doesn't support hardware ray tracing will not generate a score. Integrated graphics solutions on the previous generation of Surface devices don't support RT. The Snapdragon X Elite does have hardware ray tracing, though it is 20-30% behind both the Arc graphics on the Intel Meteor Lake architecture and the Apple M3.

Finally, a brand new tests that was released today, the Steel Nomad benchmark is meant specifically to look at integrated graphics performance on Windows and Windows on Arm platforms, but won't run on MacOS. The results look a bit different than what Wild Life Extreme shows us: a 2x improvement for the new Surface Laptop over the previous Surface Laptop 5, but the Arc graphics on the Intel Core Ultra 155H shows well with a solid 35% advantage.

Graphics & Gaming

This section of our analysis of the new Surface Laptop might be the most complex and one that pushes us to revisit our testing in a few months. It's clear from the synthetic 3DMark test results that the Adreno GPU that Qualcomm has built into the Snapdragon X Elite is powerful enough to stand within range of the integrated graphics leaders in the market today including the Intel Arc graphics on Meteor Lake and the Apple M3. And it offers modern features like ray tracing and image upscaling.

What you don't see here yet is performance measurements in games. We spent many hours looking at different titles that do work on the new Surface Laptop, and to be clear there are many (and plenty that Qualcomm has been demoing during its press tours over the last 6 months). We were able to play Cyberpunk 2077, Shadow of the Tomb Raider, Borderlands 3, and others at a 1080p resolution and image quality settings generally on low.

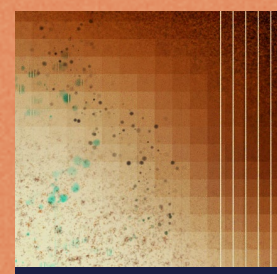
Some of the biggest game titles that require kernel-level anti-cheat platforms won't run today, like Fortnite, and that's a significant miss for a mainstream gaming option.

PC gaming is a complicated and long-term investment that both Microsoft and Qualcomm will have to make, improving the software and driver stack for gamers to grow confidence in Adreno as even a mainstream gaming option.

Emulation Performance

Performance of emulated applications under Windows on Arm.

Though we continue to see that the ecosystem of Windows applications improves in its support of native Arm architectures, there are still some tools and apps that do not have native Arm versions and thus need to run in an emulated state. Microsoft is very proud of its new emulation layer that is part of Windows 11, but one area of interest from our team in terms of performance is if the Snapdragon X Elite platform can provide a good enough experience in those particular cases.



Blender + Adobe Lightroom Classic

For this testing we looked at two different applications: Adobe Lightroom Classic and Blender.

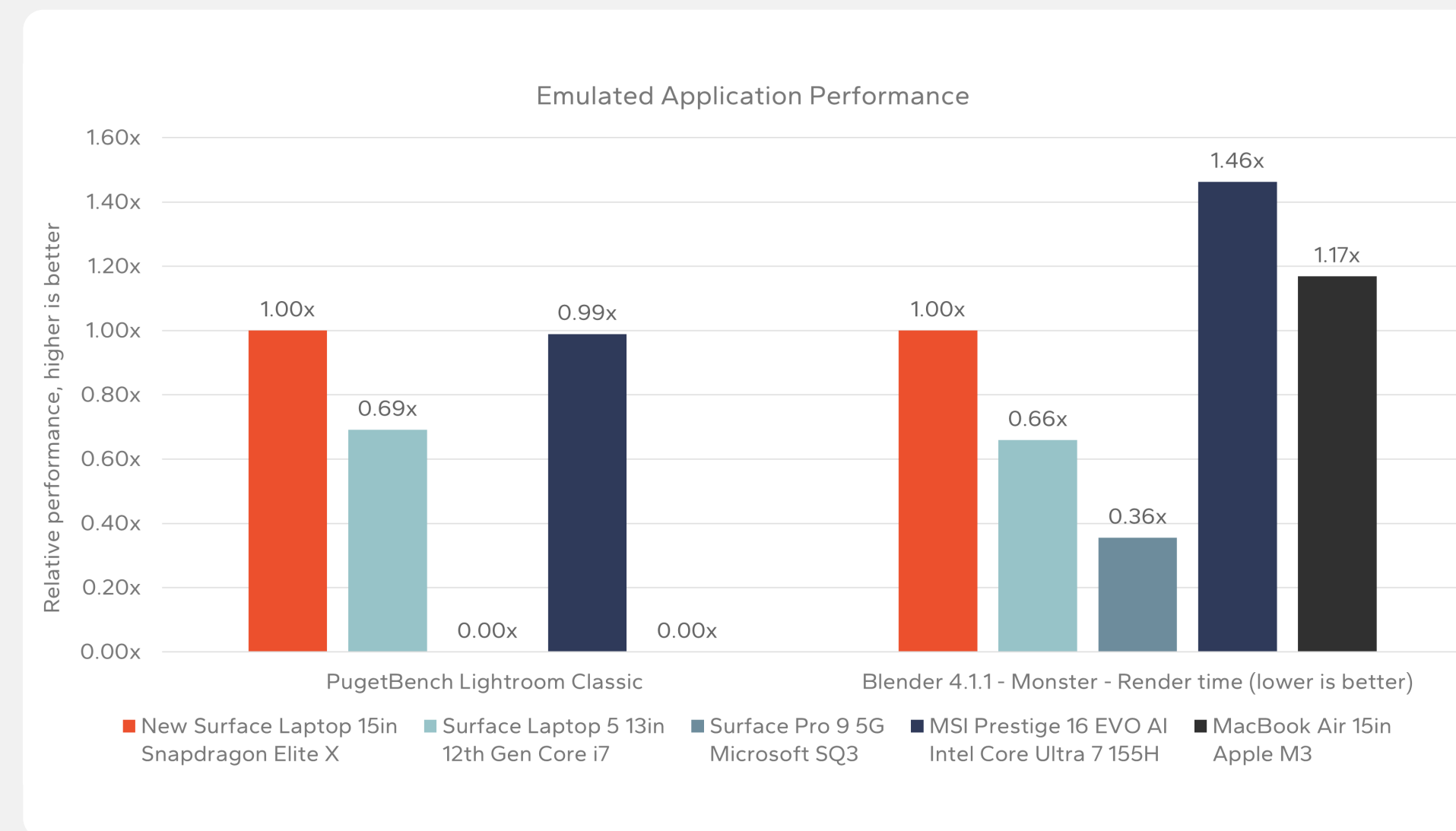
To measure the performance of Lightroom Classic we used the PugetBench tool, and the results are impressive. Not only is the new Surface Laptop with the X Elite CPU 30% faster than the previous generation Surface Laptop 5 with the 12th Gen Core i7

(that is obviously running the app natively), but it matches performance of the new Intel Core Ultra.

Blender 4.1 is a much more intense workload with a single long-form render. The new Surface Laptop is 35% faster than the previous generation Surface but due to the sustained nature of this workload is ~40% behind the Core Ultra system under test. The MacBook Air does outperform the Snapdragon X Elite here by 17%, though it is also running in a native

application mode, just as the Intel-based platforms are.

It is worth noting that the standard version of Adobe Lightroom (not the Classic version that many users still use) does run natively on Windows on Arm. Also, there is an alpha build of Blender 4.2 that supports Windows on Arm too, but it was early enough in that development process that we didn't want to integrate it into our test plan yet. The key point of this testing was to find relevant and popular titles that run in an emulated state today to evaluate Prism and the improved X Elite performance.



Emulation Thoughts

Both test results indicate that the emulation performance for Windows on Arm and the capability of the Snapdragon X Elite platform provide enough performance to ensure that any programs that haven't yet been converted over to an Arm-native version will still run exceedingly well on the new Surface Laptop. Emulated performance on the new device is outperforming even the native performance of the 12th Gen Core i7 previous generation Surface Laptop 5 – an impressive feat that should settle the nerves of any consumer debating the purchase of a new PC using this processor.

Microsoft was very proud of the telemetry it shared with press and analysts about the progress on both its emulator performance and the transition of the application ecosystem to native Windows on Arm. Microsoft claims that 87% of “application minutes” will run natively on the new Snapdragon X Elite platforms. That is significant progress from just a couple of years ago where finding tools and apps that just wouldn't run on Windows on Arm was common.

That remaining 13% isn't without some important tools that need to be addressed. As of this writing we still do not have a native version of Adobe Premier, the leading tool for video editing and content creators. There are others that are in the same state that will apply to some subset of readers, but the current outlook for the future of Windows on Arm is a night-and-day difference from where we stood just a few years ago.

Emulated performance on the new Surface is outperforming even the native performance of the 12th Gen Core i7

Signal Through the Noise

What a flagship, premium Windows device can be & the most impressive new laptop to hit the PC market in a long time



While we are still in the earliest stages of determining what an AI PC will be, our testing and analysis of the new Surface Laptop shows us what a flagship, premium Windows device can do. It combines a leading performance CPU with a neural processing unit (NPU) that has the opportunity to change the direction of personal computing.

Microsoft and its Copilot+ PC category promises consumers and businesses a drastic improvement and shift in how we get work done and how our computers will help us create. Much of that vision isn't discussed in this paper and is something we'll be analyzing and testing over the rest of 2024. But make no mistake, the Surface product group is betting on the NPU and general performance capability of the Snapdragon X Elite processor to bring that vision to life.

The 45 TOPS NPU on the X Elite is by far the fastest in consumer products today, but newer NPU integrations are due later in the year from Intel and AMD that will match these results, creating another opportunity to accelerate AI PC adoption.

Even isolated from the Copilot+ PC discussion, the new Surface Laptop offers great performance for a modern PC. Compared to other Windows machines

on the market powered by traditional x86 processors, the Snapdragon X Elite offers better single threaded and multi-threaded performance generally, besting the previous generation Surface Laptop 5 by more than 50% in heavily threaded workloads. This platform even goes toe to toe with the Intel Core Ultra system we compared it to.

Application compatibility is an area that Microsoft has made significant strides in, with thousands of the most popular apps now running natively on the Arm architecture. And for programs that still need to run under emulation, the new Prism engine improves performance over previous emulators to meet or exceed the native performance of the last gen Surface Laptop 5. Seeing the Snapdragon X Elite as the fastest CPU for the Google Chrome browser is quite the turnaround from just a couple years ago!

Our measured battery life on the new Surface Laptop is impressive too, with over 21 hours of video playback and providing more than 2x the usable battery life compared to the previous Surface Laptop. It also lasts longer than the Apple MacBook Air using the M3 chip by more than 15%. Our time spent with the new Surface Laptop when it came to usable battery life in real-world workloads, standby time, and snappiness coming back from sleep made it

the best PC experience we've had.

The Surface division has always seen its primary competition as the Mac, and the new Surface Laptop and the new Surface Pro tablet absolutely position the Windows ecosystem stiffly against the MacBook line. Microsoft knew that the Snapdragon X Elite and its Arm-based architecture was a pivotal part of its strategy against the Mac, both with high performance Oryon cores and an innovative NPU AI accelerator built in. The M3 is still a great chip, but the new Surface Laptop offers an amazing build quality and physical design, innovative new AI experiences that Mac hasn't started to compete with yet, and does it all for \$200 less than an equivalent MacBook Air.

Microsoft and the Surface group have created the most impressive new laptop to hit the PC market in a long time. The new Surface Laptop is managing to combine a new processor architecture, an updated emulation layer for Windows on Arm, the new highest performance PC processor for this class of laptop, an OS paradigm shift to AI, and one of the best physical keyboard and trackpad designs into a single package. It manages to be both unique and innovative but also familiar and comfortable for the modern consumer.



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Signal65 provides research, analysis, advising, and lab services to many high-tech companies, including those mentioned in this paper. Research of this document was commissioned by Microsoft.



About Signal65

Signal65 exists to be a source of data in a world where technology markets and product landscapes create complex and distorted views of product truth. We strive to provide honest and comprehensive feedback and analysis for our clients in order for them to better understand their own competitive positioning and create optimal opportunities to market and message their devices and services.

System Configurations

	MICROSOFT SURFACE LAPTOP	MICROSOFT SURFACE LAPTOP 5	MICROSOFT SURFACE PRO 9 5G	MSI PRESTIGE 16 AI EVO A1MG	APPLE MACBOOK AIR 15
CPU	Qualcomm Snapdragon X Elite X1E-80-100	Intel Core i7-1255U	Microsoft SQ3	Intel Core Ultra 7 155H	Apple M3
RAM	16GB LPDDR5X-8448	16GB DDR5-5200	16GB LPDDR4X-2092	32GB LPDDR5X-6400	16GB LPDDR5X-6400
Storage	512GB Samsung MZ9L4512HBLU-00BMV	512GB Samsung MZ9L4512HBLU-00BMV	512GB KIOXIA KBG40ZNS512G	1TB Western Digital SN560	512GB SSD
GPU	Qualcomm Adreno GPU	Intel Iris Xe Graphics	Qualcomm Adreno GPU	Intel Arc Graphics	Integrated
NPU	Qualcomm Hexagon NPU	N/A	Qualcomm Hexagon NPU	Intel AI Boost	Apple Neural Engine
Display	15" 2496x1644	15" 2496x1644	13" 2880x1920	16" 3840x2400	15" 2880x1864
OS	Windows 11 Pro 26097.5003	Windows 11 Home 26100.1	Windows 11 Home 26080.1400	Windows 11 Home 26100.1	MacOS Sonoma 14.4
Windows Power Mode (Performance)	Best Performance	Best Performance	Best Performance	Best Performance	N/A
Windows Power Mode (Battery Tests)	Recommended	Recommended	Recommended	Best Power Efficiency	N/A
OEM Power Settings (Performance)	N/A	N/A	N/A	Extreme Performance	N/A
OEM Power Settings (Battery Tests)	N/A	N/A	N/A	Super Battery	N/A
Firmware Version	110.1.235	11.104.13	18.7.235	E15A1IMS.10A	N/A
Virtualization Based Security	Enabled	Enabled	Enabled	Enabled	N/A

Applications Used

Geekbench 6.3.0

Cinebench 2024.0.1

Google Chrome version 124

3DMark 2.28.8228

UL Procyon 2.7.1108

Handbrake 1.7.3

Microsoft Office 365 0403

Adobe Lightroom Classic 13.2

Blender 4.1.1

Davinci Resolve 18.6.4 Dev Build (Snapdragon Surface Laptop)



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