ADLINK
LEADING EDGE COMPUTING

Intel® Meteor Lake and COM Express Type 6: Fewer Components, More Efficiency, Greater Value

Technical Highlights of Intel Meteor Lake

The Intel® Core™ Ultra processor incorporates multiple architectural innovations, including its integrated Intel® Arc™ graphics, which nearly doubles performance per watt (PPW) compared to previous-generation integrated GPUs. With up to 8 Xe cores, the Intel Arc™ provides the performance of an entry-level discrete GPU, eliminating the need for separate graphics cards in many embedded designs.

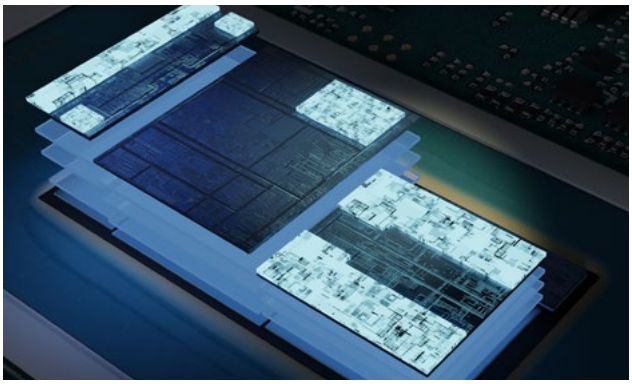
For AI workloads, Meteor Lake integrates three distinct AI engines designed to handle different computational tasks:

- GPU: Delivers up to 18 TOPS (Tera Operations Per Second) for high-throughput data processing.
- NPU: Provides 11 TOPS, with up to 2.56x improved AI performance per watt compared to the previous generation, for maximum efficiency.
- CPU: Adds an additional 3 TOPS for general-purpose AI tasks.

Together, these engines offer a combined AI performance of up to 32 TOPS, providing high computational throughput and energy efficiency. This architecture makes Meteor Lake an ideal choice for power-sensitive, high-performance applications, with the added benefit of delivering 30–50% greater power efficiency than its predecessors.

Abstract

Edge computing OEMs are seeking increased performance and graphics capabilities in smaller physical footprints with fewer thermal management challenges and longer battery life. The cExpress-MTL COM Express Type 6 module, powered by Intel® Meteor Lake processors, addresses these needs through extreme integration of CPU, GPU, and NPU on a single chiplet. This integration dramatically improves graphics and AI performance per watt (PPW), and the module's PCIe 4.0 connectivity streamlines the integration of additional accelerator cards, ensuring a forward migration path for higher performance edge computing. This off-the-shelf module enables OEMs to reduce design complexity, lower power consumption, improve reliability, and minimize total cost of ownership (TCO) for next-generation applications such as medical imaging.



Introduction: The Need for Simpler Integrated Solutions

Edge computing and IoT applications are reaching a critical juncture where traditional hardware architectures are no longer sufficient. Modern workloads require a mix of complex computing, sophisticated graphics, and cutting-edge AI. This demanding combination is pushing the limits of traditional CPUs, forcing designers to add GPU cards and other peripherals to meet system requirements.

The challenge with these additional components is that they significantly increase system complexity, driving up costs, increasing power consumption, expanding physical footprints, and generating excess heat. These factors make the design process more complex and costly while compromising reliability and scalability.

Intel® Meteor Lake, also known as Intel® Core™ Ultra processors, offers a more streamlined approach by integrating CPU, high-performance graphics (GPU), and AI acceleration (NPU) into a power-efficient chiplet. These processors, available on the cExpress-MTL COM Express module, provide outstanding computational and graphics performance in a compact 28W board, making them ideal for battery-powered systems, edge devices, and environments requiring low power consumption.

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Application Example: Medical Imaging



Medical imaging applications, including ultrasound devices, dental scanners, and ophthalmology systems, increasingly rely on advanced AI and image processing capabilities to deliver real-time diagnostics. Traditionally, these devices required separate graphics cards and AI accelerators to meet their performance needs. This not only increased the complexity and cost of the systems but also expanded their physical size and power requirements.

With Intel Meteor Lake's integrated CPU, GPU, and NPU, medical imaging systems can now handle high-resolution image processing and real-time AI analytics on a single chiplet. This eliminates the need for additional hardware, reducing the overall system footprint, improving reliability, and simplifying design. The Meteor Lake chiplet's built-in AI capabilities also enhance real-time diagnostic imaging, enabling faster and more accurate detection of medical conditions such as tumors and tissue abnormalities. For instance, in ultrasound imaging, the AI engine can enhance image reconstruction and processing, leading to clearer, more detailed images that assist physicians in diagnosing patients more efficiently.

In dental imaging, AI algorithms can assist with tasks such as identifying cavities, assessing bone structure, and planning orthodontic treatments with greater precision. Similarly, ophthalmology equipment benefits from integrating advanced AI models that aid in detecting conditions like glaucoma and macular degeneration at earlier stages. By incorporating Intel Meteor Lake's processing power into medical imaging devices, manufacturers can reduce heat generation, improve reliability, and extend the operational lifespan of their products, while also lowering maintenance costs.

Advantages of Integration

The key advantage of Intel Meteor Lake processors lies in their heterogeneous architecture, which integrates CPU, GPU, and NPU in a single package. This high level of integration reduces the need for additional discrete accelerators, enabling substantial power efficiency improvements while simplifying system complexity. By eliminating external GPUs and AI accelerators, Meteor Lake decreases the overall system footprint and simplifies thermal management, allowing for more compact and efficient designs.

In terms of performance, Intel Meteor Lake processors deliver up to 1.81x the graphics performance and up to 1.5x the AI performance compared to the 13th generation Intel Core processors. This performance boost allows developers to scale their designs to meet the demanding requirements of complex applications in fields such as medical imaging, AI-driven analytics, and high-performance edge computing. Additionally, leveraging the cExpress-MTL module ensures that users of existing COM Express Type 6 boards can easily upgrade their systems, reaping the benefits of the latest AI accelerators and Intel Arc graphics without needing to overhaul their entire system architecture.



ADLINK cExpress-MTL: Simplifying System Design

ADLINK's cExpress-MTL COM Express Type 6 module integrates Intel Meteor Lake processors and other critical system components into a single, compact package. This module offers the following key features:

- PCIe Gen4 signaling for all connections: Ensures fast data transfer and supports future upgrades with high-performance peripherals.
- 2.5GbE Ethernet with optional TSN support: Provides reliable, low-latency network connectivity, making the module ideal for real-time applications such as industrial automation and smart cities.
- 2x USB4 (optional): Allows for high-speed peripheral connections and supports a wide range of devices.
- Up to 96GB DDR5 memory with in-band ECC/non-ECC support: Delivers fast memory access and error correction, ensuring reliability in mission-critical applications.

As a pre-integrated, off-the-shelf module, the cExpress-MTL significantly reduces design complexity, shrinks system footprints, and shortens time-to-market. For developers using the PICMG COM Express Type 6 pinout, the cExpress-MTL offers a seamless upgrade path without the need for a full system redesign. The module's eight PCIe Gen4 connections also allow for future expansion, enabling the integration of additional accelerators or other high-performance devices to meet evolving system requirements.

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Development Kit: Accelerating Productivity

To help developers accelerate product development and bring solutions to market faster, ADLINK offers the I-Pi development kit for the cExpress-MTL. This comprehensive kit includes:

- Intel® Core Ultra 5 processor “125H” (Meteor Lake-H).
- Housed on an Express-Base-6-R3.1 carrier.
- THSF-cMTL-B heat sink with an active fan for effective heat dissipation.
- DB30 x86 debug board with corresponding connections for troubleshooting.
- Cable set, including SATA cables and pin header to DB9 adapter cables for the COM port.

The I-Pi development kit provides developers with a fully functional platform for rapid prototyping, enabling them to test and optimize their designs quickly. With support for a wide range of peripheral connections and advanced debugging tools, developers can streamline the transition from prototype to production, reducing development time and cost.



Conclusion and Key Takeaways

The cExpress-MTL addresses critical design challenges related to system complexity, power efficiency, and space constraints by integrating CPU, GPU, and AI processing into a single module. This makes it an ideal solution for forward-looking, compute-intensive applications such as medical imaging, autonomous systems, and AI-driven analytics. By incorporating Intel Meteor Lake’s advanced AI and graphics capabilities, the cExpress-MTL offers significant improvements in performance, reliability, and cost-efficiency.

For developers, ADLINK’s I-Pi development kit provides a ready-to-use platform that accelerates prototyping and reduces time-to-market. The combination of advanced processing power and simplified system design makes the cExpress-MTL an essential tool for OEMs and integrators looking to build next-generation embedded systems. To learn more about the cExpress-MTL and how it can simplify your system designs, visit ADLINK’s website or contact their team for further information.

Tel: +886-3-216-5088
Fax: +886-3-328-5706
Email: service@adlinktech.com
www.adlinktech.com

www.adlinktech.com

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