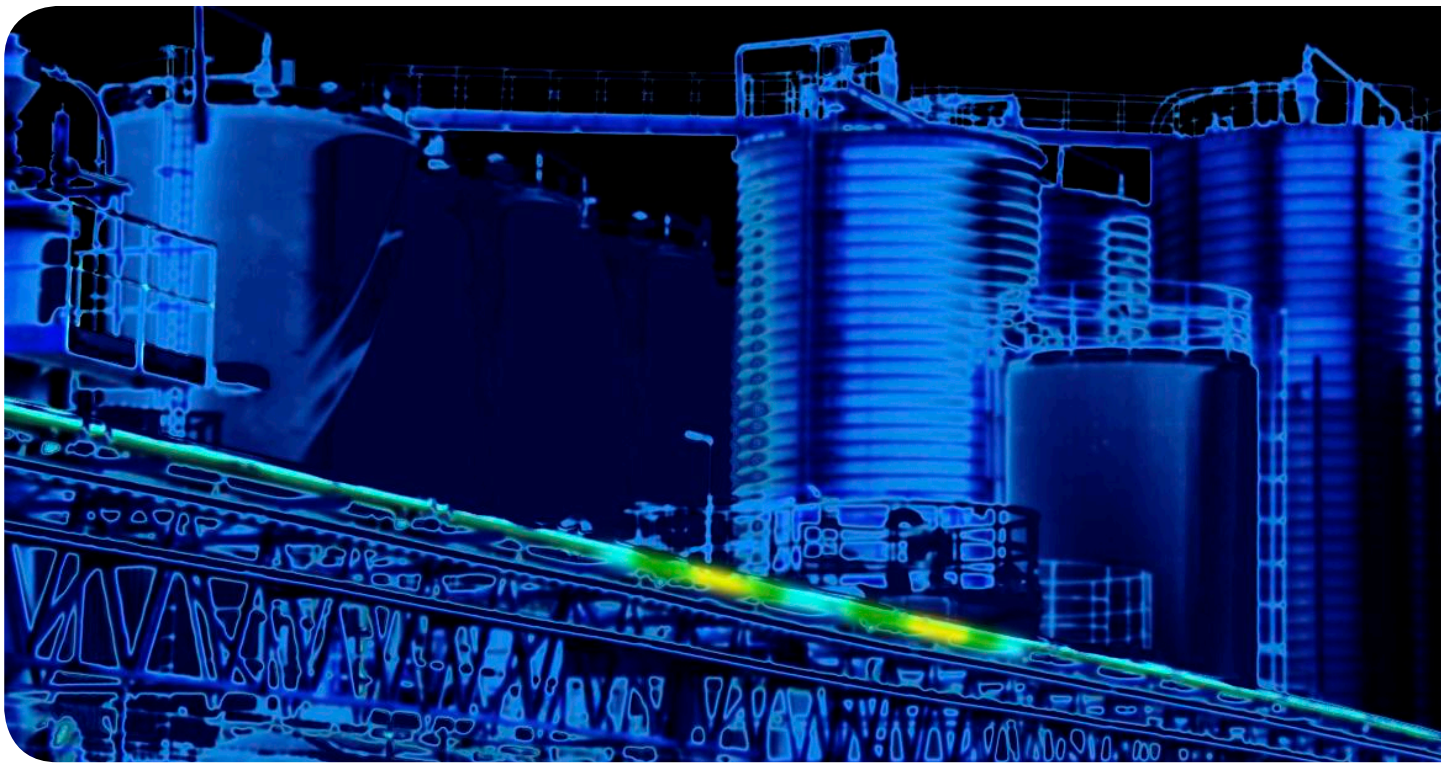

White Paper

Visual Processing in Rugged Environments

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Complex visual processing is becoming an important part of many rugged industrial applications. Automated optical inspection (AOI) of manufacturing lines, infrared thermography (IRT) in oil refineries, and traffic safety enforcement are just some examples of the ways image and video processing improve quality, efficiency, and safety. Visual computing in rugged environments is not without challenges, however. Most applications are resource-intensive and include extensive 2D and 3D graphics processing. Tough environmental conditions call for fanless designs that limit power and present thermal dissipation challenges. Customers are also pushing for ever-lower system cost and size. Embedded systems designers clearly have their work cut out for them.

Fortunately, the 3rd generation Intel® Core™ processor family helps address these challenges. In this article we will show how this new processor's increased graphics, computing, and I/O throughput combine with new power-saving features to enable advanced visual computing within strict thermal constraints. We will also illustrate how developers can deliver compact, rugged systems with the NEXCOM NISE 3600E, a state-of-the-art fanless embedded computer designed for high-performance and graphics-intensive applications.

Design Challenge: Graphics Performance

Similar themes can be seen in infrared thermography (IRT), which is used in applications such as determining fuel levels in oil refinery tanks or detecting overheating components (Figure 1). IRT is also used by firefighters, in building construction, and in clinical diagnostics. With faster processors, IRT systems can perform more automated analysis; with better graphics, operators can more easily monitor conditions. The same holds true for traffic enforcement, where faster processors support automated traffic analysis and multiple displays can help operators monitor more roads.

Figure 1. Infrared thermography (IRT) can be used to detect dangerous hot spots, preventing equipment failure.

Figure 2. The NEXCOM NISE 3600E includes two DisplayPort interfaces on the front panel (left photo) and DVI-D and VGA interfaces on the rear (right photo).

In the past, to meet the high demands for display resolution, quality, and responsiveness, these applications often required discrete graphics cards. Adding such external subsystems meant extra size, power, cost, complexity, and additional points of failure.

The 3rd generation Intel® Core™ processor family alleviates many of these issues with much more powerful integrated graphics. 3D graphics performance is up to 60% higher than that of the prior generation, eliminating the need for add-in cards in many applications. New DirectX 11 support also brings an overall better 3D experience. The processor also supports up to three independent displays, further reducing the need for external graphics.

There are also major improvements in processing performance. The 3rd generation Intel® Core™ processor is up to 15% faster than its predecessor, enabling faster, more sophisticated image and video analysis. Many of these algorithms can benefit from the Intel® Advanced Vector Extensions (Intel® AVX), which provide 256-bit floating point processing. Video streaming and storage is enhanced by Intel® Quick Sync Video 2.0, which performs encoding and decoding in hardware for effortless integration of full 1080p HD video and high-resolution cameras. Among other benefits, Intel® Quick Sync Video 2.0 performs video transcoding at twice the speed of the previous generation, and greatly reduces processor loading during transcoding.

Together with the graphics upgrades, the processor enhancements help developers deliver cutting-edge features while minimizing system power, size, and cost. Developers can take advantage of these upgrades with rugged computers like the NEXCOM NISE 3600E. For example, the NEXCOM NISE 3600E offers built-in support for three independent displays through a combination of DisplayPort, DVI-D, and VGA interfaces (Figure 2).

Design Challenge: CPU Performance vs. Thermal Constraints

Rugged environments require fanless designs that limit system power and therefore limit performance. This is a challenge for visual computing, which requires high processor and graphics performance. The 3rd generation Intel® Core™ processors address these conflicting requirements through smart design changes and innovations that provide more performance at the same power levels. They also scale performance to a much wider application load range than was possible before. How was it done, and how does it benefit embedded systems?

First, the switch from the older 45 nm and 32 nm process technologies to 22 nm process technology with a novel 3D Tri-Gate transistor design yields better performance per watt via reduced current leakage, lower operating voltage and improved on/off switching speed of transistors. This means lower power consumption and heat at the same performance levels, or higher performance at the same power level. What's especially interesting is that the performance gain of 3D Tri-Gate transistors becomes larger at lower voltage compared to 32 nm planar transistors (18% faster at 1.0 V; 37% faster at 0.7 V).

Second, the 3rd generation Intel® Core™ processors offer design optimizations that provide a closer match between power and performance. Intel® Turbo Boost Technology 2.0 automatically allows processor cores to run faster than the base operating frequency if they're operating below power, current, and temperature specification limits. This feature is particularly useful for applications that do not use all of the processor cores. In these applications, the unused cores can be powered off and the remaining cores run at higher frequencies (Figure 3). Among other upgrades, version 2.0 of this feature has more Turbo steps than before, allowing the processor to more closely track the available power budget. Other improvements include a new Low Power Mode that reduces active power below the nominal TDP through techniques such as placing an idle core in Minimum Frequency Mode.

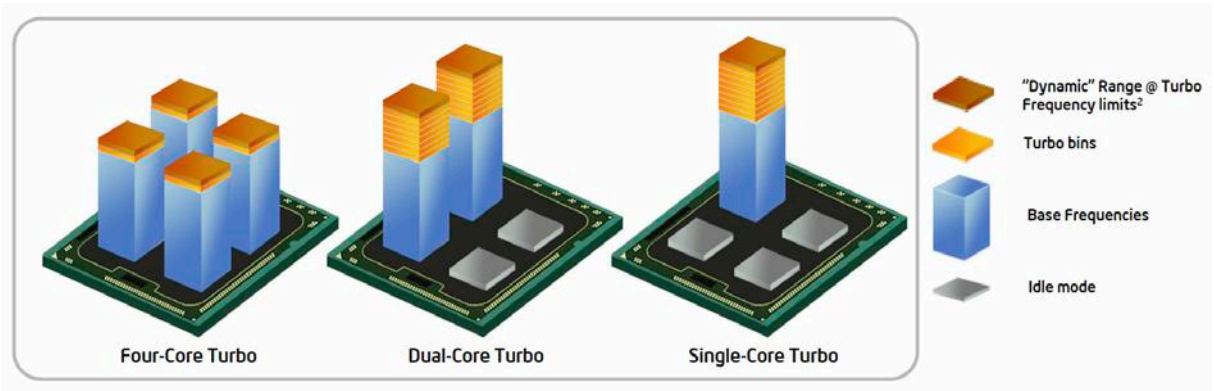

Figure 3. Intel® Turbo Boost Technology 2.0 allows the processor to operate beyond the base frequency.

RAll of this combines to provide performance characteristics comparable to those of a modern turbocharged engine in a car. It's small and gets great mileage around town, but there's plenty of extra punch when needed. Likewise, Intel's 3rd generation Intel® Core™ processors assist embedded computing, which has long been caught in a performance vs. power tradeoff, in the transition from bulky rack-mount form factors to smaller systems that no longer need fans to get the job done.

NEXCOM has taken advantage of these new features to deliver high performance for visual computing in a remarkably compact 216 mm (W) x 270 mm (D) x 93 mm (H) (10.6" x 8.5" x 3.65") package. The NISE 3600E housing features unique wave pattern fins that increase surface areas for air circulation and heat dissipation, to deliver performance improvements beyond what traditionally has been available in fanless designs (Figure 4).

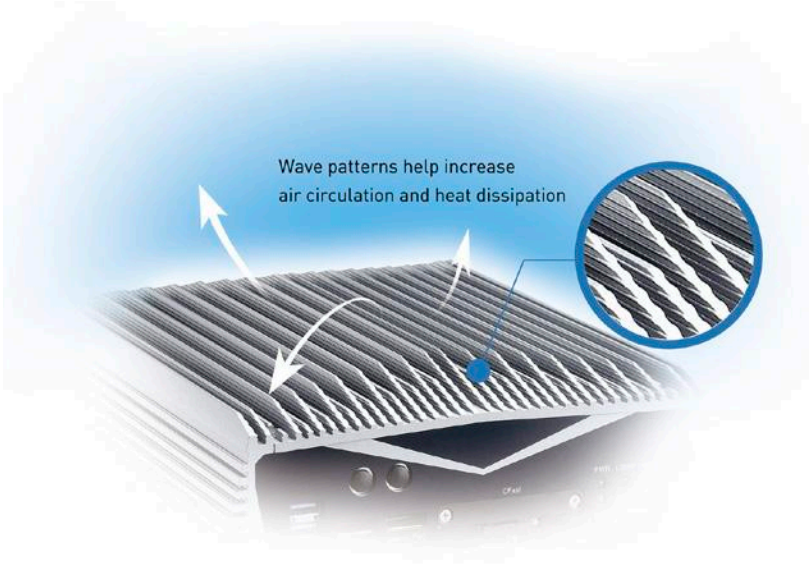

Figure 4. The NISE 3600E housing features unique wave pattern fins.

Design Challenge: I/O Bandwidth

High-performance I/O is also critical for graphics-intensive applications. The native USB 3.0 and PCI Express* (PCIe*) Gen 3 support introduced in the 3rd generation Intel® Core™ processor family (Figure 5) allow embedded systems to process much higher data loads and provide quicker, richer, and more complex visuals.

These bandwidth improvements are not just incremental. With a maximum transmission speed of up to 5 Gbps USB 3.0 — which is backward compatible with USB 2.0 — is more than 10 times as fast as USB 2.0 (480 Mbps), reducing both data transfer time and power consumption. PCIe Gen 3, which is also backward compatible with existing PCIe implementations, has twice the bandwidth per lane of PCIe* Gen 2 (1GBps vs. 500 MBps). This means that a single third gen PCIe x16 slot has a capacity of a full 16 GBps per direction.

The NEXCOM NISE 3600E takes advantage of the enhanced I/O, offering a total of four

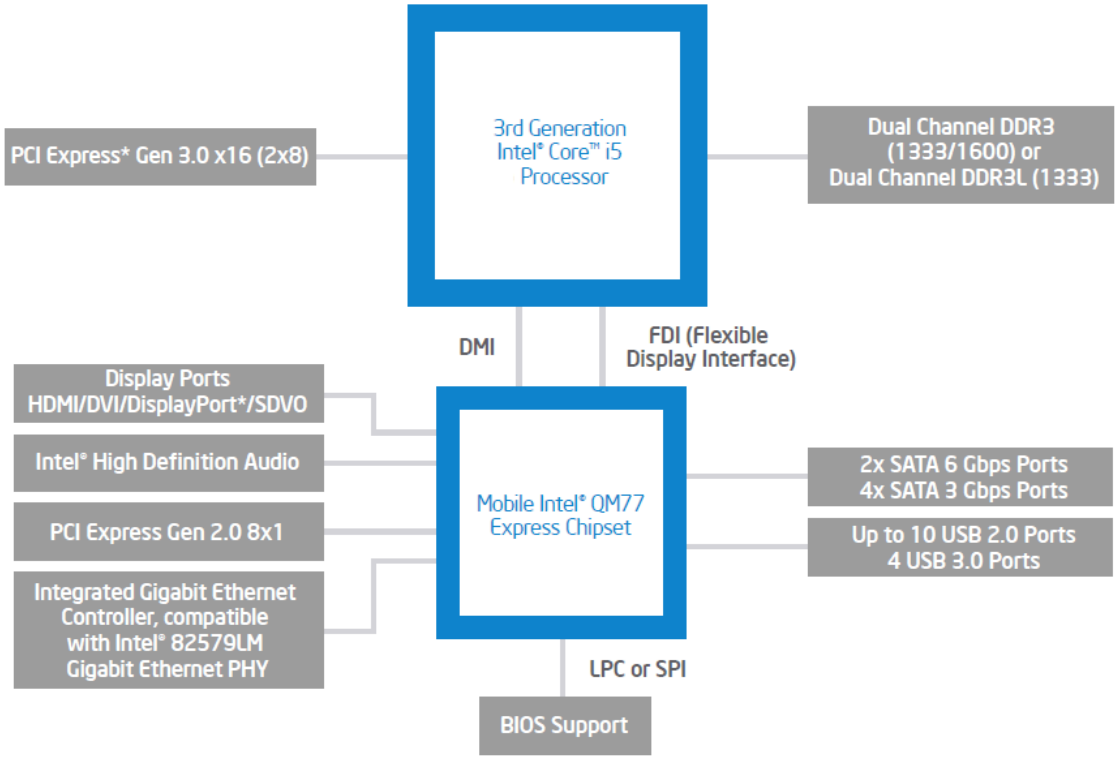

Figure 4. The NISE 3600E housing features unique wave pattern fins.

native USB 3.0 ports and up to two PCIe Gen 3 x4 expansion ports. These expansion options are ideal for high-speed machine and factory automation applications, allowing for easy integration of specialized motion control, data capture, and other industry-specific add-on cards and peripherals.

3rd Generation Intel® Core™ Processor Family: Reliable Performance

Performance and reliability are both crucial for visual computing in rugged environments where downtime and unscheduled repairs can have far-reaching consequences. Reliability in rugged systems requires not only good design and industrial quality components, but also optimal thermal management and the fewest possible points of failure. The much faster integrated graphics of the 3rd generation Intel® Core™ processors eliminate the need for discrete graphics subsystems, reducing cost and complexity. Their advanced power-saving features let designers control heat generation, offering performance safely and efficiently. And their native USB 3.0 and PCIe Gen 3 support eliminate old bandwidth bottlenecks.

By taking advantage of the 3rd generation Intel® Core™ processor family, industrial embedded computers such as the NEXCOM NISE 3600E can offer superior visual computing performance and capabilities while at the same time maximizing operation uptime, and minimizing power consumption and heat generation, thus enabling consolidation of previously separate hardware and lowering overall system cost and power.

About NEXCOM

NEXCOM International Co Ltd. is an Associate Member of the Intel® Intelligent Systems Alliance. Founded in 1992 and headquartered in Taipei, Taiwan, NEXCOM is committed to being your trustworthy partner in building the digital infrastructure. NEXCOM offers innovative and versatile industrial computing solutions and security surveillance applications built around industry leading technology, localized customer support and worldwide logistic services.

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From modular components to market-ready systems, Intel and the 200+ global member companies of the Intel® Intelligent Systems Alliance provide the performance, connectivity, manageability, and security developers need to create smart, connected systems. Close collaboration with Intel and each other enables Alliance members to innovate with the latest technologies,helping developers deliver first-in-market solutions.

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