

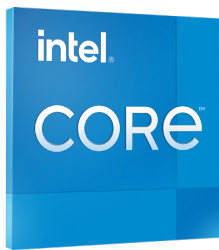
Product Brief



12th Gen Intel® Core™, Intel® Pentium® Gold,
and Intel® Celeron® Desktop Processors for IoT

Prioritize Performance with Revolutionary Hybrid Architecture at the Edge

Innovative performance hybrid architecture in 12th Gen Intel® Core™ desktop processors enhances single-thread and multithread performance while delivering AI acceleration for flexible IoT deployments.



Maximize performance for compute-intensive edge workloads and deploy robust, hardware-enabled AI and graphics acceleration. 12th Gen Intel® Core™ desktop processors deliver up to 16 cores and 24 threads—the highest core/thread count across IoT SKUs in the Intel® Core™ processor lineup—for IoT and mainstream applications. The platform drives PCIe 5.0–ready platforms and includes DDR5/DDR4 memory, PCIe 4.0 for flexible expansion, and a processor base power range of 35W to 65W for a balance of performance and efficiency. All IoT SKUs support long-life availability¹ and long-term software support for lasting value from IT/OT investments.

The first Intel Core processor to feature performance hybrid architecture

With performance hybrid architecture, 12th Gen Intel Core desktop processors represent Intel's largest leap in Intel Core processor architecture and performance in years, driving up to 1.36x faster single-thread performance and up to 1.35x faster multithread performance vs. 10th Gen Intel® Core™ processors.² This revolutionary chip design integrates up to eight Performance-cores, or P-cores, that enhance IoT workload consolidation and up to eight Efficient-cores, or E-cores, that enhance background task management and multitasking. Intel® Thread Director intelligently guides the OS to assign the right workload to the right core.

Enhanced graphics performance for immersive, engaging video

Deploy your most visually intensive, immersive, and engaging applications. The CPU design integrates up to 32 graphics execution units (EUs) based on Intel® UHD Graphics 770 driven by Intel® X^e architecture, delivering up to 1.94x faster graphics performance compared to 10th Gen Intel Core processors.² This is the first Intel Core desktop processor platform to introduce a fourth display pipe, allowing solution providers to deploy up to four independent 4K displays or up to 8K resolution in one display. For use cases that sync multiple displays in a video wall, the platform supports Genlock video synchronization for Windows to enable smooth playback and synchronization.

Fast AI with hardware acceleration and Intel® UHD Graphics 770

As AI becomes more prevalent across industries and use cases, 12th Gen Intel Core desktop processors help meet increased demand with up to 2.81x faster in GPU image classification inference performance.² The high-performance graphics architecture is well suited to AI workloads, allowing for greater parallelization with fast and efficient inference. AI builders also benefit from Intel® Deep Learning Boost (Intel® DL Boost), which provides hardware-based AI acceleration, and optimized inference from the Intel® Distribution of OpenVINO™ toolkit.

More connectivity with PCIe 5.0 and DDR5

Compared to previous generations with only PCIe 3.0 lanes, 12th Gen Intel Core desktop processors are PCIe 5.0 ready and also include PCIe 4.0 lanes for high-

What's new

- Performance hybrid architecture with up to 16 cores, 24 threads on Intel® 7 process technology
- Intel® Time Coordinated Computing (Intel® TCC) and Time-Sensitive Networking (TSN) supported on select CPU/PCH combinations
- Up to 16 lanes of PCIe 5.0 and four lanes of PCIe 4.0 on the CPU and 12 additional PCIe 4.0 lanes on the PCH
- Intel® UHD Graphics 770 driven by Intel® X^e architecture with up to 32 execution units (EUs)
- Support for up to four independent displays at up to 4K resolution or one display at 8K resolution
- Up to DDR5-4800 MHz memory
- Discrete Intel® Wi-Fi 6E and discrete Thunderbolt™ 4 support

<p>12th Gen Intel® Core™ desktop processors</p> <p>Compared to 10th Gen Intel® Core™ processors²</p>	<p>Up to</p> <h1>1.36x</h1> <p>faster single-thread performance²</p>	<p>Up to</p> <h1>1.35x</h1> <p>faster multithread performance²</p>	<p>Up to</p> <h1>1.94x</h1> <p>faster graphics performance²</p>	<p>Up to</p> <h1>2.81x</h1> <p>faster in GPU image classification inference performance²</p>
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10th Gen Intel® Core™ processors are the previous generation in this series for IoT. For workloads and configurations, visit intel.com/PerformanceIndex. Results may vary.

speed expansion cards or SSDs and a bigger data pipeline directly to the CPU. Support for up to DDR5-4800 and up to DDR4-3200 memory enables faster and more simultaneous applications, so IoT architects can push the limits of their deployments with converged, cost-efficient infrastructure. Select CPU/PCH combinations deliver high uptime and performance for embedded-use conditions.

Smooth operation and time-sensitive data processing in multidevice environments

12th Gen Intel Core desktop processors are the first Intel desktop processors with real-time capabilities in this series of processors. Select CPU/PCH combinations support Intel® Time Coordinated Computing (Intel® TCC) and

Time-Sensitive Networking (TSN) to help ensure smooth operation when connecting multiple edge devices, especially in industrial or logistics use cases that depend on time-sensitive data transmission. Intel provides tools, libraries, and APIs to help systems architects tune their real-time deployments, along with support for real-time operating systems and real-time hypervisors.

Help secure IoT devices and prevent tampering

Customers want to safeguard their embedded and desktop devices against on-site tampering and advanced digital threats. Intel® Converged Security and Management Engine (Intel® CSME) version 16 provides a root of trust with a manageability and security controller that's isolated from the CPU.

Key features

Performance

- Intel® 7 process technology
- Up to 16 cores, up to 24 threads in IoT SKUs
- Up to 30 MB Intel® Smart Cache
- Processor base power range of 35W to 65W
- Real-time capability (on select SKUs)
- One-board scalability: Choose any PCH and CPU from 12th Gen Intel Core desktop processors for IoT applications

Intel UHD Graphics

- Intel UHD Graphics 770 driven by Intel X^e architecture with up to 32 EUs
- Graphics and display virtualization
- Support for up to four independent displays at up to 4K resolution or one display at 8K resolution
- Up to two video decode boxes (VDboxes)

Accelerated AI

- Intel DL Boost with VNNI instructions on the CPU, int8/dp4 instructions on the GPU, and the Intel Distribution of OpenVINO toolkit to accelerate AI inferencing workloads

Memory and I/O

- Up to DDR5-4800, up to DDR4-3200
- Up to 16 lanes PCIe 5.0, up to four lanes PCIe 4.0 on the CPU
- Up to 12 lanes PCIe 4.0, up to 16 lanes PCIe 3.0 on PCH

Security and manageability

- Intel vPro® platform eligible on select SKUs
- Intel Converged Security and Management Engine version 16

Flexible deployments

- LGA socket scalability for IoT deployments
- Long-life availability¹ to support ongoing validation and certification in key markets
- IoT and mainstream products available
- Genlock video synchronization for Windows

Software

- Windows 10 IoT Enterprise 2021 LTSC
- Yocto Project Linux
- Celadon (Android) in VM (community support)
- KVM and ACRN (community support)
- UEFI, Slim Bootloader
- Software development kits

Connectivity

- Discrete Thunderbolt™ 4 or USB4
- Discrete 2.5GbE LAN
- Integrated Intel® Wi-Fi 5 (802.11ac) and support for discrete Intel Wi-Fi 6E with embedded-use conditions

Use cases

Retail, banking, hospitality, and education: Deliver rich experiences with converged infrastructure

Applications: Point of sale (POS), kiosks, video walls, and interactive flat panel displays (IFPDs)

- More cores and more threads enable workload consolidation for POS, IFPDs, digital security, and digital signage applications in small-format retail.
- The addition of a fourth display pipe allows customers to build video walls of 2x2 displays at 4K/60 fps or 4x4 displays at 8K by combining four SoCs. Genlock support on Windows helps ensure a smooth video wall experience.
- Higher performance helps enable touchless interactions and video POS object recognition for self-serve kiosks and checkout stations.
- Platform support for more simultaneous streams helps enable robust classroom analytics or audience measurement in digital signage.
- Accelerated AI enables smart retail deployments for rich customer engagement, streamlined inventory management, and digital security and safety.

Industrial manufacturing: Simplify complex controllers

Applications: Industrial PC, edge server, advanced controllers, machine vision box, and virtualized control platforms

- Powerful IPCs with more cores and threads drive more-complex workloads to deliver greater operational insights and production optimization.
- Optimized computer vision/AI inferencing with the Intel Distribution of OpenVINO toolkit enables IPCs connected to multiple HD cameras for anomaly detection or asset tracking.
- PLCs can use real-time capabilities to enhance time-sensitive operations.

Healthcare: More-efficient AI imaging to fuel diagnostics

Applications: Ultrasound imaging, medical carts, endoscopy, and clinical devices

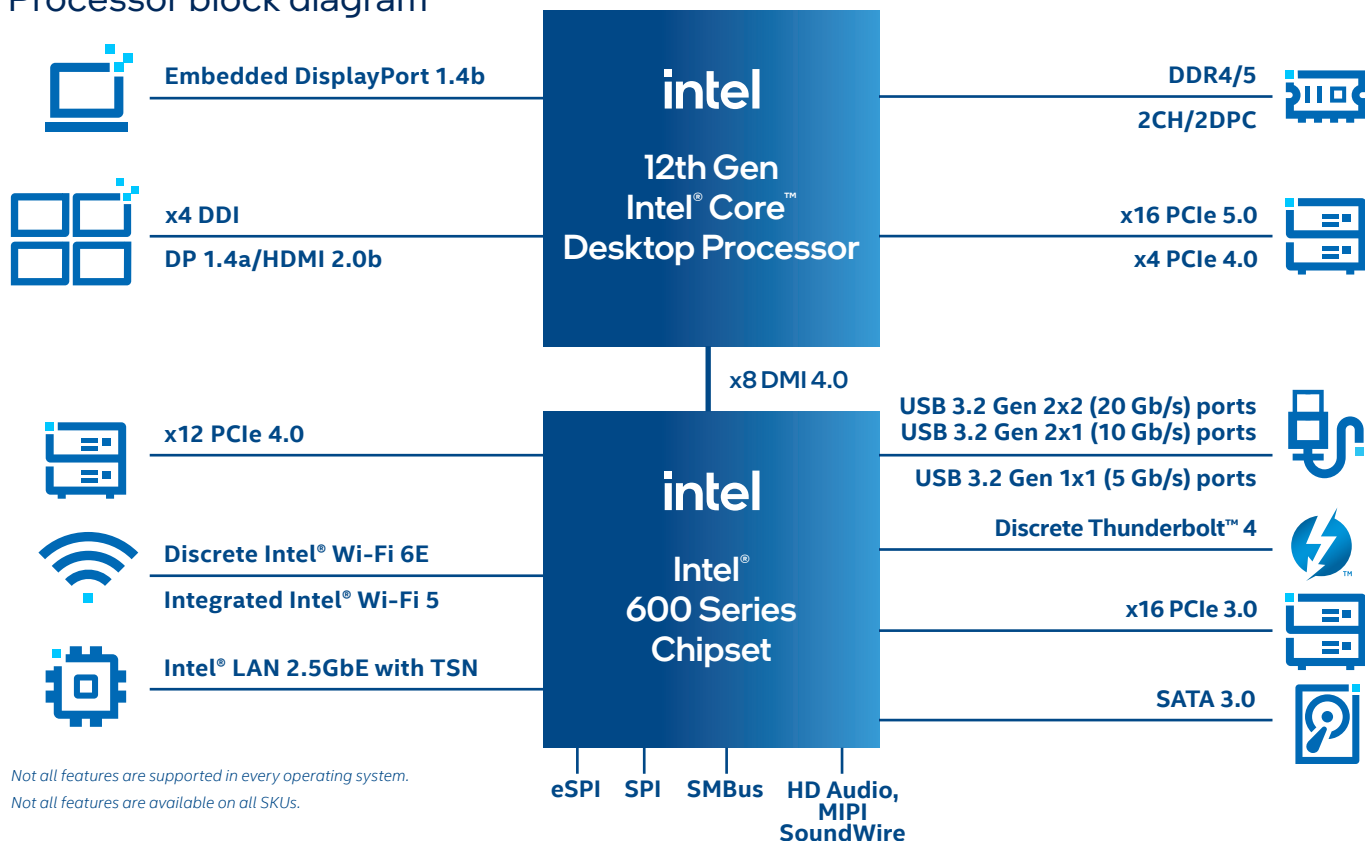
- Improved graphics performance and up to DDR5 memory with multiple PCIe 5.0/PCIe 4.0 lanes to the CPU contribute to greater data bandwidth and processing capability, allowing for enhanced imaging in ultrasound scans.
- Intel DL Boost and AI acceleration can assist with diagnostics and procedures.
- Long-life availability¹ helps medical systems leverage the most out of certification and regulatory approvals common in medical device development.

Video: Powerful graphics and memory accelerate AI use cases

Applications: AI box analytics, network video recorders (NVRs), and video walls

- Increase the channel density of AI video analytics and NVRs with Intel UHD Graphics 770 driven by Intel X^e architecture.
- Higher DDR5 bandwidth helps boost the throughput of memory-dependent AI models.
- Video walls benefit from four display pipes supporting 2x2 displays at 4K/60 fps or 4x4 displays at 8K by combining four SoCs.

Processor block diagram



Not all features are supported in every operating system.
Not all features are available on all SKUs.

Software overview

CATEGORY	OPERATING SYSTEMS/SDKS/BOOT LOADERS	IMPLEMENTATION	DISTRIBUTION AND SUPPORT
Operating Systems	Windows 10 IoT Enterprise 2021 LTSC	Intel	Intel, Microsoft
	Windows Server 2022 (Only Intel® Core™ i5-i9 processors with Intel® R680E chipset)	Intel	Intel, Microsoft
	Ubuntu, SuSe, Red Hat Enterprise, WR Linux ^b	Canonical Ltd., Attachmate Grp, Red Hat, and Wind River Systems	Canonical Ltd., Attachmate Grp, Red Hat, and Wind River Systems
	Yocto Project BSP tool-based embedded Linux distribution	Intel	Intel, Yocto Project community
	Celadon (Android) in VM	Intel	Celadon community
	Wind River VxWorks 7	Wind River	Wind River
Hypervisors	KVM, ACRN ^b	KVM, ACRN community	KVM, ACRN community
	RTS Hypervisor	Real-Time Systems	Real-Time Systems
Boot Loaders ^a	UEFI/BIOS and Intel® FSP	Intel	Intel, IBVs
	Slim Bootloader and Intel FSP	Intel	Intel, SBL community
SDK	Intel® oneAPI Video Processing Library (Intel® oneVPL)	Intel	Intel
	Intel® Distribution of OpenVINO™ toolkit	Intel	Intel
	Intel® oneAPI Toolkit	Intel	Intel
	Intel® TCC tools	Intel	Intel
	Intel® In-Band Manageability and Intel® Active Management Technology (Intel® AMT)	Intel	Intel

Not all features are supported in every operating system. Refer to Intel's IoT Solutions Community for partner contact information.

a. Legacy boot is not supported for Windows or Linux. Customers should work with their BIOS vendors for enabling/validating legacy BIOS features.

b. Supported by Intel via upstreaming to the open source community. Adoption into individual Linux distributions/hypervisors is dependent upon the OS/HV vendors.

12th Gen Intel® Core™ processor lineup

CPU Part Number ^a	CPU Category	Processor Cores (P+E) ^b	Processor Threads	Intel® Smart Cache (L3)	Processor Base Power (W)	Single P-core Turbo Freq ^c	Single E-core Turbo Freq ^c	GFX Execution Units	ECC	Intel vPro® Platform	Real Time	PCHs
Intel® Core™ i9-12900E Processor	IoT	16 (8+8)	24	30 MB	65	Up to 5 GHz	Up to 3.8 GHz	32 EU	Yes	Yes	Yes ^d	Intel® R680E, W680 chipsets
									No	Yes	No	Intel® Q670E, Q670 chipsets
									No	No	No	Intel® H610E, H610 chipsets
Intel® Core™ i9-12900TE Processor	IoT	16 (8+8)	24	30 MB	35	Up to 4.8 GHz	Up to 3.6 GHz	32 EU	Yes	Yes	No	Intel R680E, W680 chipsets
									No	Yes	No	Intel Q670E, Q670 chipsets
									No	No	No	Intel H610E, H610 chipsets
Intel® Core™ i9-12900 Processor	Mainstream	16 (8+8)	24	30 MB	65	Up to 5 GHz	Up to 3.8 GHz	32 EU	Yes	Yes	No	Intel R680E, W680 chipsets
									No	Yes	No	Intel Q670E, Q670 chipsets
									No	No	No	Intel H610E, H610 chipsets
Intel® Core™ i7-12700E Processor	IoT	12 (8+4)	20	25 MB	65	Up to 4.8 GHz	Up to 3.6 GHz	32 EU	Yes	Yes	Yes ^d	Intel R680E, W680 chipsets
									No	Yes	No	Intel Q670E, Q670 chipsets
									No	No	No	Intel H610E, H610 chipsets
Intel® Core™ i7-12700TE Processor	IoT	12 (8+4)	20	25 MB	35	Up to 4.7 GHz	Up to 3.6 GHz	32 EU	Yes	Yes	No	Intel R680E, W680 chipsets
									No	Yes	No	Intel Q670E, Q670 chipsets
									No	No	No	Intel H610E, H610 chipsets
Intel® Core™ i7-12700 Processor	Mainstream	12 (8+4)	20	25 MB	65	Up to 4.8 GHz	Up to 3.6 GHz	32 EU	Yes	Yes	No	Intel R680E, W680 chipsets
									No	Yes	No	Intel Q670E, Q670 chipsets
									No	No	No	Intel H610E, H610 chipsets
Intel® Core™ i5-12500E Processor	IoT	6 (6+0)	12	18 MB	65	Up to 4.5 GHz	—	32 EU	Yes	Yes	Yes ^d	Intel R680E, W680 chipsets
									No	Yes	No	Intel Q670E, Q670 chipsets
									No	No	No	Intel H610E, H610 chipsets
Intel® Core™ i5-12500TE Processor	IoT	6 (6+0)	12	18 MB	35	Up to 4.3 GHz	—	32 EU	Yes	Yes	No	Intel R680E, W680 chipsets
									No	Yes	No	Intel Q670E, Q670 chipsets
									No	No	No	Intel H610E, H610 chipsets
Intel® Core™ i5-12500 Processor	Mainstream	6 (6+0)	12	18 MB	65	Up to 4.6 GHz	—	32 EU	Yes	Yes	No	Intel R680E, W680 chipsets
									No	Yes	No	Intel Q670E, Q670 chipsets
									No	No	No	Intel H610E, H610 chipsets
Intel® Core™ i5-12400 Processor	Mainstream	6 (6+0)	12	18 MB	65	Up to 4.4 GHz	—	24 EU	No	No	No	Intel R680E, W680 chipsets
									No	No	No	Intel Q670E, Q670 chipsets
									No	No	No	Intel H610E, H610 chipsets
Intel® Core™ i3-12100E Processor	IoT	4 (4+0)	8	12 MB	60	Up to 4.2 GHz	—	24 EU	Yes	No	Yes ^d	Intel R680E, W680 chipsets
									No	No	No	Intel Q670E, Q670 chipsets
									No	No	No	Intel H610E, H610 chipsets
Intel® Core™ i3-12100TE Processor	IoT	4 (4+0)	8	12 MB	35	Up to 4.0 GHz	—	24 EU	Yes	No	No	Intel R680E, W680 chipsets
									No	No	No	Intel Q670E, Q670 chipsets
									No	No	No	Intel H610E, H610 chipsets
Intel® Core™ i3-12100 Processor	Mainstream	4 (4+0)	8	12 MB	60	Up to 4.3 GHz	—	24 EU	Yes	No	No	Intel R680E, W680 chipsets
									No	No	No	Intel Q670E, Q670 chipsets
									No	No	No	Intel H610E, H610 chipsets

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

B. Processor cores listed first are the total number of cores in the processor followed by the number of Performance-cores and number of Efficient-cores in parentheses (P+E).

C. Efficient-core frequencies are lower to optimize power usage. The frequency of cores and core types varies by workload, power consumption, and other factors.

D. Real-time capability only supported with Intel® R680E chipset.

Visit [intel.com/content/www/us/en/architecture-and-technology/turbo-boost/turbo-boost-technology.html](https://www.intel.com/content/www/us/en/architecture-and-technology/turbo-boost/turbo-boost-technology.html) for more information.

For product specifications, please refer to ark.intel.com.

Learn more about 12th Gen Intel Core, Intel® Pentium® Gold, and Intel® Celeron® desktop processors at intel.com/alderlake-s.



1. Intel does not commit or guarantee product availability or software support by way of road map guidance. Intel reserves the right to change road maps or discontinue products, software, and software support services through standard EOL/PDN processes. Contact your Intel account rep for additional information.
2. Performance results are based on testing as of dates shown in configurations and may not reflect all publicly available updates. For more complete information about performance and benchmark results, visit intel.com/PerformanceIndex.

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Not all features are supported in every operating system.

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Your costs and results may vary.

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

Performance hybrid architecture combines two new core microarchitectures, Performance-cores (P-cores) and Efficient-cores (E-cores), on a single processor die. Select 12th Gen Intel® Core™ processors (certain 12th Gen Intel® Core™ i5 processors and lower) do not have performance hybrid architecture, only P-cores.

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.

Intel® Advanced Vector Extensions (Intel® AVX) provides higher throughput to certain processor operations. Due to varying processor power characteristics, utilizing AVX instructions may cause, a) some parts to operate at less than the rated frequency and, b) some parts with Intel® Turbo Boost Technology 2.0 to not achieve any or maximum turbo frequencies. Performance varies depending on hardware, software, and system configuration, and you can learn more at intel.com/go/turbo.

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