White Paper

Intel® Core™ Ultra Processors (Series 3)
Industrial and Robotics Division

Industrial and Robotics Innovation with Intel® Core™ Ultra Processors (Series 3)

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Intel Core Ultra processors (Series 3), previously codenamed Panther Lake, give solution providers a flexible, high-performance CPU built for rugged industrial and robotics applications. To advance solution capabilities at the edge, the processors enable consolidation of low-latency, safety and other mixed-criticality workloads with dedicated hardware resources for accelerated AI, time-coordinated computing and functional safety.[1]

Elevated intelligence at the edge is enabling transformative solutions for industrial computing. From control systems and robotics to semi-autonomous equipment, increasingly capable edge technologies provide the high-throughput, low-latency compute needed for innovative, forward-looking solutions. Intel® Core™ Ultra processors (Series 3) drive solution innovation with energy-efficient high performance, flexible AI acceleration and integrated enhancements.

Next-generation edge computing for AI and mixed criticality

Intel Core Ultra processors (Series 3) are engineered for high-throughput AI workloads at the edge, including safety-critical applications that demand minimal latency. Architectural enhancements drive up performance for all workloads, supported by a rich and open software and solutions ecosystem.

Accelerated edge AI is complemented by other edge-oriented features and capabilities, including extended-temperature operation, industrial reliability and long-life availability. The processors also feature silicon IP that enables deterministic, real-time performance and mixed criticality applications.

Execution

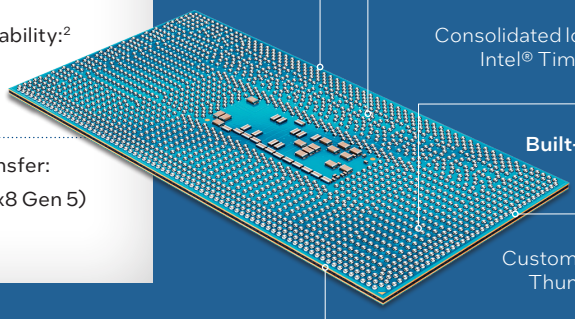
Architecture to support diverse workloads:
- **CPU** with up to 16 total P-core and E-cores
- **GPU** based on Xᵉ 3 architecture
- **NPU** for dedicated AI acceleration

Memory

High-speed, low latency, high reliability:[2]
- **LPDDR5** up to 8533 MT/s
- **DDR5** up to 7200 MT/s

I/O

Flexible high-bandwidth data transfer:
- **PCIe** up to 20 lanes (x12 Gen 4, x8 Gen 5)
- **Thunderbolt™ 4** (integrated)



Best-in-class CPU performance with up to **16 cores**; built-in GPU and neural processing unit **(NPU)** with up to **180 TOPS** for edge AI workloads

Industrial reliability and extended temperature support (dynamic temperature range up to **140° C**)

Consolidated low-latency, safety and other workloads using Intel® Time Coordinated Computing **(Intel® TCC) and Intel® Silicon Integrity Technology**

Built-in media IP accelerates video decoding and pre-processing, handling up to 51 streams of 1080p30 HEVC video

Customizable-expandable with up to **20 PCIe lanes**, Thunderbolt, **MIPI** CSI for camera, **BGA** package support, and long-life

Robotics

Automation Compute & Control

Test & Measurement

Industrial Controllers

Energy Generation & Distribution

Flexible AI resources: Hybrid processing architecture

Intel Core Ultra processors (Series 3) incorporate multiple AI inference engines within the system-on-chip (SoC) to handle local inference tasks. Assigning AI workloads to specialized execution resources allows dynamic adjustment of performance and power efficiency as needed.

- **CPU** (Central Processing Unit): Fast response for low-latency AI workloads (e.g., low-latency object detection)
- **GPU** (Graphics Processing Unit): High throughput for accelerated large AI workloads (e.g., video analytics, robotics AI vision, AI language workloads)
- **NPU** (Neural Processing Unit): Power efficiency for sustained AI workloads (e.g., smart robotics and automation)

Heavy workloads can be divided into smaller tasks and distributed across multiple inference engines to enhance overall performance.

Real-time and AI at the edge with Intel® Time-Coordinated Computing (Intel® TCC)

Intel TCC is a comprehensive set of optimizations throughout the platform from silicon to network stack that enables highly deterministic behavior for real-time workloads while supporting high-performance AI. When combined with endpoint connectivity that supports IEEE 802.1, Time-Sensitive Networking (TSN) provides precise timing with bounded low latency and jitter for time-critical workloads distributed across a network.

Streamlined implementation of functional safety (FuSa)

A ready path to FuSa implementation improves the efficiency and effectiveness of mitigating risks to people, equipment or the environment associated with faults and malfunctions. Enabling resources include Intel® Silicon Integrity Technology, a set of SoC hardware/firmware-based integrity-related features that work in conjunction with the system BIOS to support FuSa solutions in manufacturing, robotics, avionics and other markets. Specific FuSa technical collaterals are available in documentation packages such as the Intel® Functional Safety Essential Design Package (Intel® FSEDP), which provides SoC information relevant to IEC 61508 and ISO 13849. These capabilities are essential to the future of truly autonomous systems.

Cross-industry use cases

Intel Core Ultra processors are a robust, forward-looking foundation for industrial computing. They deliver energy-efficient high performance for rugged media, AI and mixed-criticality applications at the edge, with long-life availability. This section introduces a few of many target use cases to demonstrate the processor's breadth of suitability.

INDUSTRIAL CONTROLLERS

Applications: Human-machine interface, programmable logic controllers

Focus: High performance, low power, FuSa, extended-temperature operation

AUTOMATION COMPUTE AND CONTROL

Applications: Industrial PCs and gateways, high-end automation and machine controllers

Focus: Intel® TCC, low power, extended availability, in-band ECC, machine learning and computer vision[3] in automation

ROBOTICS

Applications: Industrial robot arms, collaborative robots, AGVs and AMRs, robot vision controllers

Focus: Low-latency AI and computer vision, functional safety, high performance, low power

TEST AND MEASUREMENT

Applications: Automated test equipment, PXI embedded controllers, optical inspection systems

Focus: High performance, PCIe Gen 5 accelerated data acquisition, high memory bandwidth

ENERGY GENERATION AND DISTRIBUTION

Applications: Substations and smart microgrids

Focus: Security, high performance, industrial reliability, accelerated edge AI

Conclusion

With Intel Core Ultra processors (Series 3), industrial and robotics applications have a flexible foundation for high-throughput, low-latency workloads at the edge. A rich and open software ecosystem takes advantage of the hybrid CPU/GPU/NPU silicon architecture to optimize the balance between performance and power efficiency for local AI inference. The processor delivers power-efficient performance to transform and innovate across industries.

Learn More:

Intel technologies power the next generation of industrial solutions with work across the ecosystem that extends silicon innovation into mission-critical implementations.

Intel® Core™ Ultra processors

Intel® Solutions for Industry 4.0

[1] Available on select SKUs.

[2] Speeds vary based on processor SKU, T3 vs T4 board and memory topology (SO-DIMM, LP down, LP-CAMM).

[3] Machine Learning (ML) is a subset of artificial intelligence that enables systems to learn patterns from data and improve performance over time without being explicitly programmed. Computer Vision (CV) combines ML with image processing to enable machines to interpret and understand visual information from the world such as images and videos.

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