Product Brief

PS Series of Intel® Core™ Ultra processors

Elevate edge innovation with power-efficient AI, graphics, and versatility combined

Deliver new levels of performance and efficiency with the latest power-efficient Intel® Core™ Ultra processors. These processors feature stunning graphics and advanced AI in a simplified system-on-chip (SoC) LGA package to support your demanding edge use cases. The LGA packaging enables faster time to market for build-to-order edge systems.

What's new

- Built-in Intel® Arc™ GPU[1] with up to 8 Xᵉ-cores
- Intel® AI Boost[2]
- Integrated NPU dedicated to AI

Support AI at the edge with a purpose-built, power-efficient SoC

Power up your competitiveness with the Intel® Core™ Ultra processor, a purpose-built platform for the advanced AI workloads that organizations need now. The versatile LGA socket-based SoC houses multiple compute engines that work together to accelerate inference at the edge. This unique architecture reduces the need for a discrete accelerator, simplifying system design and reducing cost.

Stream four 4K HDR displays concurrently with a built-in Intel® Arc™ GPU[1]

Consolidate systems and cut hardware costs in kiosks, terminals, and 4x 4K video walls. Intel® Core™ Ultra processors feature built-in Intel® Arc™ GPU[1] and the Intel® AI Boost (NPU) to help minimize the need for a discrete GPU. This generation supports up to 50 HDR video streams, delivers visuals in greater detail, and accelerates the popular AV1 codec in hardware for efficient compression.

Multiple AI engines enable power efficiency at the edge

Streamline your edge AI builds with platforms that deliver outstanding power efficiency that doesn't compromise on performance. Intel® Core™ Ultra processors feature built-in GPU and NPU in a single LGA package to help meet customer requirements with flexible configurations. This efficient SoC architecture delivers high performance for power-sensitive applications in space-constrained environments. Ideal for edge designs that require fanless or minimal cooling.

[1] Intel® Arc™ GPU only available on select HL Series, Intel® Core™ Ultra processor powered systems with at least 16GB of system memory in a dual-channel configuration. OEM enablement required; check with OEM for system configuration details.

[2] Limited enablement at launch.

Incredible AI for the edge

Take on challenging AI workloads at the edge with multiple compute engines working together: P-cores, E-cores, Intel® Arc ™ GPU,[3] and an integrated NPU called Intel® AI Boost.[4]

- Streamline operations with powerful AI and automation
- Use performance headroom to support data and business growth
- Support more multitasking and more apps

Intel® Core™ Ultra processors

Up to 3.13x	Up to 5.02x	Up to 3.85x
the graphics performance	faster in GPU image classification inference performance	faster in GPU object detection inference performance

vs Intel® Core™ desktop processor (14th Gen)[8]

The latest innovations in graphics and media

- Get built-in Intel® Arc™ GPU[3]—which is as powerful as entry-level discrete graphics—plus up to two 8K displays, 8K encode/decode, full hardware AV1 encode/decode, HDMI 2.1, Pipelock, bezel correction, and lock display.
- Engage customers with crisp visual experiences and video walls
- Support more video streams
- Run concurrent workloads across multiple virtual edge systems
- Get fast video streaming with hardware-accelerated AV1

Power-efficient design in an LGA package

- Drive LGA solutions into efficient space-constrained designs with built-in GPU and AI engines, enabling smaller form factors and fanless designs.
- Support compact, fanless designs for space-constrained applications with scalable power down to 12W
- SoC in an LGA package allows for single-board designs across the entire SKU stack
- Deploy efficient signage, HMI, and video walls with dual low-power embedded DisplayPort
- LGA flexibility helps reduce R&D cost, accelerate time to market, and enable future expansions and upgrades

[3] Intel® Arc™ GPU only available on select HL Series, Intel® Core™ Ultra processor powered systems with at least 16GB of system memory in a dual-channel configuration. OEM enablement required; check with OEM for system configuration details.
[4] Intel® AI Boost enablement limited at launch.
[8] Performance varies by use, configuration, and other factors. Learn more at intel.com/processorclaims: Intel® Core™ Ultra processors, Edge. Results may vary..

Key features

Performance
- Intel® 4 process
- Performance hybrid architecture in Intel® Core™ processors with Intel® Thread Director[9]
- Up to 16 cores and up to 22 threads
- Up to 24 MB Intel® Smart Cache
- 45W processor base power HL series with 35W to 65W assured power range
- 15W processor base power UL series with 12W to 28W assured power range

Accelerated AI
- Multiple compute engines in one SoC: P-cores, E-cores, Intel® Arc™ GPU[10] and Intel® AI Boost,[11] an integrated NPU dedicated to AI
- Intel® Deep Learning Boost (Intel® DL Boost) with DP4a instructions

Power efficiency
- Optimized power flows
- Dual low-power embedded DisplayPort

Graphics
- Built-in Intel® Arc™ GPU[10] with up to 8 Xᵉ cores (up to 128 graphics execution units)
- Hardware-accelerated AV1 encode
- Integrated DisplayPort 2.1 (USB-C) and HDMI 2.1
- Graphics system controller (GSC)
- Integrated Intel® Image Processing Unit
- Pipelock video synchronization for Windows with bezel correction and EDID management/lock display
- Up to 50 simultaneous HEVC HDR 10b 1080p30 video streams
- Up to four concurrent 4K60 HDR displays or two 8K displays
- Single root I/O virtualization (SR-IOV) for GPU virtualization

Memory and I/O
- Up to DDR5-5600
- Up to 20 lanes PCIe 4.0

Flexible deployments
- Socketed LGA package for flexible/compact designs
- Long-life availability of up to 10 years[12]

Security and manageability
- Elemental security engine (ESE)
- NIST 800-88r1 (storage media sanitization)
- Support for Intel vPro® platform on select SKUs

Connectivity
- 4x USB4/Intel® Thunderbolt™ 4 technology
- Validated with Intel-based discrete Wi-Fi modules (Intel® Wi-Fi 6E AX210)
- Bluetooth 5.3

Software and OS support
- Intel® oneAPI Tools for IoT, Intel® oneAPI Video Processing Library (oneVPL), Intel® Distribution of OpenVINO™ toolkit (validation to be completed in 2024)
- Windows 10 IoT Enterprise 2021 LTSC and Windows 11 IoT Enterprise 2024 LTSC (2H'24)
- Ubuntu, Red Hat Enterprise Linux, Wind River Linux
- Azure IoT EFLOW, Celadon (Android) in VM, and KVM virtual machine manager
- UEFI/BIOS + Intel® Firmware Support Package (Intel® FSP) and Slim Bootloader + Intel® FSP

[9] Support for Intel® Thread Director is expected in Windows 11 IoT Enterprise LTSC and Linux 6.x.

[10] Intel® Arc™ GPU only available on select HL Series, Intel® Core™ Ultra processor powered systems with at least 16GB of system memory in a dual-channel configuration. OEM enablement required; check with OEM for system configuration details..

[11] Intel® AI Boost enablement limited at launch..

[12] 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.

Use cases

Applications: Point of Sale (POS)/kiosks, self-checkout, digital signage, restaurant automation

- Built-in Intel® Arc™ GPU[13] with eight Xe cores (up to 128 graphics execution units) supports up to 4x 4K displays or 2x 8K displays, with Pipelock synchronization and bezel correction.
- Multiple compute engines in one SoC deliver powerful AI inferencing without a discrete GPU.
- Wi-Fi 6E enable high-quality audio system and wireless connectivity with less interference in device-rich environments.

Applications: Digital security and safety, network video recorders, roadside units

- Multiple compute engines—including Intel AI Boost[14]—in one SoC deliver fast AI and vision processing without an entry-level discrete GPU.
- Supports up to 50 simultaneous 1080p30 video streams.
- Long-life availability[15] extends the duration between upgrades for long-lasting devices in hard-to-reach field deployments.

Applications: Video conferencing, interactive whiteboards, thin clients, and remote classrooms or distributed workforce

- Multiple compute engines in one SoC deliver fast AI and vision processing without a discrete GPU and support up to 4x 4K displays or 2x 8K displays.
- The 15W–45W platform allows for innovative fanless cooling and designs that fit easily in constrained spaces.
- Long-life availability[15] ensures more value with a consistent supply of replacement parts and longer duration between upgrades.

Applications: AI-augmented industrial process control (AIPC), industrial PCs, human-machine interfaces (HMIs), machine control, microgrid controller

- Performance hybrid architecture, more cache, PCIe 5.0, and DDR5 memory drive platform consolidation and allow for more add-in cards.
- Low-power, 15-45W platform allow for innovative fanless designs that fit easily in constrained spaces.
- Long-life availability[15] ensures more value with a consistent supply of replacement parts and longer duration between upgrades.

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[14] Intel® AI Boost enablement limited at launch.

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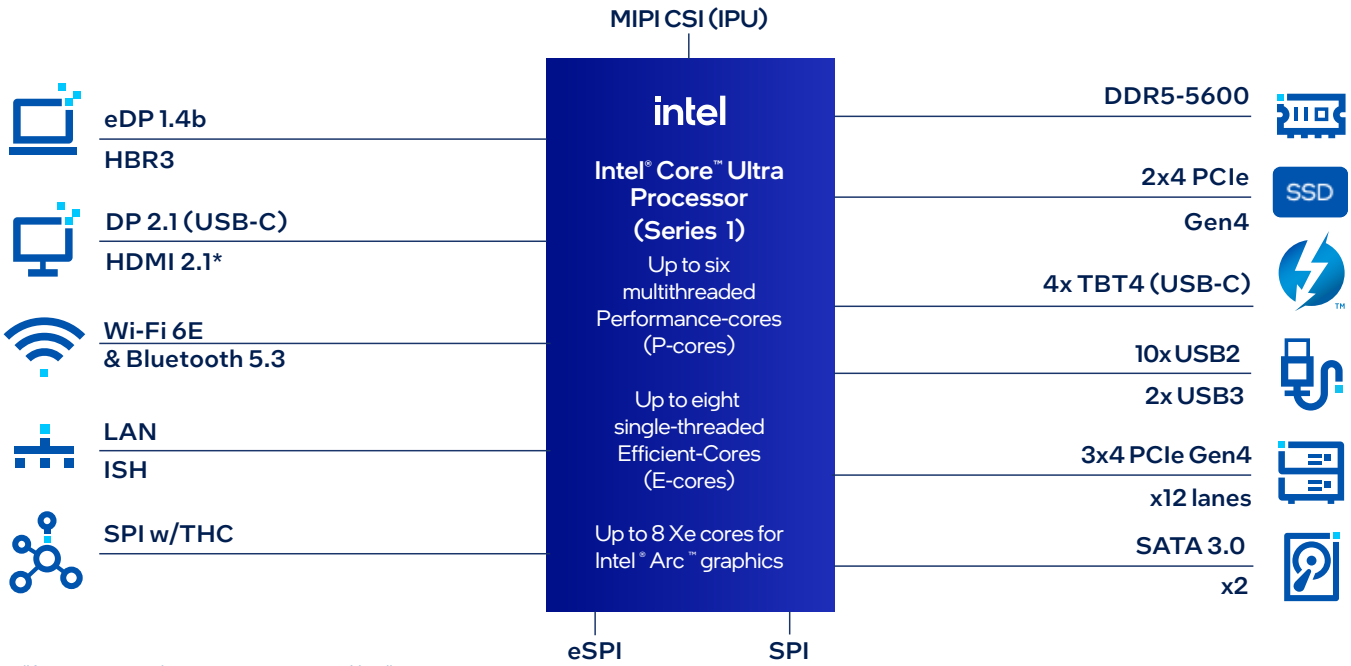
Processor block diagram



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

*HDMI 2.1 includes Fixed Rale Link (FRL) mode with support up to 12Gbps.

Software overview

CATEGORY	OPERATING SYSTEMS / SDKS / BOOTLOADERS	IMPLEMENTATION	DISTRIBUTION AND SUPPORT
Operating systems[1]	Windows* 10 IoT Enterprise 2021 LTSC Windows* 11 IoT Enterprise 2024 LTSC (2H'24)	Intel	Intel, Microsoft*
	Ubuntu*, Red Hat* Enterprise Linux*, Wind River Linux* [3]	Canonical Ltd., Red Hat & Wind River Systems	Distributed and supported by commercial Linux* vendors; Intel upstream kernel drivers
	Kernel Overlay & BKC	Intel	Intel, Linux* ISVs
	Celadon (Android*) in VM	Intel	Celadon community, ISV Partners
Hypervisors	KVM[3]	KVM	KVM community
Boot Loaders[2]	UEFI/BIOS and Intel® FSP	Intel	Intel, IBVs
	Slim Bootloader and Intel® FSP	Intel	Bootloader Ecosystem & SBL community
SDK	Intel® oneVPL (Video Processing Library)	Intel	Intel
	OpenVINO™ toolkit (validation to be completed in 2024)	Intel	Intel
	Intel® oneAPI toolkit	Intel	Intel
	Intel® In-Band Manageability and Active Management Technology	Intel	Intel

[1] Not all features are supported in all operating systems.

[2] Legacy boot is not supported for Windows* and Linux* OSes. Customers should work with their BIOS vendors for enabling/validating legacy BIOS features.

[3] Supported by Intel via the up-streaming to Open-Source Community. Adoption into individual Linux* distributions/hypervisors is dependent upon the OS/HV vendors.

*Other names and brands may be claimed as property of others

Intel® Core™ Ultra Processor SKUs

Intel® Core™ Ultra processors (HL Series, 45W base power)

Brand	Processor Number MM# Order Code	Processor Cores	Number of P-cores	Number of E-cores	Number of LPE-cores	Number of Threads	Intel® Smart Cache (L3)	Max Turbo Freq (GHz)[1] P-core	Max Turbo Freq (GHz)[1] E-core	Processor Base Freq (GHz) P-core	Processor Base Frequency (GHz) E-core	Graphics Max Freq (GHz)	Intel® vPro® Enterprise[2]	Version and Type of Firmware Support ME16		Processor Graphics	Number of Execution Units (EUs)	Video Decode Boxes	Total PCIe Lanes	Max Memory Speed	Max Memory Capacity	Processor Base Power (W)
Intel® Core™ Ultra7	165HL 99CGPF	16	6	8	2	22	24MB	5.0	3.8	3.1(@65W) 2.4 (@45W) 1.0 (@20W)	1.9	2.3	√	Corp	Consumer	Intel® Arc™ GPU[4]	128	2	Up to 20x PCIe Gen4	DDR5-5600	64GB	65W (Max Assured Power) 45W (Base Power) 20W (Min Assured Power)
Intel® Core™ Ultra7	155HL 99CGPD	16	6	8	2	22	24MB	4.8	3.8	3.0 (@65W) 2.4 (@45W) 1.0 (@20W)	1.9	2.25		Corp	Consumer	Intel® Arc™ GPU[4]	128	2				
Intel® Core™ Ultra5	135HL 99CGPG	14	4	8	2	18	18MB	4.6	3.6	3.2 (@65W) 2.8 (@45W) 1.0 (@20W)	2.3	2.2	√	Corp	Consumer	Intel® Arc™ GPU[4]	128	2				
Intel® Core™ Ultra5	125HL 99CGPC	14	4	8	2	18	18MB	4.5	3.6	3.0 (@65W) 2.5 (@45W) 1.0 (@20W)	2.0	2.2		Corp	Consumer	Intel® Arc™ GPU[4]	112	2				

Intel® Core™ Ultra processors (UL Series, 15W base power)

Brand	Processor Number MM# Order Code	Processor Cores	Number of P-cores	Number of E-cores	Number of LPE-cores	Number of Threads	Intel® Smart Cache (L3)	Max Turbo Freq (GHz)[1] P-core	Max Turbo Freq (GHz)[1] E-core	Processor Base Freq (GHz) P-core	Processor Base Frequency (GHz) E-core	Graphics Max Freq (GHz)	Intel® vPro® Enterprise[2]	Version and Type of Firmware Support ME16		Processor Graphics	Number of Execution Units (EUs)	Video Decode Boxes	Total PCIe Lanes	Max Memory Speed	Max Memory Capacity	Processor Base Power (W)
Intel® Core™ Ultra7	165UL 99CH60	12	2	8	2	14	12MB	4.9	3.8	2.7(@28W) 1.7 (@15W) 1.4 (@12W)	1.2	2.0	√	Corp	Consumer	Intel® Graphics	64	2	Up to 20x PCIe Gen4	DDR5-5600	64GB	28W (Max Assured Power) 15W (Base Power) 12W (Min Assured Power)
Intel® Core™ Ultra7	155UL 99CH5Z	12	2	8	2	14	12MB	4.8	3.8	2.7(@28W) 1.7 (@15W) 1.4 (@12W)	1.2	1.95		Corp	Consumer	Intel® Graphics	64	2				
Intel® Core™ Ultra5	135UL 99CH61	12	2	8	2	14	12MB	4.4	3.6	2.7(@28W) 1.6 (@15W) 1.4 (@12W)	1.1	1.9	√	Corp	Consumer	Intel® Graphics	64	2				
Intel® Core™ Ultra5	125UL 99CH62	12	2	8	2	14	12MB	4.3	3.6	2.7(@28W) 1.3 (@15W) 1.0 (@12W)	0.8	1.85		Corp	Consumer	Intel® Graphics	64	2				
Intel® Core™ Ultra3	105UL 99CH32	8	2	4	2	10	10MB	4.2	3.5	2.7(@28W) 1.5 (@15W) 1.0 (@12W)	1.0	1.8		Corp[3]	Consumer	Intel® Graphics	48	1				

[1] 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.
[2] Intel vPro® Enterprise includes Intel® TXT, Intel® Hardware Shield, Intel® AMT. Please refer to vPro brand requirements for full details (RDC #635949).
[3] Validated, but Intel® Active Management and other security features not available.
[4] Intel® Arc™ GPU only available on select HL-Series, Intel® Core™ Ultra processor powered systems with at least 16GB of system memory in a dual-channel configuration.
OEM enablement required; check with OEM for system configuration details.
For product specifications, please refer to ark.intel.com.

Start innovating at the edge today.

Learn more about the PS series of Intel® Core™ Ultra Processors at https://www.intel.com/coreultra-ps

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Performance results are based on testing as of dates shown in configurations and may not reflect all publicly available updates. See backup for configuration details. No product or component can be absolutely secure.

Intel® processors of the same SKU may vary in frequency or power as a result of natural variability in the production process.

All product plans and road maps are subject to change without notice.

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Not all features are available on all SKUs.

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 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 12th Gen and newer Intel® Core™ processors do not have performance hybrid architecture, only P-cores or E-cores, and may have the same cache size. See ark.intel.com for SKU details, including cache size and core frequency.

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