2024 ASUS ZENBOOK S 16

AMD Ryzen™ AI 9 HX 370 Processor with Radeon™ 890M Graphics

Reviewer's Guide: Processor Features & Performance

Introducing the 2024 ASUS ZENBOOK S 16

Unlock Transformational AI PC experiences

The Asus Zenbook S 16, powered by AMD Ryzen™ AI 300 processors, offers high-performance computing and introduces new AI PC experiences in an ultra-slim, highly portable design. These processors incorporate next-generation architectures across the CPU, GPU, and NPU, delivering leadership performance and power efficiency for this emerging category of AI PCs.[1]

Equipped with AMD Ryzen AI, the Zenbook features a 50 TOPS NPU[2] that enables innovative AI applications directly on the device. This includes AI assistants, chatbots, and generative AI, enhancing user interaction and productivity.

The Zenbook's design showcases high-tech ceramic materials and a 3K OLED display, complemented by ample storage and memory, amazing battery life, efficient cooling, and robust connectivity.

Altogether, the Zenbook S 16 sets a new standard in portable computing, combining powerful performance with advanced AI capabilities to meet modern computing demands.

Quick Start Guide

Specific Features (As Tested)

System Model	ASUS ZENBOOK S 16 (UM5606)
Processor Model	AMD Ryzen™ AI 9 HX 370
Processor Family	AMD Ryzen™ AI 300 Series
Boost Frequency (GHz)[3]	Up to 5.1 GHz
Base Frequency (GHz)[4]	2.0 GHz
Physical Cores	12
Threads	24
Processor cTDP (Watts)	Processor: 15W – 54W Zenbook TDP: 28W (performance fan mode), 17W (standard fan mode)
Battery (Watt Hours)	78Wh
Memory Configuration	32GB (4x 8GB) LPDDR5x-7500 SDRAM
Graphics Device	AMD Radeon™ 890M (AMD RDNA™ 3.5 Graphics Architecture)
Framebuffer Size (Gbytes)	512Mb
Graphics Device Driver	32.0.11018.8007
Display Panel	16" 16:10 3K (2880 x 1800) 120Hz OLED (touch screen) 400nits, 500nits HDR peak brightness, with stylus support
Native Resolution	3K (2880 x 1800)
Game Test Resolution	1080p
Maximum Refresh Rate	120Hz
Storage	1TB SSD
Connectivity	WiFi-7
Operating System	Windows 11 Pro / Windows 11 Home
Audio	6 built-in speakers /Harman Kardon®-certified/Dolby Atmos® sound system Built-in 3 array microphone
Dimensions	35.36 x 24.30 x 1.19 ~ 1.29 cm (13.92" x 9.57" x 0.47" ~ 0.51")
Weight	1.50 kg (3.31 lbs)

Important Notice on Versions / Drivers / sBIOS

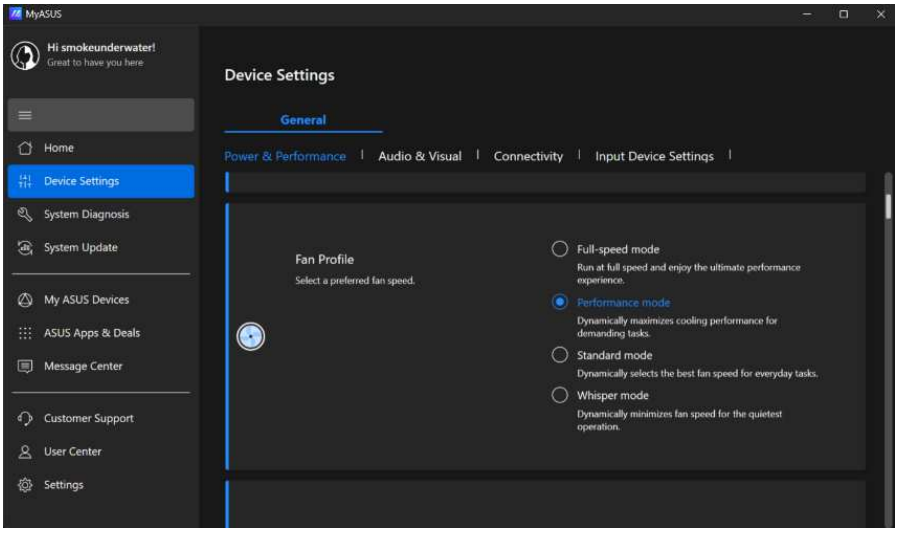
Please ensure you are using latest versions:

- Windows: Microsoft Windows 11 Pro (x64) Build 26100 or newer
- sBIOS version: 308
- AMD Radeon™ graphics driver version: Adrenalin 24.10.18.08 (WHQL)
- Chipset driver version: 6.07.10.130

Current driver versions are available in your press folder. Please reach out to your PR contact in case you have any questions.

Points to Consider When Reviewing

- For repeatable results, it is important to allow sufficient idle time between tests.
- Ensure that you run every test in the same location, at room temperature, and away from direct sunlight and other heat sources.
- Out of the box, the system is tuned for a balanced experience between performance, battery life and ergonomics. Windows power mode defaults to balanced mode and the fan profile defaults to standard. This provides a great ergonomic experience, however it limits platform power to ~60% of its ideal 28W thermal capability.
- To maximize performance for benchmarking, please ensure the **fan profile setting is set to Performance Mode** (see picture).



- When selecting competitive designs for performance comparisons please consider selecting platforms that operate at a similar power/thermal solution. Here are some examples:
- For Qualcomm Snapdragon X Elite based platforms:
  - Samsung Galaxybook, Asus Vivobook, Lenovo Yoga Slim, Microsoft Surface
- For Intel Core Ultra based systems:
  - Core Ultra 9 only comes as 185H variant, which has a higher power profile than the Ryzen AI 9 HX 370 in the Zenbook
  - For similar power profile, consider comparing to a 28W platform with Core Ultra 7 155H
- For Apple based systems, the Macbook Air is the similarly positioned system
- For battery life comparisons please consider selecting systems with an OLED display due to higher panel power consumption
- Use our results below as a guide to see if the system is running at expected performance levels

Calibration Check

Running a few tests upfront and checking them against the below scores will ensure your system is meeting the basic performance metrics for extended testing. If your scores vary significantly, please contact your AMD PR lead to diagnose any possible problem with your sample. The data below was gathered on an Asus Zenbook S 16 with an AMD Ryzen AI 9 HX 370 and Radeon™ 890M graphics with **Performance Fan Mode setting selected**.

Cinebench 2024 1T Score: 111

Cinebench 2024 nT Score: 941

AMD Ryzen™ AI 9 HX 370 Processor – Product Highlights

AMD Ryzen™ AI 300 Series is all about giving more of everything in as many ways as possible, and the flagship, top of stack model does exactly that.

New "Zen 5" Architecture: Based on new high performance "Zen 5" architecture, AMD Ryzen™ AI 9 HX 370 processors offer the world's fastest performance for x86 ultrathin AI PC laptops[5]. Compared to previous gen, "Zen 5" delivers up to 16% higher IPC.[6]

High Performance Cores: AMD Ryzen™ AI 300 processors come with up to 12 high-performance cores and 24 threads for leadership multi-threaded performance. That's a 50% increase in cores from previous generation Ryzen processors for thin and light laptops.

AI performance with AMD XDNA™ 2 Architecture: AMD XDNA™ 2 architecture is the latest generation NPU architecture powering Ryzen™ AI with up to 50 TOPs of AI processing performance.[7,2] This massive performance upgrade enables AI capabilities such as locally running generative AI applications, Large Language Models, and AI assistants directly on your laptop.

AMD Radeon™ 800M Graphics: AMD Radeon™ 800M Graphics are built-in for thrilling gaming performance, high resolution display support, and hardware-accelerated encoding with or without a discrete graphics card.[8] The GPU is built on new AMD RDNA™ 3.5 architecture and comes with a core count boost of up to 16 CUs, 33% more compared to previous generation.

Power efficient processing: AMD Ryzen™ AI 300 processors are optimized for low power consumption enabling excellent battery life plus impressive performance.

Large Cache Sizes: AMD Ryzen™ AI 300 processors offer up to 36MB of combined cache for accelerated productivity and ultra-responsive gaming.

SOC Architecture: Designed for Performance & Efficiency

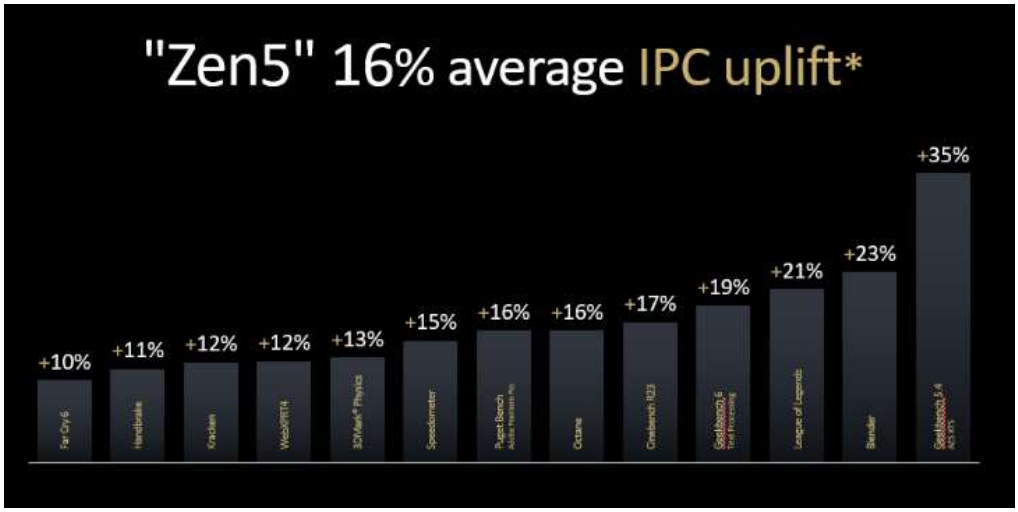
"Zen 5" CPU Architecture Overview

"Zen 5" is the next big step in the AMD high performance CPU roadmap. It is a grounds-up design that is both highly-performant and incredibly power efficient. "Zen 5" will power everything from supercomputers to data centers and of course PCs.

With a new, parallel dual-pipeline front end that improves branch prediction accuracy and reduces latency, Zen 5 delivers more performance at every clock tick. "Zen 5" was also designed with a wider CPU engine and instruction window to run more instructions in parallel for leadership compute throughput and efficiency.

As a result, "Zen 5" delivers double the instruction bandwidth, double the data bandwidth and double the AI performance compared to "Zen 4", which is already the industry's highest performance, most efficient x86 CPU core.

All of this comes together to deliver up to 16% higher IPC across a broad range of applications, benchmarks and games compared to "Zen 4".[6]



AMD XDNA™ 2 NPU Architecture Overview

The AMD XDNA™ 2 NPU architecture delivers an impressive 50 TOPS[2] of AI compute, driving the next generation of AI PCs. This architecture enhances AI experiences in collaboration, creativity, personal assistance, and enterprise productivity.

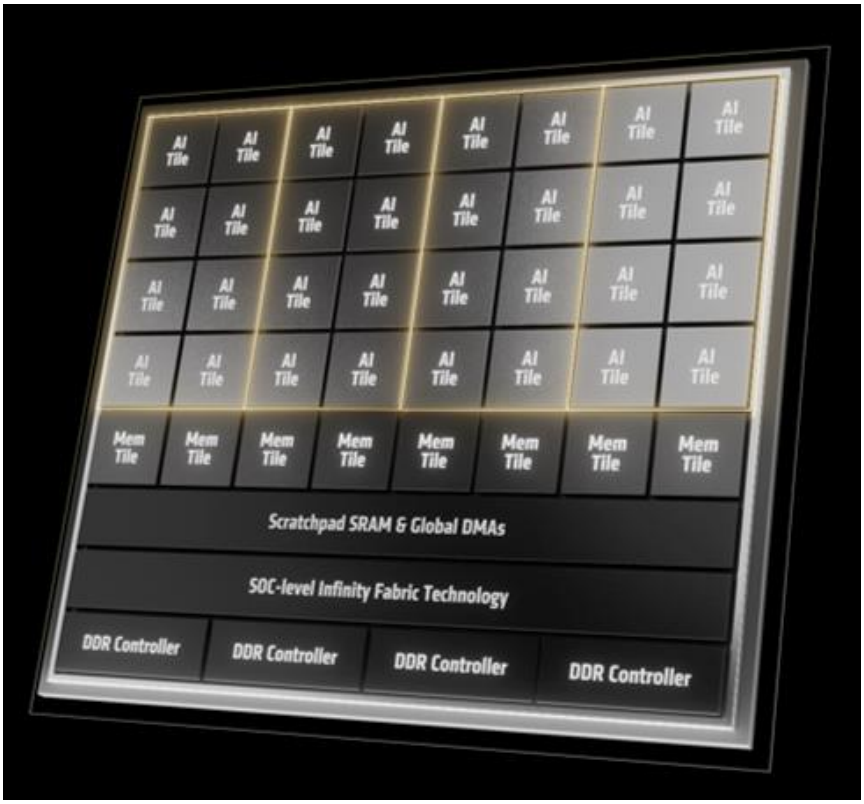
The AMD XDNA™ 2 architecture builds on AMD's expertise in AI, having powered applications from 5G calls and augmented reality in NBA games to medical imaging. Now, this robust architecture is integrated into AI PCs with the AMD Ryzen AI 300 Series processors.

Featuring a flexible, spatial dataflow architecture, AMD XDNA™ 2 architecture employs a 2D tiled array of compute tiles and a customizable interconnect. This design supports efficient AI workload implementation, enabling multicast data reads and deterministic operation without caches. Spatial partitioning allows concurrent real-time video, audio, and content creation streams without quality loss.

The AMD XDNA™ 2 architecture significantly advances its predecessor with more compute tiles (from 20 to 32), doubled compute within each tile, and 1.6x more on-chip memory. This results in a 5x AI TOPS lift and 2x power efficiency uplift (as compared to the AMD Ryzen™ 7040 Series processors).[9,10]

A key innovation is the Block FP16 datatype, offering 8-bit performance with near 16-bit accuracy. This allows high performance and accuracy simultaneously, eliminating the need for quantization and retraining. Block FP16 supports a range of neural network models, consistently delivering strong accuracy and performance.

AMD's collaboration with partners like Microsoft has optimized AI models for efficient performance on AMD Ryzen™ AI 300 processor-based platforms. Examples include ultrafast image generation with SDXL Turbo and faster responses in Llama2 implementations. The AMD XDNA™ 2 architecture's capabilities are accessible through the AMD Ryzen™ AI software stack, marking a transformative era in computing.



AI is revolutionizing the PC experience, and AMD's NPUs are at the forefront, empowering developers and delivering top-tier AI performance to laptop users worldwide.

AMD RDNA™ 3.5 Architecture Overview

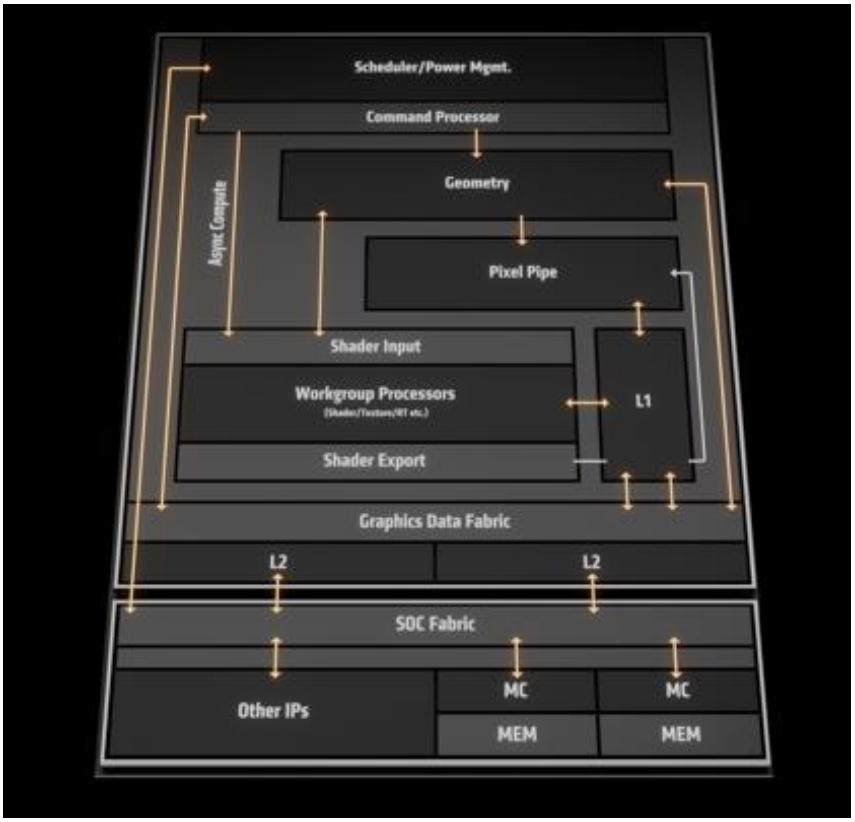
The AMD RDNA™ 3.5 architecture represents a major update, focusing on enhancing device power and efficiency. Building on the partnership with Samsung for Galaxy smartphones, AMD has achieved substantial feats in power efficiency for mobile GPUs.

Key graphics processes have been optimized, allowing the AMD RDNA™ 3.5 architecture to deliver more performance per unit of power. Memory access and power management have been refined, enabling significant performance gains without increased energy use.

In the texture subsystem, the rate at which textures are processed has been doubled, speeding up game graphics. The shader subsystem now can handle common tasks like pixel interpolation and comparison up to twice as fast. Additionally, a feature in the Scalar ALU skips unnecessary steps, improving processing speed.

Enhancements in the rasterization subsystem reduce memory access needs by working more efficiently with the cache and employing smarter memory access patterns.

The AMD RDNA™ 3.5 architecture is tailored to work well with LPDDR5 memory, reducing latency and using advanced compression to lower memory traffic. These improvements are designed to significantly boost overall performance efficiency.



Benchmark tests highlight these advancements compared to previous generation AMD RDNA™ 3 architecture: the 3DMark Time Spy Graphics benchmark for gaming PCs shows a 32% performance increase on average, and the Night Raid benchmark for low-power mobile platforms demonstrates a 19% boost.[11] The AMD RDNA™ 3.5 architecture marks a significant leap in mobile GPU performance and efficiency.

AMD Ryzen™ AI 9 HX 370 Processor Specifications

Processor	Max Boost [3] Base Freq [4]	CPU Cores / Threads	GPU Model Cores Frequency	NPU TOPS (Up to)	Total Cache (L2 + L3)	cTDP	Process /uArch
AMD Ryzen™ AI 9 HX 370	up to 5.1 GHz 2.0 GHz	12/24	AMD Radeon™ 890M 16 2.9GHz	50	36MB	15-54W	4nm / “Zen 5”

Benchmark Performance

Benchmarks	Scores (Performance Fan Profile)
Cinebench	
R23 (23.2.0.0) 1-thread	1928
R23 (23.2.0.0) n-Thread	17230
2024 1-thread	111
2024 n-thread	941
Geekbench 6.3	
CPU Single-Core	2747
CPU Multi-Core	13455
OpenCL	36405
PCMark v2.1.2600	
Benchmark	7836
Express	6964
Extended	7440
Gaming Test Group	6357
Digital Content Creation Test Group	9849
Photo Editing	15335
Video Editing	6772
Blender 3.5.0	
bmw27 CPU TTC (s)	147
classroom CPU TTC (s)	353
PugetBench For Creators Photoshop 25.4.0 (Puget v1.0.0)	
Filter Score	70
General Score	75.5
Overall Score	7270
PROCYON Office	
Office Productivity Score	7390
Office Productivity MP Score (Cross Platform)	263500
3DMark v2.29.8256	
Time Spy	
CPU Score	9835
Graphics Score	3388
Overall Score	3757
Night Raid	
Graphics Score	37393
Overall Score	29505
Kraken v1.1 (edge_chrome_126.0 25-92.102)	
Total Time - seconds	335
7zip v19.00	
All Total: Compressing Rating	99748

Gaming Performance

FHD (1920x1080) Low Detail Settings, Balance Power Profile, Average Frame Rates

Game Titles	Scores (Frames Per Second)
Assassins Creed Mirage	45
Borderlands 3	73
Cyberpunk 2077	43
F1 2023	83
Far Cry 6	62
Final Fantasy 14	72
Hitman 3	71
Shadow of the Tomb Raider	77

Battery Life

The Asus Zenbook S 16 comes with a 78wHr battery. In our tests, the Asus Zenbook S 16 averaged 17.3 hours of battery life for video playback. This is a strong showing for an ultra slim x86 AI PC laptop, holding its own against new ARM-based variants.

Test methodology: Local video playback of a fullscreen 1080p video in the Movies & TV app. 150 nits, WiFi connected to a router with no external network access. Power efficiency power mode and Silent fan profile

Conclusion

The Asus Zenbook S 16, featuring the AMD Ryzen™ AI 9 HX 370 processor and AMD Radeon™ 890M graphics, sets a new benchmark for ultra-thin mobile performance. With an industry-leading 50 TOPS NPU[1] and integrated AMD Ryzen™ AI[9], this AI PC enables cutting-edge AI experiences. The advanced CPU and GPU architecture deliver top-tier productivity, creativity, and gaming performance. Encased in an ultra-slim, high-tech design with excellent ergonomics, it offers an exceptional all-day computing experience[12].

Contact Information

For any further information, questions or anything else not included in this guide, please use the following contacts:

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ITEM 8. FINANCIAL STATEMENTS AND SUPPLEMENTARY DATA

Advanced Micro Devices, Inc.

Consolidated Statements of Operations

	Year Ended		
	December 30, 2023	December 31, 2022	December 25, 2021
	(In millions, except per share amounts)		
Net revenue	$ 22,680	$ 23,601	$ 16,434
Cost of sales	11,278	11,550	8,505
Amortization of acquisition-related intangibles	942	1,448	—
Total cost of sales	12,220	12,998	8,505
Gross profit	10,460	10,603	7,929
Research and development	5,872	5,005	2,845
Marketing, general and administrative	2,352	2,336	1,448
Amortization of acquisition-related intangibles	1,869	2,100	—
Licensing gain	(34)	(102)	(12)
Operating income	401	1,264	3,648
Interest expense	(106)	(88)	(34)
Other income (expense), net	197	8	55
Income before income taxes and equity income	492	1,184	3,669
Income tax provision (benefit)	(346)	(122)	513
Equity income in investee	16	14	6
Net income	$ 854	$ 1,320	$ 3,162
Earnings per share			
Basic	$ 0.53	$ 0.85	$ 2.61
Diluted	$ 0.53	$ 0.84	$ 2.57
Shares used in per share calculation			
Basic	1,614	1,561	1,213
Diluted	1,625	1,571	1,229

See accompanying notes to consolidated financial statements.

Through the end of 2023, we continue to maintain a valuation allowance of approximately $2.1 billion for certain federal, state, and foreign tax attributes. The federal valuation allowance maintained is due to limitations, under Internal Revenue Code Section 382 or 383, separate return loss year rules, or dual consolidated loss rules. Certain state and foreign valuation allowances are maintained due to a lack of sufficient sources of future taxable income.

In addition, the calculation of our tax liabilities involves addressing uncertainties in the application of complex, multi-jurisdictional tax rules and the potential for future adjustment of our uncertain tax positions by the Internal Revenue Service or other taxing authorities.

Results of Operations

Additional information on our reportable segments is contained in Note 4 – Segment Reporting of the Notes to Financial Statements (Part II, Item 8 of this Form 10-K).

Our operating results tend to vary seasonally. Historically, our net revenue has been generally higher in the second half of the year than in the first half of the year, although market conditions and product transitions could impact these trends.

The following table provides a summary of net revenue and operating income (loss) by segment for 2023 and 2022:

	Year Ended	
	December 30, 2023	December 31, 2022
	(In millions)	
Net revenue:		
Data Center	$ 6,496	$ 6,043
Client	4,651	6,201
Gaming	6,212	6,805
Embedded	5,321	4,552
Total net revenue	$ 22,680	$ 23,601
Operating income (loss):		
Data Center	$ 1,267	$ 1,848
Client	(46)	1,190
Gaming	971	953
Embedded	2,628	2,252
All Other	(4,419)	(4,979)
Total operating income	$ 401	$ 1,264

Data Center

Data Center net revenue of $6.5 billion in 2023 increased by 7%, compared to net revenue of $6.0 billion in 2022. The increase was primarily driven by higher sales of AMD Instinct GPUs and 4th Gen AMD EPYC CPUs.

Data Center operating income was $1.3 billion in 2023, compared to operating income of $1.8 billion in 2022. The decrease in operating income was primarily due to product mix and higher research and development (R&D) investment.

Client

Client net revenue of $4.7 billion in 2023 decreased by 25%, compared to net revenue of $6.2 billion in 2022, primarily due to lower sales of Ryzen mobile and desktop processors, resulting from a 16% decrease in average selling price and a 12% decrease in unit shipments. Lower Ryzen processor sales were due to weak PC market conditions and inventory correction across the PC supply chain that impacted the first half of 2023.

Client operating loss was $46 million in 2023, compared to operating income of $1.2 billion in 2022. The decrease in operating income was primarily due to lower revenue.