13th Gen Intel® Core™ S-series Processors

September 12, 2022
Introducing 13th Gen Intel® Core™

Mandy Mock
Vice President and General Manager
Desktop, Workstation, and Channel Group
The Performance Hybrid Architecture Journey Continues

**13th Gen Processor Family**

Continued innovation in performance hybrid architecture

**Meteor Lake / Arrow Lake**

Leap in XPU improvement with integrated AI and tiled GPU architecture

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**12th Gen Processor Family**

Intel's first performance hybrid architecture showcasing P-cores, E-cores and Intel® Thread Director

Thank You!
## A Strong Partner Ecosystem

<table>
<thead>
<tr>
<th>Company</th>
<th>Quote</th>
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</table>
| Acer    | "Through close co-engineering with Intel, we've been able to push the overclocking experience on Predator gaming desktops with 12th Gen Intel Core processors, allowing gamers to dynamically and reliably custom-tune their processor."

Jeff Lee, General Manager, Desktops, IT Products Business, Acer Inc. |

| Dell    | "We teamed up with Intel to design the Alienware Aurora R13, one of the first gaming desktops in the industry chosen for Intel’s exclusive Innovation Excellence Program (IEP) in over 5 years. We combined Intel’s 12th Gen Intel® Core™ desktop processors with Alienware’s custom-built Cryo-tech cooling solution, the latest DDR5 memory, and support for PCIe 5.0 to provide an incredible gaming experience."

Vivian Lien, Dell Technologies, VP of Gaming. |

| HP      | "Gamers crave the best performance possible when playing their favorite games, which is why we offer Intel 12th Generation CPUs in our latest gaming desktops from both our OMEN and Victus by HP brands."

Josephine Tan, Global Head and General Manager, Consumer PCs at HP Inc. |

| Lenovo  | "With 12th Gen, Intel brought its leadership back in gaming."

Karan Kapur, Lenovo Global Director Of Product Marketing & Head Of Gaming |

| Puget Systems | Intel 12th Gen CPUs have been amazing for creator workloads! The new hybrid architecture has enabled us to drive the highest performance yet, but also keep our workstations quiet and power efficient."

Jon Bach, President of Puget Systems |

| Origin  | "Intel 12th gen has been the perfect balance of performance, technology, and value and it amazes me how Intel continues to innovate and improve on processors every generation."

Kevin Wasielewski, Origin PC Co-founder and Senior Director Systems Marketing and Partner Alliance at CORSAIR |

| Skytech Gaming | "Intel 12th gen processors have delivered high end performance at all ends of our product sectors. Whether gaming or creating, Alderlake product has continued to deliver exceptional results."

Kevin Hsu, President of Skytech Gaming |
Incredible partnerships for product readiness at launch

- 140+ customers
- 30+ countries
- 70+ motherboards

Unmatched Ecosystem Breadth and Collaboration
From engineering optimization to the retail shelf

Sample list of customers and partners:
Introducing New 13th Gen Intel® Core™ Processor Family

**Desktop**
S-series 35/65/125W

**Mobile**
U, P, H, HX-series
13th Gen Intel® Core™ Delivers the World’s Fastest Desktop Processor

World's Best Gaming Experience
Faster cores and amazing simultaneous gaming, streaming and recording

A Leap in Creator Performance
Increased cores, threads and cache to keep people in the creative flow

Unmatched Overclocking Experience
The best experience for everyone – from experts to beginners

Claims as of Sept. 7, 2022. Intel Core i9-13900K is the world’s fastest desktop processor at 5.8 GHz. World’s Best Gaming Experience based on performance and unique features of unlocked 13th Gen Intel Core processors, including in comparison to 12th Gen Intel Core, AMD Ryzen 9 5950X and AMD Ryzen 7 5800X3D. Best overclocking based on enhanced overclocking ability enabled by Intel’s comprehensive tools and unique architectural tuning capabilities. Overclocking may void warranty or affect system health. See www.intel.com/overclocking for details.

For all workloads and configuration see www.intel.com/PerformanceIndex. Results may vary.
The World’s Fastest Desktop Processor

13th Gen Intel® Core™ i9-13900K

Fastest P-Cores
5.8GHz

Double E-Cores
24C / 32T

Larger L2 Caches
2MB per P-core
4MB per E-core cluster

Delivering up to 15% ST and 41% MT Performance

Source Intel: As estimated by measurements made using SPECint_rate_base2017_IC2022.1 (1-copy & n-copy) using Intel validation Platforms comparing Core i9 13900K versus Core i9 12900K

For all workloads and configuration see www.intel.com/PerformanceIndex. Results may vary.
13th Gen Desktop Processors: Unleashing the Ultimate Gaming Platform

- **Intel 7 Process Technology**
- **PCIe Gen 5.0 support**
- **4 PCIe Gen 4.0 support**
- **Increased to DDR5 - 5600/DDR5 - 5200 support**
- **3 DDR4 support**
- **Up to 2X L2 cache**
- **Increased L3 cache**
- **Core and Memory Overclocking**
- **Intel Speed Optimizer**
- **Improved P-core cache architecture; More E-cores**
- **Up to 24 cores (8P+16E) for Core i9 SKUs**
- **Expanding Performance Hybrid Architecture** (6P+8E/6P+4E) to Core i5
- **Fast versatile connectivity with Thunderbolt 4™ & Intel® Killer™ Wi-Fi 6E (Gig+)**
- **Increased Chipset PCIe Gen 4.0**
- **Increased USB 3.2 Gen 2x2 20Gbps**

CHIPSET Z790
Designed For Platform Flexibility

Forward & Backward Compatibility

Support for Both DDR5 & DDR4 Memory

Not a comprehensive list of customers and partners
Requires latest BIOS & SW drivers from motherboard vendor
World’s Best Overclocking Experience

Enhanced Experiences

- New Per Core Tuning Visualizations with Intel® Extreme Tuning Utility
- Easy 1-Click Overclocking with the Intel® Speed Optimizer feature and new simplified “Compact View”
- Robust Memory OC with Extreme Memory Profile 3.0 technology (XMP) offers 1-click automatic memory overclocking experiences with both DDR4 and DDR5

Extreme Tuning Utility

Intel® Speed Optimizer

Based on enhanced overclocking ability enabled by Intel’s comprehensive tools and unique architectural tuning capabilities. Your results may vary. Overclocking may void warranty or affect system health. For details see intel.com/overclocking. For all workload and configuration see www.intel.com/PerformanceIndex. Results may vary.
Huge Generational Gains Across the Stack

Intel Core i5-13600K
14-core up to 5.1 GHz
+4 cores, +4 threads
+200 MHz Turbo

Intel Core i7-13700K
16-core up to 5.4 GHz
+4 cores, +4 threads
+400 MHz Turbo

Intel Core i9-13900K
24-core up to 5.8 GHz
+8 cores, +8 threads
+600 MHz Turbo

All comparisons vs 12th Gen Intel Core
13th Gen Intel Core Desktop Performance Overview

Marcus Kennedy
General Manager
Gaming, Creator, and Esports Segment
13th Gen Intel® Core™ Desktop Processors Deliver:

**World’s Best Gaming Experience**
Faster cores and amazing simultaneous gaming, streaming and recording

**A Leap in Creator Performance**
Increased cores, threads and cache to keep people in the creative flow

**Unmatched Overclocking Experience**
The best experience for everyone – from experts to beginners

“Claims as of Sept. 7, 2022. Intel Core i9-13900K is the world’s fastest desktop processor at 5.8 GHz. World’s Best Gaming Experience based on performance and unique features of unlocked 13th Gen Intel Core processors, including in comparison to 12th Gen Intel Core, AMD Ryzen 9 5950X and AMD Ryzen 7 5800X3D. Best overclocking based on enhanced overclocking ability enabled by Intel’s comprehensive tools and unique architectural tuning capabilities. Overclocking may void warranty or affect system health. See www.intel.com/overclocking for details.”
Leadership Gaming Performance

Intel Core i9-13900K vs Intel Core i9-12900K

For all workloads and configuration see [www.intel.com/PerformanceIndex](http://www.intel.com/PerformanceIndex). Results may vary.
Leadership Gaming Performance

For all workloads and configuration see www.intel.com/PerformanceIndex. Results may vary.

<table>
<thead>
<tr>
<th>Game/Title</th>
<th>Ryzen 9 5950X</th>
<th>Core i9 12900K</th>
<th>Core i9 13900K</th>
<th>Ryzen 7 5800X3D</th>
</tr>
</thead>
<tbody>
<tr>
<td>World of Warcraft: Shadowlands</td>
<td>+6%</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Mount &amp; Blade II: Bannerlord</td>
<td>+16%</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Counter-Strike: Global Offensive</td>
<td>+16%</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Total War: Warhammer III</td>
<td>+19%</td>
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<tr>
<td>F1 2022</td>
<td>+27%</td>
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<tr>
<td>Far Cry 6</td>
<td>+31%</td>
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<tr>
<td>The Riftbreaker</td>
<td>+45%</td>
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<tr>
<td>Arcadegeddon</td>
<td>+52%</td>
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<tr>
<td>Marvel’s Spider-Man Remastered</td>
<td>+58%</td>
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</tbody>
</table>
Leadership Gaming Frame Consistency

Core i9-13900K delivers higher FPS at the 99th percentile low-water mark

As measured by benchmark mode score and/or fps measurements of 13th Gen Intel Core i9-13900K with internal reference board and DDR5 5600 MT/s DRAM and AMD Ryzen 9 5950X with Asus ROG Crosshair Hero 8 board and DDR4 3200MT/s DRAM. The configurations for all systems include Windows 11 Pro, 1920x1080 Resolution – High Quality Graphics Preset with EVGA RTX 3090 GPU.

For all workloads and configuration see www.intel.com/PerformanceIndex. Results may vary.
“We’ve been working with Intel for over a decade to deliver an incredible Total War experience on Intel CPUs. We’ve optimized Total War: WARHAMMER III for the hybrid 12th Gen architecture, and we’re excited to continue the work with the new 13th Gen Intel Core Processors.”

– Rob Bartholomew, CPO of Creative Assembly
“Working in partnership with Intel has allowed us to bring Call of Duty Modern Warfare II to even more players than before. Gamers from around the world running brand new PCs equipped with the latest Intel CPUs will be able to enjoy the best Call of Duty experience to date.

We’re excited to bring the latest Intel CPU technologies to support the Call of Duty family. Their work helped us raise the game’s performance to higher levels and meet expectations even from our most demanding and competitive players. This is essential for a AAA First Person Shooter, even more with the release of Call of Duty Modern Warfare II, launching later this year, October 28th.”

- Philippe Troie, Technical Director, Beenox
“Intel’s affordable CPUs featuring high thread count enable Oxide Games to use its proprietary, highly threaded Nitrous engine to bring experiences to gamers that have never been seen before.

Without Intel’s continued innovation, a game such as our upcoming Ara: History Untold would simply not have been possible.”

- Oxide Games Senior Representative
Leap in Performance for Content Creation

Leadership across various usages of content creation including photo & video editing & 2D, 3D modeling

For all workloads and configuration see www.intel.com/PerformanceIndex. Results may vary.
13th Gen Intel Core Desktop Processors
Powerful Multitasking for Creative Professionals

Media Creation
- Adobe Media Encoder + Adobe Photoshop

Game Development
- Blender + Unreal Engine

Photo Video Workflow

- Core i9 13900K: 27% faster than Core i9 12900K

- Core i9 13900K: 34% faster than Core i9 12900K

Lower is better

For all workloads and configurations, see www.intel.com/PerformanceIndex. Results may vary.
ISV Engagement
Optimizing performance and enabling features with software partners

“We appreciate the major leap forward that Intel’s 13th Gen processors deliver. Modern video editing, formats, and technologies demand more and more processing power, and can benefit greatly from the improved efficiency and power that comes with Raptor Lake and additional E-Cores.”
- Gary Rebholz, VEGAS Creative Software

“With Nuke 13.2 and the new top-down architecture we released a performance feature on modern CPUs – especially hybrid architecture, that allows our customers to speed-up their work up to 150% with the help from Intel”
- Jen Goldfinch, Senior Director of Industry Marketing, Foundry

“Faster! Impressive! We’ve worked closely with Intel on 13th-generation processors to provide Wondershare Filmora users with a great experience. We’re excited about Intel’s AI performance boost on next-generation platforms, leveraging technologies such as hybrid-core architecture optimization. Compared with the previous generation processor, the results of the 13th generation processor have improved the performance of Filmora AI features by 1.85 times.
- Liu Qiuwei, Wondershare Technology Group VP, GM of Video Creative Division
Intel’s Highest Overclocked Frequencies

Liquid Nitrogen (Extreme Cooling)
- P-Cores reaching well beyond the 8 GHz threshold!
- DDR5 speeds in excess of 10,000 MT/s
- Anticipating numerous new OC World Records

Liquid Cooled
- Higher OC frequencies with headroom similar to 12th Gen
- DDR5 XMP memory speeds ranging to 6,600 MT/s and beyond.

Higher frequency for Beginner, Intermediate, and Extreme Overclockers!
<table>
<thead>
<tr>
<th>Feature</th>
<th>Performance</th>
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</thead>
<tbody>
<tr>
<td>Up to 5.8 GHz</td>
<td></td>
</tr>
<tr>
<td>15% better ST</td>
<td></td>
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<tr>
<td>41% better MT</td>
<td></td>
</tr>
<tr>
<td>24% Better Gaming Performance</td>
<td></td>
</tr>
<tr>
<td>34% Faster Creator Workflow</td>
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<tr>
<td>70+ Top Gaming Titles</td>
<td></td>
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<tr>
<td>60+ Top Creator Applications</td>
<td></td>
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</table>

Claims as of Sept. 7, 2022. World’s Best Experience for DT Enthusiasts based on performance and unique features of unlocked 13th Gen Intel Core processors, including in comparison to 12th Gen Intel Core, AMD Ryzen 9 5950X and AMD Ryzen 7 5800X3D. For all workloads and configuration see [www.intel.com/PerformanceIndex](http://www.intel.com/PerformanceIndex). Results may vary.
Daniel Rogers
Sr Director, Mobile Product Marketing

Raptor Lake Technology
Raptor Lake
The Fastest Performance Core

Upgraded Intel 7 Process
3rd gen Intel SuperFin transistor
Significantly better channel mobility

Faster ‘Raptor Cove’ Core
Updated design with improved speed paths
Up to 600MHz faster

Larger L2 Cache
2MB L2 cache per core
New dynamic prefetcher algorithm “L2P”

Shifting the V-F Curve
- >50mV reduction iso-frequency
- +200Mhz iso-voltage
- +600MHz turbo
Raptor Lake
Double the Efficient-Cores

**Wider**
Up to 16 E-cores
4MB L2 per cluster

**Faster**
Up to 600MHz faster (ACT)
Up to 4.3GHz turbo

**Smarter**
Significantly optimized prefetcher algorithm
Raptor Lake
Better Memory Latency & Bandwidth

**Faster DDR5**
Up to 5600 MT/s with 1DPC
Up to 4400 MT/s with 2DPC

**Faster Fabric**
Up to 900MHz faster (ACT)
Up to 5.0GHz max turbo

**Larger LLC**
Up to 36MB shared L3
New dynamic inclusive/non-inclusive “INI”
Raptor Lake
Leading Performance

Single Thread Performance

- SPECrate2017_int_base 1 copy
- +15%

Multi Thread Performance

- SPECrate2017_int_base n copy
- +41%

Source: Intel. As estimated by measurements made using SPECInt_rate_base2017_IC2022.1 (1-copy & n-copy) using Intel validation Platforms comparing Core i9 13900K versus Core i9 12900K. Frequency includes enhancements to the CPU and the Fabric.

For all workload and configuration see www.intel.com/PerformanceIndex. Results may vary.
Raptor Lake
Scalable Performance per Watt

<table>
<thead>
<tr>
<th>Multi Thread Performance</th>
<th>241W</th>
<th>253W</th>
<th>241W</th>
<th>115W</th>
<th>65W</th>
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</thead>
<tbody>
<tr>
<td>Baseline</td>
<td></td>
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<tr>
<td>+41%</td>
<td></td>
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<tr>
<td>+37%</td>
<td></td>
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<tr>
<td>+21%</td>
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<tr>
<td>On Par</td>
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</table>

Similar performance at ~25% power

Source Intel: As estimated by measurements made using SPECint_rate_base2017 JC2022.1 (n-copy) using Intel validation Platforms comparing Core i9 13900K versus Core i9 12900K

For all workload and configuration see www.intel.com/PerformanceIndex. Results may vary.
Raptor Lake
Software Improvements

**Intel Thread Director**
Updated thread class boundaries (0,1,2,3) via machine learning techniques

**Windows 11 22H2**
Optimized handling of background services (utility QoS) vs. user-initiated background tasks (low QoS)

**Dynamic Tuning Technology**
Coming soon to mobile ... new core parking techniques
| Processor Number | Processor Cores (P+E) | Processor Threads | Intel® Smart Cache (L3) | Total L2 Cache | P-core Max Turbo Frequency (GHz) | E-core Max Turbo Frequency (GHz) | P-core Base Frequency (GHz) | E-core Base Frequency (GHz) | Unlocked | Processor Graphics | Total CPU PCIe Lanes | Max Memory Speed (MT/S) | Memory Capacity | Processor Base Power (W) | Max Turbo Power (W) | RCP (USD) |
|------------------|----------------------|-------------------|------------------------|----------------|-----------------|----------------|----------------|----------------|--------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|---------|
| i9-13900K        | 24 (8+16)            | 32                | 36MB                   | 32MB           | Up to 5.8       | Up to 4.3      | 3.0            | 2.2            | √       | Intel® UHD Graphics 770 | 20              | DDR5 5600 DDR4 3200 | 128GB         | 125              | 253              | 589             |
| i9-13900KF       | 24 (8+16)            | 32                | 36MB                   | 32MB           | Up to 5.8       | Up to 4.3      | 3.0            | 2.2            | √       | n/a            | 20              | DDR5 5600 DDR4 3200 | 128GB         | 125              | 253              | 564             |
| i7-13700K        | 16 (8+8)             | 24                | 30MB                   | 24MB           | Up to 5.4       | Up to 4.2      | 3.4            | 2.5            | √       | Intel® UHD Graphics 770 | 20              | DDR5 5600 DDR4 3200 | 128GB         | 125              | 253              | 409             |
| i7-13700KF       | 16 (8+8)             | 24                | 30MB                   | 24MB           | Up to 5.4       | Up to 4.2      | 3.4            | 2.5            | √       | n/a            | 20              | DDR5 5600 DDR4 3200 | 128GB         | 125              | 253              | 384             |
| i5-13600K        | 14 (6+8)             | 20                | 24MB                   | 20MB           | Up to 5.1       | Up to 3.9      | 3.5            | 2.6            | √       | Intel® UHD Graphics 770 | 20              | DDR5 5600 DDR4 3200 | 128GB         | 125              | 181              | 319             |
| i5-13600KF       | 14 (6+8)             | 20                | 24MB                   | 20MB           | Up to 5.1       | Up to 3.9      | 3.5            | 2.6            | √       | n/a            | 20              | DDR5 5600 DDR4 3200 | 128GB         | 125              | 181              | 294             |

Intel processor numbers are not a measure of performance. Processor numbers differentiate features within each processor family, not across different processor families.

The frequency of cores and core types varies by workload, power consumption and other factors. Visit https://www.intel.com/content/www/us/en/architecture-and-technology/turbo-boost/turbo-boost-technology.html for more information. Max Turbo Frequency for P-cores may include Intel® Thermal Velocity Boost and/or Intel Turbo Boost Max 3.0.

All SKUs listed above support up to DDR5 (5600 MT/S)/DDR4 (3200 MT/S) memory. See ark.intel.com for more specification details.
The World’s Fastest Desktop Processor
13th Gen Intel® Core™ i9-13900K

- Up to 5.8 GHz
- 15% better ST
- 41% better MT

- Up to 24% Better Gaming Performance

- Up to 34% Faster Creator Workflow

The World’s Best Gaming Experience
A Leap in Content Creation
Unmatched Overclocking Experience
Platform Innovation & Flexibility

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Notice and Disclaimers

Performance varies by use, configuration and other factors. Learn more at www.Intel.com/PerformanceIndex. Performance results are based on testing as of dates shown in configurations and may not reflect all publicly available updates. See www.Intel.com/PerformanceIndex for configuration details. For additional 13th Gen Intel® Core™ processor family details learn more at https://intel.com/13thgen.

No product or component can be absolutely secure. Your costs and results may vary.

Intel technologies may require enabled hardware, software or service activation.

6 GHz Wi-Fi 6E operation requires use of Intel® Wi-Fi 6E (Gig+) products in conjunction with operating systems and routers/APs/Gateways that support Wi-Fi 6E, together with regional spectrum allocation & required regulatory certifications. Visit www.intel.com/PerformanceIndex (connectivity) for details.

Altering clock frequency or voltage may void any product warranties and reduce stability, security, performance, and life of the processor and other components. Check with system and component manufacturers for details.

Results that are based on systems and components as well as results that have been estimated or simulated using an Intel® Reference Platform (an internal example new system), internal Intel analysis or architecture simulation or modeling are provided to you for informational purposes only. Results may vary based on future changes to any systems, components, specifications or configurations.

All information provided here is subject to change without notice. Contact your Intel representative to obtain the latest information.

1. Performance hybrid architecture combines two core microarchitectures, Performance-cores (P-cores) and Efficient-cores (E-cores), on a single processor die first introduced on 12th Gen Intel Core processors. Select 13th Gen Intel Core processors do not have performance hybrid architecture, only P-cores, and have same cache size as prior generation; see ark.intel.com for SKU details.

2. Built into the hardware, Intel® Thread Director is provided only in performance hybrid architecture configurations of 12th Gen Intel® Core™ processors; OS enablement is required. Available features and functionality vary by OS.

3. DDR5 Memory speeds are associated with 1DPC configurations. For additional 2DPC configuration details refer to the Alder Lake Processor External Design Specification (EDS), Doc ID 619501.

4. CPU PCIe 5.0 lanes are only validated for discrete graphics (x16) and PCIe storage (x4). x8 bifurcated to 2x8 provides discrete graphics (x8) + additional storage configuration support (x8).

5. Discrete Intel® Thunderbolt™ 4 (Maple Ridge) is only validated and supported from Intel® 600 and 700 Series Chipset PCIe lanes.

6. ‘Best in Class wired and wireless connectivity with Wi-Fi 6’: Intel® Wi-Fi 6 (Gig+) products support optional 160 MHz channels, enabling the fastest possible theoretical maximum speeds (2402 Mbps) for typical 2x2 802.12ax PC Wi-Fi products. Premium Intel® Wi-Fi 6 (Gig+) products enable 2-4X faster maximum theoretical speeds compared standard 2x2 (1201 Mbps) or 1x1 (600 Mbps) 802.12ax PC Wi-Fi products, which only support the mandatory requirement of 80 MHz channels. Gigabit Wi-Fi Requirements: To achieve speed of over 1 Gbps requires Gigabit internet service, router/gateway with either Wi-Fi 6 or 12ac with 160 MHz channel support, and PC with Intel® Wireless 9260/9560 or Intel® Wi-Fi 6 (Gig+) AX200/AX201.

7. CPU PCIe 5.0 lanes are only validated for discrete graphics (x16) and PCIe storage (x4). 1x16 bifurcation to 2x8 supported on select Intel® 600 and 700 Series chipsets.

8. Unlocked features are present with select chipsets and processor combinations. Altering clock frequency or voltage may void any product warranties and reduce stability, security, performance, and life of the processor and other components. Check with system and component manufacturers for details.

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