



White Paper

Intel Technology in
Gaming Equipment

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Addressing the performance, security, availability
and long life cycle needs of the gaming industry

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Executive Summary

Gaming equipment manufacturers are under pressure to provide more games and greater innovation, along with the flexibility and capability to enhance the customer experience. Gaming machines – serving diverse industries like lottery, arcade and casino – are employing high-performance computing technology to attract players while improving infrastructure by increasing security, system uptime and long-term availability.

Lotteries are using the latest technologies to continuously optimize game mix, distribution channels and customer-facing terminals to draw in more players, and ultimately increase revenues. In a competitive battle with home gaming systems, arcade owners are demanding cutting-edge machines that go beyond what can be done at home; they want to offer patrons more interactivity, better graphics and a more satisfying group experience. Casino game manufacturers are adopting technology to work seamlessly with servers, networking and backroom systems in support of client-server applications such as real-time player tracking, surveillance, data analysis and accounting. And faced with the increased sophistication of hackers, these systems also use built-in security to protect system integrity and guard against cyber theft.

The gaming industry is at the forefront of electronics technology, using it to provide entertainment, comply with regulatory agencies and grow shareholder value. Helping to meet these objectives, Intel is committed to developers in the gaming industry and offers advanced technologies backed by long life cycle programs, development tools and technical support. This paper provides an overview of the key features and benefits of Embedded Intel® Architecture products for gaming applications:

- Embedded Intel® Architecture multi-core processor platforms, including the Intel® Core™2 Duo processor and the Intel® GME965 Express chipset, deliver low-power, high-performance computing and graphics.
- Intel® Virtualization Technology¹ (Intel® VT) helps isolate gaming and client-server applications to enhance security and reliability.
- Intel® Active Management Technology² (Intel® AMT) provides more comprehensive system management, recovery and security.
- Intel® Trusted Execution Technology³ (Intel® TXT) deploys hardware-based mechanisms to protect against software-based attacks on platform subsystems such as data storage, graphics, user-input and application software. This feature will be supported on a future Intel chipset.

Embedded Intel processors are backed by robust development tools and technical assistance from Intel that enable the rapid development and optimization of software applications. These products are also supported by the Intel® Embedded and Communications Alliance, one of the world's most recognized embedded ecosystems. The alliance provides equipment manufacturers with a trusted supply line of Intel-based products and services, and offers leading-edge products, design expertise and total life cycle support from worldwide service organizations. This rich ecosystem of products and services helps developers speed time-to-market and improve reliability.

Gaming Industry Requirements

Casino operators are looking for gaming devices that are smart, stylish, "green" and designed to perform. In response, system designers are developing high-performance (compute and graphics) platforms that produce a multi-faceted gaming experience and run reliably 24 hours a day. They are using low-power components on small factor boards that can fit into slimmer cabinets. With lower power consumption, these systems are greener and reduce utility expenses.

Gaming systems must pass testing by outside organizations, such as GLI (Gaming Laboratories International), who audit physical security, random-number generation, software integrity and all electronic circuitry. Operators also expect secure platforms that protect against malicious behavior and safeguard software and internal circuitry.

Due to the high cost of product testing and certification, gaming equipment vendors are averse to making frequent system changes. Certification is valid for a specific hardware and software configuration, and any change or update must be approved by regulatory agencies. The cost of recertifying a board can easily exceed its acquisition cost, so equipment manufacturers need long-term board availability.

In addition to casino games, there are other gaming devices with specific requirements and priorities. Arcades require very high-performance games, robust player interfaces and receipt tracking. Lottery terminals must be low cost and tamper proof, and they rely on secure networking connections and high system availability.

Intel processors and technologies help gaming system developers meet these challenges:

- **Performance and Low Power:** Intel multi-core processors deliver high-performance computing and world-class performance per watt.
- **High Availability:** Intel Virtualization Technology (Intel VT) increases system availability by isolating applications, executing them in silos and protecting data and software execution. Intel Active Management Technology (Intel AMT), using enhanced remote management capabilities, can help fix more system problems and keep systems running with fewer on-site technician visits.
- **Secure and Tamper Proof:** Intel Trusted Execution Technology (Intel TXT) protects system data across various machine subsystems, and Intel AMT detects unauthorized software updates and out-of-date or disabled security policies.
- **Low Cost:** Intel processors and chipsets incorporate many features, such as the Intel® Graphics Media Accelerator X3100 that can reduce system cost by eliminating the need for additional components and circuitry.
- **Long-Term Availability:** Embedded Intel products are supported for long life cycles of at least seven years.

Intel embedded components have already been deployed in multiple gaming jurisdictions around the world.

Embedded Intel® Architecture Processors

Intel offers a wide range of leading-edge embedded components, tools and technologies that can help meet stringent platform requirements and aggressive development schedules. Embedded Intel® Architecture processors and chipsets provide validated platform configurations that speed time-to-market while providing developers with a roadmap to next-generation capabilities.

- Dual-Core Intel® Core™2 Duo processors are based on Intel's revolutionary Intel® Core™ microarchitecture, which delivers the best system-level performance per watt. Multi-core architecture is now the vehicle for delivering higher computing performance, yielding processors with significantly higher raw performance and performance per watt than prior single-core processors. Dual-Core Intel Core 2 Duo processors, operating in space-constrained environments, provide the performance needed to support multiple applications running simultaneously.

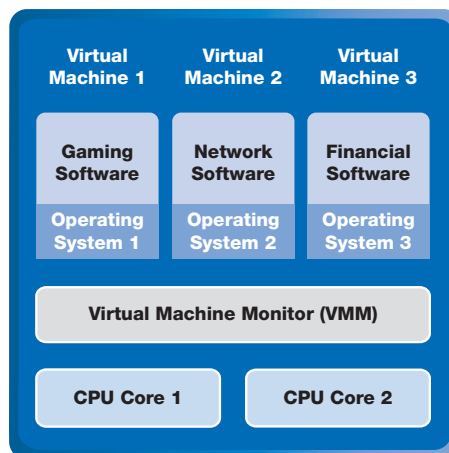


Figure 1. Virtualization Isolates Gaming Applications

- Intel® Celeron® processor 440^A balances proven technology with exceptional value. Featuring Intel® Intelligent Power Capability, which automatically saves power during periods of low compute demand, this processor supports smaller, quieter and more energy-efficient gaming devices with improved performance over previous Intel Celeron processors.
- The Intel® GME965 Express chipset has a rich set of features including graphics, sound, asset management capabilities, RAID storage controllers and multiple I/O interfaces:
 - Intel Graphics Media Accelerator X3100 supports dual independent displays using an integrated 3D graphics engine with eight graphics cores.
 - Intel® High Definition Audio⁴ (Intel® HD Audio) interface delivers premium digital multi-channel sound.
 - Intel AMT offers asset management capabilities such as remote management of unmanned sites.
 - Intel® Matrix Storage Technology (Intel® MST) provides RAID functionality for improved storage speed and data redundancy.
 - There are various connectivity options including PCI Express*, Ethernet, Serial ATA and high-speed USB 2.0.
- Intel VT provides several benefits when different software applications run on a single computing platform, as is typically the case for gaming devices. Gaming devices run various applications including multiple games, networking applications, player tracking, user interface, data analysis, random number generation and accounting. Virtualization places these applications into individual silos, shown as virtual machines (VMs) in Figure 1, which can increase availability and security.

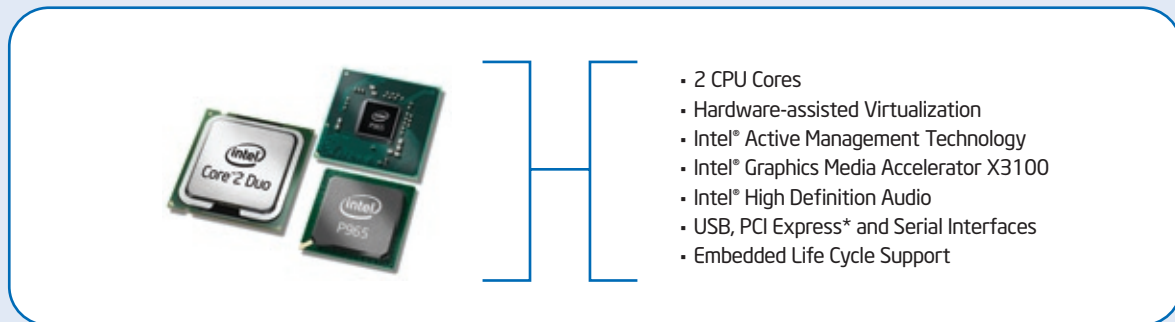
Benefits of Intel Multi-Core Platforms in Gaming Applications

The latest multi-core processors from Intel are delivering more performance, virtualization and advanced remote management. Here are some Intel® Architecture features that enhance gaming equipment responsiveness, security and availability:

- More CPU cores in the system
 - Runs gaming and background applications on separate cores to increase responsiveness.
- Hardware-assisted virtualization for application isolation and security
 - Reduces virtualization computing overhead and software complexity.
- Remote management with out-of-band communications
 - Gets equipment online faster even when the system locks-up, hangs, crashes and has other problems.

- Revolutionary performance per watt
 - Enables the use of high-performance processors in space-constrained systems.
- Embedded life cycle support
 - Protects product development and platform certification investments.

In addition to these architecture advantages, equipment makers typically find maintaining software code for general-purpose processors, like the Dual-Core Intel® Core™2 processors, is easier than for application-specific hardware. This is because Intel processors are supported by a broad ecosystem offering a wide range of mature development tools.



Intel® Core™2 Duo Processor T7400 and Intel® GME965 Express Chipset

- 2 CPU Cores
- Hardware-assisted Virtualization
- Intel® Active Management Technology
- Intel® Graphics Media Accelerator X3100
- Intel® High Definition Audio
- USB, PCI Express* and Serial Interfaces
- Embedded Life Cycle Support

- Intel AMT enables secure, remote management of systems through unique built-in capabilities. It provides around-the-clock ability to monitor and repair networked embedded systems such as gaming equipment. Intel AMT is a hardware and firmware-based solution, employing a secure out-of-band communication channel, providing persistent access and control over gaming systems.

Intel AMT supports many features that can benefit gaming Operators:

- Detect problems quickly through alerting and logging functions, and reduce downtime.
- Reload system software remotely, in order to update or repair application software or the operating system.
- Control the system whether or not the CPU and the operating system are functioning.
- Alert on any BIOS firmware or system software modifications and identify potential system tampering.
- Store hardware and software information in non-volatile memory (e.g., FLASH), so system information (configuration, error logs) is always available.
- Diagnose system failures remotely and inform service personnel which spares to bring.

Regulations of the Nevada Gaming Commission and State Gaming Control Board, Regulation 14 – Technical Standards for Gaming Devices and On-Line Slot Systems

Requirement	Intel® Active Management Technology (Intel® AMT) Provides a Solution
Electrical Integrity Immunity	
Gaming device must use appropriate communication protocols to protect Random Number Seeds.	Intel AMT uses security methods to protect the host to client communications. These protocols are not susceptible to magnetic, mechanical or electro-static corruption.
Physical Security	
Conventional gaming devices must have a protective cover to protect intrusion and unauthorized alterations.	Intel AMT detects the status of device interlocks and takes preprogrammed action upon intrusions.
Communication and Associated Equipment	
Must ensure the server is operating with an authorized client.	Games that operate between server and client can utilize security keys or certificates stored in non-volatile memory to ensure legal connectivity and security.
Remote Access to Gaming Devices	
All gaming devices need history of games recently played.	Gaming logs can be stored in the non-volatile memory and retrieved by the remote console, regardless of the state of the machine.
Control Program Requirements for a System-Supported Game	
System-based games must ensure the correct server-based games are downloaded.	Agent Presence feature can ensure appropriate software is loaded at all times.

Table 1. Intel® Active Management Technology Provides Solutions for Compliance Requirements

These features can help improve gaming system security and availability, IT efficiency and asset management. Intel AMT even allows IT managers to access gaming machines when they are powered off, as long as the systems are connected to the network.

Virtualization provides a software layer, called a Virtual Machine Monitor (VMM), beneath the operating systems. This software layer manages multiple virtual machines, each containing an operating system and a software application such as gaming, network and financial. Applications running in virtual machines can't disturb each other. For example, if a networking application fails, the system can reboot it without stopping the game, which increases availability.

The VMM can be used to create another layer of security that prevents applications from gaining access to another application's data. This capability can inhibit someone, such as a hacker writing malware, from creating an application that modifies the data in another program.

Virtualization can eliminate the need to port legacy code to a new operating system. If a gaming manufacturer has an existing application running on an old operating system, the application and operating system can run in a VM while other applications run on different operating systems. Since many legacy applications were written to run alone on dedicated hardware, virtualization provides a safe environment where this software can run in isolation and avoid conflicts with other applications.

Satisfying Gaming Requirements

Gaming regulatory agencies publish gaming machine standards to enforce system integrity, and many of these gaming requirements can be met by using Intel AMT. Since Intel AMT is built into the silicon components, it is virtually impossible to change its functionality in the field, thereby meeting the requirement of being consistent and tamper proof. Intel AMT can help satisfy certification requirements, as shown in Table 1, and shorten time-to-market.

Tools and Support

Intel and the Intel® Embedded and Communications Alliance ecosystem provide developers with the advantages of a broad selection of silicon, boards, software, development tools and support to enable faster time-to-market and more reliable gaming solution deployment. Developers are taking advantage of the following products and support programs:

- Embedded Intel Architecture processors, chipsets and other silicon components are supported for embedded product life cycles, with a minimum availability of seven years.
- A wide choice of vendors offering boards in various form factors.

Portwell's WADE-8XX6* Mini-ITX Embedded-Systems Boards

The WADE-8XX6* series is a family of advanced mini-ITX embedded system boards (ESBs) that combine robust computing power, a smaller footprint and lower power consumption with increased product longevity. They are equipped with the Intel® Q965 Express and GME965 chipsets to pair with the latest Dual-Core Intel® Core™2 Duo processors. Dual video output, VGA and DVI, can drive two displays independently or simultaneously, especially suitable for gaming devices. The expansion slots, one PCI slot and one Mini-PCI slot, provide the flexibility to add peripherals such as player card readers and embedded wireless adapters.

The Intel Core 2 Duo processor provides the extra computing power to run today's multi-tasking games and the enhanced graphics that players demand. The dual display enables side-by-side gaming and provides players with more information to enhance the gaming experience. The WADE-8556 also supports Intel® Virtualization Technology¹ (Intel® VT), which can increase software security and availability. Using Intel® Active Management Technology² (Intel® AMT), gaming operators can run regular diagnostics on the machines without interrupting the games.



Portwell WADE-8556* Mini-ITX Embedded-Systems Board

“With its implementation of Intel Active Management Technology, the WADE-8556 ESB offers robust computing power and reliability for embedded applications in which the IT manager needs to discover, heal or protect the operation, and for customers who are seeking increased computing, lower power consumption and a longer product lifespan. The WADE-8556’s dual video outputs can drive two displays simultaneously at a maximum resolution of 2048 x 1536 or 1920 x 1080 for HDTV,” says Vincent Liao, product marketing manager for Portwell, Inc. The WADE-8066 ESB employs the latest Intel GME965 mobile chipset, which is suitable for slot machines and lottery terminals that require reduced power consumption and board profile.

Portwell is an Associate member of the Intel® Embedded and Communications Alliance.



Portwell WADE-8066* Mini-ITX Embedded-Systems Board

- Many software solutions are available, such as drivers, application software and development tools optimized for Embedded Intel multi-core processors.
- Developers may use a variety of operating systems including Microsoft Windows,* Linux,* Wind River and QNX.
- Intel technical information and support are available for developers from design through manufacturing.
- Intel provides reference and evaluation platforms to help shorten design cycles.

Conclusion

The gaming industry has specific equipment requirements around performance, security, system uptime and long-term product availability. Attentive to these requirements, Intel has a long history of serving gaming manufacturers, and continues to do so with its latest products. Some of the most recent innovations that increase security and availability are already available in Intel processor-based platforms. These technologies enable gaming developers to engineer cost-effective improvements and create the next generation of gaming innovations.

Intel's commitment to developers in the gaming industry is reflected in product lines with long life cycle support that are backed by Intel development tools and technical support. Developers can also choose from an extensive selection of ecosystem solutions and services from the Intel Embedded and Communications Alliance. Intel is offering system developers leading-edge technologies to usher in the next generation of attractive, secure, energy-efficient and compelling gaming devices.

Where to Learn More

For details about Embedded Intel® Architecture processors in embedded applications, visit embedded.intel.com

For details about Intel® technology in interactive client applications, visit www.intel.com/go/ic

For details on the Intel® Embedded and Communications Alliance, visit www.intel.com/go/ica

Please contact your Intel representative for assistance with your next design.

Acronyms

GLI	Gaming Laboratories International	RAID	Redundant arrays of inexpensive disks
Intel® AMT	Intel® Active Management Technology	VM	Virtual Machine
Intel® TXT	Intel® Trusted Execution Technology	VMM	Virtual Machine Manager
Intel® VT	Intel® Virtualization Technology		

⁴ Intel processor numbers are not a measure of performance. Processor numbers differentiate features within each processor family, not across different processor families. See www.intel.com/products/processor_number for details.

¹ Intel® Virtualization Technology requires a computer system with an enabled Intel® processor, BIOS, virtual machine monitor (VMM) and, for some uses, certain platform software enabled for it. Functionality, performance or other benefits will vary depending on hardware and software configurations and may require a BIOS update. Software applications may not be compatible with all operating systems. Please check with your application vendor.

² Intel® Active Management Technology (Intel® AMT) requires the computer system to have an Intel® AMT-enabled chipset, network hardware and software, as well as connection with a power source and a corporate network connection. Setup requires configuration by the purchaser and may require scripting with the management console or further integration into existing security frameworks to enable certain functionality. It may also require modifications of implementation of new business processes. For more information, see www.intel.com/technology/platform-technology/intel-amt/.

³ No computer system can provide absolute security under all conditions. Intel® Trusted Execution Technology is a security technology under development by Intel and requires for operation a computer system with Intel® Virtualization Technology, an Intel Trusted Execution Technology-enabled processor, chipset, BIOS, Authenticated Code Modules, and an Intel or other compatible measured virtual machine monitor. In addition, Intel Trusted Execution Technology requires the system to contain a TPMv1.2 as defined by the Trusted Computing Group and specific software for some uses. See <http://www.intel.com/technology/security/> for more information.

⁴ Intel® High Definition Audio requires a system with an appropriate Intel chipset and a motherboard with an appropriate codec and the necessary drivers installed. System sound quality will vary depending on actual implementation, controller, codec, drivers and speakers. For more information about Intel® HD audio, refer to <http://www.intel.com/>

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

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