White Paper

Advanced High-Performance Processors for Embedded Computing

Key Features of 4th Generation Intel® Processors and related AAEON Embedded Platforms

Overview:

The recent release of the 4th Generation Intel® Core™ processors ushers in a new phase of high performance computing and represents a definitive move towards highly integrated platforms. Powerful processing architecture enables newly developed embedded systems to have lower power consumption, improved thermals, higher performance and enhanced onboard graphics capabilities. The Intel 22nm manufacturing process introduced with the previous 3rd Generation micro-architecture has been extended with the release of the latest series of Core Processors. The new series adds form factor advancements with respect to the range of bench-mark setting performance and energy efficiency capabilities. For developers, this 4th Generation represents a tock in Intel's "tick-tock" release cycle. For those not familiar with the "tick-tock" cycle: a "tick" represents the shrinking of the process used to build chips while a "tock" is the building of a new micro-architecture. This new micro-architecture creates opportunities for system integrators as embedded and modular computing systems incorporate better computational capability, graphics processor unit (GPU) enhancements, Scenario Design Power (SDP), robust platform-based security, and enhanced power management features. These advances allow for new system configurations, applications and operating environments. This paper will address how system developers can best leverage the performance and power saving advantages of the 4th Generation of advanced computing components.

High-Performance Embedded Computing for Intelligent Systems:

Embedded computing hardware for intelligent systems increasingly finds placement in environments that require higher tolerance with respect to temperature fluctuations, higher processing power, integratedsecurity features and real time task performance in both stationary and mobile systems in ever smaller form factors. Power management in intelligent systems is closer to the edge of the energy-operation threshold than general-purpose systems. For these reasons,advanced systems are engineered to meet a rigorous set of requirements that enable them to be used in complex factory automation configurations, transportation tracking, communications and guidance system deployments, medical equipment for real-time vitals monitoring and imaging, network monitoring and control systems, field computing applications, digital signage controllers, financial services, POS, Government and a range of other modern deployments.

The challenge of developing system components to meet the varied demands of these industries requires constant innovation and optimization. At the core of these developments are the advancements in processor micro-architecture.

Intel Micro-architecture Enhancements

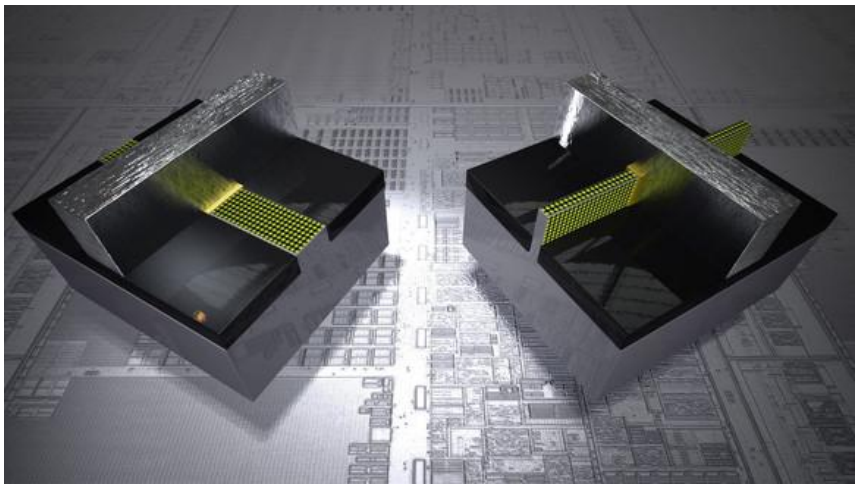
Intel's newest generation of Core processors represent a 13-15% performance improvement over the previous generation which was already a 10% improvement over its predecessor.

Therefore, the 4th Generation Core processors provide a 25% overall gain over the Core processors that were considered mainstream just over 12 months ago while at the same time using far less power.

4th Generation Intel Two Chip Solution

This is a very significant development for the IPC industry as a whole. These newer CPUs retain the x86 class configurations so that companies such as AAEON can continue to provide long-term product support and smooth migration paths for customers and applications served in the industrial PC markets. According to Intel, this new line of processors represents the biggest single generational gain in power efficiency in the history of their x86 PC processors offering. The low voltage CPU package incorporates the I/O functions of the Platform Controller Hub (PCH) that includes the storage interface, Super Speed USB and Security functions onto the packagewith a multi-core processor and graphics controller.

Intel has also launched a new set of "8 series" chipsets including the QM87, Q87, H87 and H81.



Planar vs 3D Tri-Gate transistors, the increased surface area offers more control over current for power efficiency and higher clock speeds

Some of the Major Advances for the 4th Generation Processors with the New Architecture Include:

Fully Integrated Voltage Regulator:

The inclusion of the FIVR helps by reducing the number of separate voltages required from the onboard voltage regulators. This enables component reduction leading to greater flexibility in the board layout.

- **Idle (standby) Power Reduction:**

Reduced by 20X over the previous generation. Architected new, ultra-low-power processor states.

- **Power Optimizer:**

Manages power consumption for the platform (entire device).

- **Active Power Reduction:**

Aggressive use of lower-power circuits.

- **Power Planes:**

Added new power planes that can shut down most of the CPU transistors in standby mode.

- **Transistor Leakage Minimization:**

Excessive leakage, which wastes power, is a big problem as transistors get smaller. Using Tri-Gate (3D) transistors, Intel was able to reduce the leakage of the transistors by a factor of two to three, without impacting performance.

- **Lowered Minimum Operating Voltage:**

The reduction in operating voltage reduces the active power requirement

Intel vPro™ Technology and Hardware Based Security

As today's business PCs are placed under increasingly demanding workloads in order to maintain competitive levels of productivity, they must be able to access an array of communication methods securely and quickly while providing a high level of computational performance in other areas. Many threats and vulnerabilities create risk for a business enterprise with constant potential for attacks that may result in system failures. To address this issue, Intel has continued its development of enterprise-ready security systems based on its 4th Generation Intel Core vPro processors which are engineered to help protect critical data with advanced, embedded security technologies combined into a single high-performance, business system. Intel vPro is a set of built in technologies that provide security and management features such as remote access to the computer (including monitoring, maintenance, and management) independent of the state of the operating system or power state of the computer.

A Core i5 or i7 computer featuring vPro Technology can take advantage of a number of integrated components that reduces the amount of distinct elements in the system for overall performance enhancement. These include the following elements.

- **Threat management, including protection from rootkits, viruses, and malware**
- **Identity and website access point protection**
- **Confidential personal and business data protection**
- **Remote and local monitoring, remediation, and repair of PCs and workstations**

vPro supports remote configuration technology for Active Management Technology (AMT) on systems before the OS and/or software management agents are installed. With AMT, administrators can remotely manage and secure computers out-of-band even when the power is off, or when the OS is inaccessible for various reasons, such as system crashes, or if there are corrupted or missing files that impede normal functions. AMT 9.0 allows for system updating, locking, restoration and remote wiping for enhanced security and threat mitigation. 4th Generation vPro systems have greater operational efficiency for the remote management of computers, and administrators are now able to better service a broader range of devices at lower costs irrespective of their location. From this, businesses can achieve uninterrupted service and uncompromised performance and productivity even in the course of repair and maintenance work. New manageability features such as Enhanced Keyboard Video Mouse Remote Control offers full remote diagnostic, repair and updating of systems from anywhere at any time, even if the operating system is unresponsive.

vPro offers safety features such as Intel Identity Protection Technology (Intel IPT)5: embedded one-time password, built-in public key infrastructure (PKI), and protected transaction display. These protect valuable data and

confidential business, customer and employee information and allow for faster responses to security breaches. Combined, these two powerful features deliver the most advanced security and maintenance features to date and offers greater control for enterprise IT managers.

AAEON's Hi-Manager and Intel vPro Technology

AAEON's Hi-Manager software works in tandem with the features of vPro technology and enables user BIOS-level remote management of their products when the technician is not physically present at the site. The software can be used to separate devices into logical groups that can be managed over an Ethernet connection. A group of retail digital signs or POS/POI devices spread across a shopping mall or campus for instance,can be accessed and serviced remotely utilizing this powerful software. Hi-Manager is based on the Intel Active Management Technology 9.0 (AMT 9.0) and has backward compatibility with earlier versions of AMT. This allows users to locate all AMT devices within the intranet, power On/Off target devices remotely, set power On/Off scheduling, arrange device groupings for better management, offer event logs and timer settings to wake up devices at specified times, and even recover systems that have crashed. It also allows remote hardware level KVM management and access to target device hardware information for asset management. Hi-Manager can be installed on all AAEON platforms and can remotely manage AAEON client devices that use Intel Q87, Q77, or QM87, QM77 chipsets and run Microsoft® Windows® XP or Windows® 7 Operating Systems.

Intel Advanced Vector Extensions (Intel AVX) 2.0 and (Intel AMT)

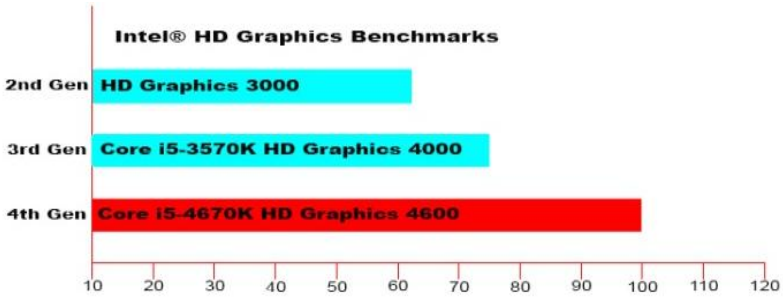
With a wide array of performance stages, the 4th Generation Intel Core processors are well-suited for a host of applications ranging from those that are computationally-intensive and graphics intensive to those that are thermal sensitive and I/O demanding. Features are available to accommodate all of these working environments. Industrial computers, transportation control systems, servers, POI and POS terminals can take advantage of features like the AVX 2.0 extension with optimized instructions that deliver enhanced performance on floating point–intensive applications. AVX 2.0 adds 256-bit integer instructions and new instructions for FMA (Fused Multiply Add). FMA delivers improved performance on media and floating point computations, including medical imaging, high-performance computing, video compression and data encryption. Operators in applications requiring network connectivity will be able to more effectively utilize remote management, update, troubleshoot, repair and protection functionality for networked computing assets with the updated Intel Active Management Technology.

4th Generation GPU Technologies

Intel has been making significant strides in designing more powerful GPUs that can compete and in an increasing number of cases exceed the processing performance of some

dedicated graphics cards. The 3rd Generation Intel HD graphics 4000 introduced support for three independent displays allowing devices like embedded box controllers for digital signage to offer High Definition multi-screen imaging while maintaining their compact form factors. In addition, 4X Multi-Scene Anti-Aliasing was given optimized hardware support for better power management while decoding video. The new Intel HD Graphics 4600 has been extensively enhanced in comparison to the HD 4000 with rendering support expanded to DirectX 11.1, OpenGL 4.0 and Open CL 1.2, which is a framework that allows even mobile devices to playback 4K2K videos at resolutions of up to 3,840 by 2,160. The decoder for ultra HD 4K videos has been upgraded along with the Quick Sync encoder. Benchmarking the previous HD 4000 against the 4th Generation HD 4600 reveals up to twenty-five percent performance gains due to expansive architecture improvements and the placement of 20 execution units on the HD 4600 Chip as opposed to only 16 on the HD 4000. This puts it in direct competition with discreet graphics cards in its ability to deliver superb visuals across multiple displays. One of the best aspects of the redesigned GPU is that it provides this dramatic performance increase while still maintaining relatively low power consumption. The HD 4600 has a range of 37-57 Watt TDP depending on the processer. It can support up to DDR3-1600 at clock speeds of up to 800Mhz and a core clock speed of 400Mhz.

For the end user, the noticeable difference is in the Graphics 4600's ability to provide a



25% performance gain with Intel® HD Graphics 4600

smoother and more efficient experience when processing graphical information over its predecessor.

Hardware-Based Security

With Intel Advanced Encryption Standard New Instructions (Intel AES–NI), networked content can be more secure by utilizing a host of available encryption applications. These applications include storage encryption, conditional access of HD content, and internet security to protect against system intrusions from malware and internet and email content, while providing faster and more effective disk encryption. This optimizes mission-critical system functionality in conjunction with the Intel BIOS Guard technology that addresses the threat of malware to BIOS flash storage. BIOS flash is shielded from modification without platform manufacturer authorization, thereby offering a defense against low-level DoS (Denial-of-Service) attacks. It is able to restore the BIOS to a known good state following an attack. This further ensures system-wide integrity for industrial operations and critical infrastructure applications.

4th Generation Intel Core Technology COM Express Module

In line with the release of the 4th generation Intel Core processor family based on 22nm process technology, AAEON introduces the latest COM Express Module, the COM-QM87. The new module is designed to meet the requirements of applications in healthcare, entertainment, government, and advertising industries among others. This COM Express module with pin-out type 6 (basic form factor) employs a 4th Generation Intel Core processor and mobile Intel QM87 Express chipset, using less power while providing enhanced graphics performance over previous COM Express modules. The two on-module SODIMM sockets support up to 16GB of DDR3 system memory and data storage is achievable through support for up to four SATA 3.0 ports. The Intel Gigabit Ethernet controller provides not only for demanding networking applications, but also supports manageability through AMT 9.0. Additionally, this module supports a number of I/O interfaces, including twelve USB ports, one PCIe[x16] port, seven PCIe[x1] ports, an LPC bus and SMBus. With the improved built-in graphics processor included in the 4th generation Intel Core i7/i5 processors, the COM-QM87 has faster HD video streaming and processing ability for up to three simultaneous displays through CRT, LVDS, HDMI, DisplayPort™ (DP) or DVI (through DDI).

COM-QM87

Small and Powerful Single Board Computer, the GENE-QM87

The GENE-QM87 is a 3.5" Subcompact Board with an integrated 4th generation Intel Core i7 processor and Intel QM87 Express chipset. The SODIMM socket supports up to 8GB of DDR3L memory, while two SATA 6.0Gb/s ports and one CFast™ slot is available for storage. Small yet powerful, this single board computer benefits from the superb graphics performance offered by Intel HD Graphics, offers ultra fast storage, and can perform encryption algorithms with minimal effort.

GENE-QM87

Graphic intensive applications such as advanced gaming and entertainment, or remote multi-screen digital signage can utilize the GENE-QM87 for its high performance computation and graphic processing. Intelligent

automation systems likewise can also take advantage of its performance, and utilize its rich features including a discrete Intel Gigabit Ethernet controller which offers quick networking connectivity, with I/O slots including four COM ports, two USB 3.0 ports, six USB2.0 ports, one keyboard/mouse port and one Line-in, Line-out, Mic-in port. GENE-QM87 also includes a Mini Card for additional expansion.

ATX and Mini-ITX Industrial Motherboards

Also based on the 4th generation Intel Core processors, the IMBA-Q87A ATX desktop motherboard offers a choice of Intel's latest processors with the Intel Q87 Express chipset. This industrial motherboard supports up to three independent displays via VGA, DVI, HDMI or DP. Support for up to 32GB of system memory is possible with four DDR3 DIMMs sockets.

IMBA-Q87A

The IMBA-Q87A has six SATA ports for operating system and storage, along with two Gigabit LAN ports for optimal networking. With six SATA ports, up to six COM ports, fourteen USB ports, a PCIe[x16] slot, a PCIe[x4] slot and five PCI slots, the IMBA- Q87A has robust storage and peripheral device connectivity for optimal configurability and system integration.

The EMB-QM87A is a Mini-ITX form factor board with a 4th generation Intel Core i7/i5 processor and the mobile Intel QM87 Express chipset. It supports two DDR3 1333/1600 SODIMMs with a maximum of 16GB system memory. Four SATA 6.0Gb/s ports and two SATA 3.0Gb/s ports provide ample storage accessibility. Additionally, this mini-ITX form factor board offers comprehensive I/O expansion capability including four USB2.0 ports, six USB3.0 ports, one keyboard/mouse and five COM ports. Users can increase board functionality by utilizing the PCIe[x16] socket,

EMB-QM87A

and Mini-PCIe slot. An optional TPM module can be implemented for enhanced HW-based security to augment the integrated SW-based security features of the Intel 4th generation Core platform. The EMB-QM87A has two Gigabit Ethernet ports for fast network connections. This motherboard supports three independent displays via three available HDMI and offers a standard VGA port as well. With these and other upcoming embedded computing solutions that meet the requirements of advanced intelligent systems, AAEON continues to push the envelope on performance and efficiency with its

rich portfolio of industrial motherboards, COM modules, box PCs and rugged mobile computing devices. Utilizing powerful microprocessors such as the 4th generation CPUs with high performance embedded graphics capabilities from its partners at Intel, AAEON meets or exceeds industry standards and required specifications in nearly every category of industrial computing applications.

4th Generation Compact-Size Fanless Embedded Computer

AAEON's AEC-6638 Embedded Controller powered by 4th Generation Intel Core i5/i3 processors and Intel QM87 chipset offers one of the smallest fanless industrial-grade computing platforms to work in environments with temperature variances from -10^{0}C ~ 50^{0}C. With VGA, DVI-D and HDMI video ports, vivid graphics can be displayed supported by the Intel HD Graphics 4600 engine. Fully equipped with multiple USB3.0 and USB2.0 ports, Serial ports and dual Gigabit Ethernet, AEC-6638 provides excellent connectivity, including optional wireless communication features. One 2.5" SATA hard diskand one CFast™ can be installed, allowing for larger capacity storage and running more applications. Built to be compact for space-constrained environments, the new AEC-6638 can be readily installed for applications from ATM machines, Transportation Controller or Signage, to Shop Floor Control in today's Industrial Automation scenario.

AEC-6638

AAEON continues to be a leading supplier in the Embedded Controllers, HMI Panels and Displays market place, implementing the latest technologies in embedded systems to meet the challenging requirements of the ever changing industrial landscape.

About AAEON

AAEON is a leading manufacturer of advanced industrial and embedded computing platforms. Committed to innovative engineering, AAEON provides integrated solutions, hardware and services for premier OEM/ODMs and system integrators worldwide. Reliable and high quality computing platforms include industrial motherboards and systems, industrial displays, rugged tablets, PC/104 modules, PICMG half-size and full-size boards and COM modules, embedded SBCs, embedded controllers and related accessories. AAEON also offers customized end-to-end services from initial product conceptualization and product development on through to volume manufacturing and after-sales service programs. AAEON is an Associate member of the Intel Intelligent Systems Alliance.

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