

Server-Hosted Workstations Made Easy

Citrix and Intel Simplify Delivery of Rich Graphics Applications as a Service Using Intel® Xeon® Processor E3-1200 Product Family with Intel® Iris™ Pro Graphics



Executive Summary

Server-hosted workstations for detailed and final design engineers traditionally are defined by virtualizing expensive multi-socket, high-core-count servers and their costly discrete GPU cards. Until now, large virtualized solutions were among the limited options for IT. Partitioning these large systems could easily lead to an under-powered virtual machine (VM) for the design tasks at hand or to over-provisioned VMs that waste expensive resources for the work to be done. Today, using high-density, low-cost servers based on the Intel® Xeon® processor E3-1200 product family with Intel® Iris™ Pro Graphics, companies have more choices for high-performance, flexible server-hosted workstation solutions with professional-level graphics that meet the demands of detailed and final design engineers at low total cost of ownership (TCO).

Powered by the latest Intel Xeon processor E3-1200 product family with Intel Iris Pro Graphics, each high-density, modular server delivers four physical cores and dedicated, powerful, professional- and workstation-quality graphics performance for the user, hosted in a high-density platform

(such as the [Citrix WorkspacePod™](#)). These platforms support native instancing with dedicated remote access via Citrix XenDesktop® and HDX® 3D Pro, or shared access through Citrix XenApp®. Using Citrix Receiver® remote graphics client, engineers can access their rich graphics applications anytime, anywhere from any mobile device to support mobilized workflows. When virtualized, these servers can provide dedicated or shared GPU resources to support virtual desktops for office and content creation or PLM usages, making them extremely flexible for a wide range of IT's hosted workloads.

Intel and Citrix, leaders in data center and remote-enabling technologies, simplify IT's workloads, while enabling delivery of rich graphics applications as a service at low TCO.

This white paper specifically examines the needs of IT as well as detailed and final design engineers for hosted workstations. It also discusses how high-density servers based on the Intel Xeon processor E3-1200 product family with Intel Iris Pro Graphics can effectively deliver remote hosted workstation solutions.

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Simplifying Rich Graphics Application as a Service for Detailed and Final Design Engineers

What Users Need

Detailed and final design engineering tasks encompass the core of product definition through 3D modeling, simulation, drawings, specifications, and rendering. With today's advanced software and massive data sets for modeling and simulation, detailed design engineers often require computing well above standard office desktops. Historically, these engineers needed the performance and proximity of desktside workstations. But today's enhanced servers and fast networks enable data center-hosted, remote workstation solutions to meet the engineers' needs for an experience characterized by the following:

- Fast load times
- Rotation, pan, and zoom performance equal to or better than the desktside experience on systems today
- Rotations must be smooth
- Application CPU performance must be equal to or better than dedicated desktside systems
- Consistent experiences across all devices and networks
- Multi-monitor and spatial mouse support
- Full print-enabling capability

Additionally, with today's increasingly mobile workflows, engineers can benefit from being able to connect to a remote, hosted application with any mobile device—from mobile workstation to tablet and smartphone—anytime and anywhere to open, update, manipulate, and render their designs.

IT's Virtualized Hosted Workstation Challenges

Server-hosted workstations eliminate the IT headaches associated with desktside systems, while delivering the resources detailed and final design engineers need in an experience they desire. A key IT benefit is that hosted solutions allow Cloud Service Providers and IT departments in large and global operations to centralize design data in the data center. Centralization enables IT to provide high security of intellectual property and strict control over management, data resiliency and recovery, and access. In addition, the realization of connectivity with a mobile device to professional-level graphics in a hosted solution brings increased flexibility, mobility, and choice of platform to the engineer, as long as the device can support the application's significant requirements for CPU, GPU, memory, and power.

Many current hosted workstation solutions involve virtualizing multi-socket servers with very high core counts and numerous costly discrete GPU add-in cards. Partitioning these large physical systems and GPUs into smaller virtual machines (VMs) can easily result in VMs that are underpowered in one respect or another, with too few CPU cores per instance or a lack of the graphics performance required for the engineer to complete tasks on complex design models. Conversely, overprovisioning of VMs only used for less demanding tasks wastes expensive resources that are better employed elsewhere.

While enabling improved information security and data localization, improperly provisioned hosted, virtualized solutions can result in limited flexibility. It can be difficult and time consuming to tune systems to meet service-level agreements (SLAs) required for detailed and final design engineers. This can lead to high per-user costs, both in terms of capital expenses and power usage, as more systems are needed to virtualize in order to meet the demands of the engineers.

Intel and Citrix Simplify Rich Graphics Applications as a Service

New, Intel-powered, high-density servers, together with Citrix XenDesktop and Citrix HDX 3D Pro, enable IT to simplify delivery of rich graphics applications as a service without virtualizing the system. These ultra-dense solutions, based on the Intel Xeon processor E3-1200 product family with Intel Iris Pro Graphics, offer each designer their own remote workstation with four dedicated cores and workstation-level, discrete GPU performance using integrated graphics. They deliver a very smooth desktop experience on a range of graphics-intensive 2D and 3D applications, such as Autodesk Inventor,* Dassault Systemes SOLIDWORKS,* and Adobe Photoshop.*

With Citrix Receiver remote graphics client software running on mobile devices, engineers can easily access their applications using a broad range of mobile end-clients—from phones and tablets to traditional PCs. Citrix HDX 3D Pro delivers a familiar experience over a range of network connectivity choices, including 4G, Wi-Fi,* and wired Ethernet. These Citrix technologies allow engineers to take advantage of mobilized workflows from anywhere, at any time.

Hosted Workstations Using the Intel Xeon Processor E3-1200 Product Family with Intel Iris Pro Graphics – Easy on IT

Instead of virtualized, complex, and expensive multi-socket systems, IT departments now have an effective, flexible, simple, and low total cost of ownership (TCO) alternative for delivering rich graphics applications as a service. With low per-user power, high efficiency, enterprise-class security and manageability, and the professional-level graphics capabilities detailed and final design engineers need, these servers can meet both IT's SLA and corporate needs as well as their clients' demands.

Intel Iris Pro Graphics – Non-discrete, Workstation-level Processor Graphics Performance

With its introduction of Intel® HD Graphics in 2010, Intel moved built-in visual technology¹ onto the processor die. On-chip graphics is an important part of Intel® processor architecture. Intel annually invests billions in manufacturing development to support the advances in its technologies, including evolving the performance of processor graphics.

Professor Clayton Christensen defines the phenomenon of disruptive innovation as when “an innovation transforms an existing market or sector by introducing simplicity, convenience, accessibility, and affordability where complication and high cost are the status quo.”² Intel Iris Pro Graphics is a disruptive innovation that delivers built-in, professional-level GPU performance that eliminates the requirement for expensive, discrete add-on devices (Figure 1).

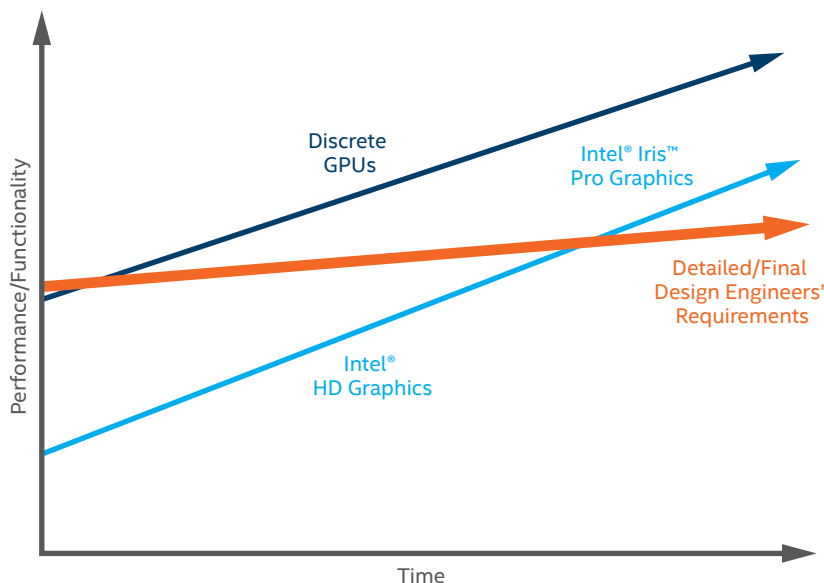


Figure 1. Intel Iris Pro Graphics changes the field for professional graphics.

Intel Processor Graphics Performance Advancements

Intel processor graphics technology has advanced significantly from its introduction in 2010. Figure 2 illustrates the evolution of Intel graphics performance over the generations. Today's Intel Iris Pro Graphics delivers 640 GFlops of performance, making it an ideal foundation for servers to deliver remote, hosted rich graphic applications.

Processor Graphics Performance
(Graphics performance at 1 GHz³)

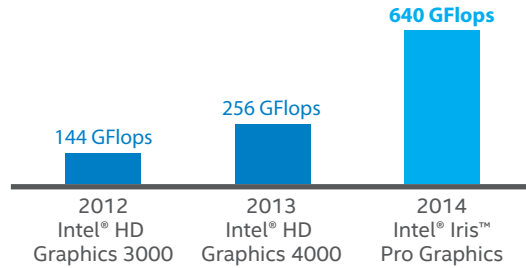


Figure 2. Intel® processor graphics advancements, generation to generation.

Processor Graphics Elements

Intel processor graphics technology is a portion of the silicon dedicated to imaging, working alongside the compute and I/O blocks of the entire chip (Figure 3). Over generations of development, high-bandwidth memory has been incorporated within the die, essentially creating up to 128 MB of high-bandwidth cache beyond the last-level cache that is available to both the CPU and GPU. The added cache eliminates many data copies and off-die fetches to system memory. This critical enhancement can significantly improve processor and graphics performance.

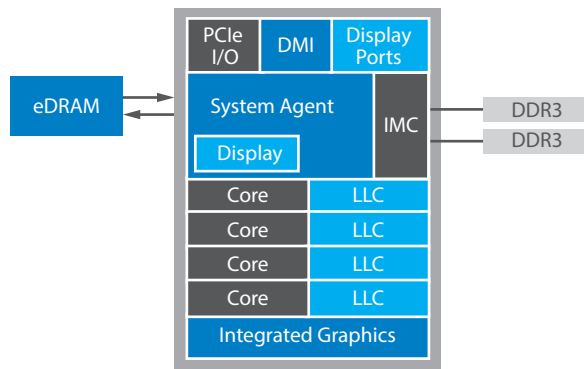


Figure 3. Intel® processor and processor graphics elements.

Intel Iris Pro Graphics Architecture

The Intel Iris Pro Graphics silicon shares the same process technology as the CPU. With the Intel Xeon processor E3-1200 v4 product family (and next-generation codename Skylake), Intel manufacturing will use 14nm process technology. This means all the benefits of power savings, efficiency, and performance are realized for both the CPU and GPU together.

Compared to the die size of previous-generation Intel HD Graphics, today's Intel Iris Pro Graphics occupies approximately half of the entire die (Figure 4) and increasingly integrates more execution units (EUs) with each generation—48 EUs in Intel Xeon processor E3 v4 (Table 1, see next page). Additionally, Intel Iris Pro Graphics embeds 128 MB of on-package eDRAM to accelerate CPU and graphics performance.

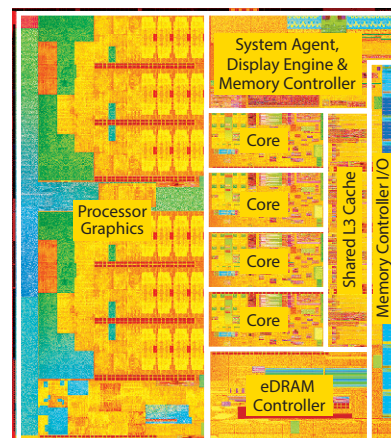


Figure 4. Intel® HD Graphics and Intel® Iris™ Pro Graphics physical real estate.

Table 1. Comparison of Intel® Graphics Capabilities

	Intel® Xeon® Processor E3-1200 v3	Intel® Xeon® Processor E3-1200 v4
Graphics Performance Improvement Over Previous Generation	N/A	Up to 80% ^{4,5}
Max. System Memory	32 GB	32 GB
Max. Memory Speed	DDR3-1600	DDR3-1866
Max. Video RAM	1.7 GB	16 GB
eDRAM Capacity	N/A	128 MB
Graphics Execution Units	20	48

Besides the built-in performance for day-to-day design tasks, Intel processor graphics architecture integrates features that enable greater functionality and interoperability for many rich applications. These features include:

- Support for DirectX* 3D 2015 version, OGL* 4.2, OpenGL* ES 3.0, and OpenCL* 2.0
- Tightly coupled CPU/GPU programming, using shared virtual memory plus OpenCL
- 16x MSAA
- Large textures and buffers/ mega-textures
- Conservative rasterization
- Intel® Quick Sync Video: hardware-acceleration for fast, High Efficiency Video Codec encode/decode (HEVC is the successor to H.264/MPEG-4 AVC); JPEG encode; and VP8 encode

With each successive generation, Intel Iris Pro Graphics advances the capabilities of high-density servers to support rich graphics usages for more remote users, while enabling great flexibility, power savings, and manageability.

Intel Xeon Processor Graphics Workstation Certifications

Many applications used by detailed and final design engineers are certified on Intel Xeon processor-based workstations, including the following.

- 3ds Max*
- AutoCAD*
- Inventor*
- Microstation*

- Revit*
- After Effects*
- Maya*
- Photoshop*
- Premier Elements*
- Solid Edge*
- SolidWorks*
- Showcase*
- Creo*
- NX*
- TCVis*
- Mudbox*

More certifications are expected with the next-generation Intel Xeon processor E3 family. Check www.intel.com/content/www/us/en/workstations/certified-applications.html for the full list of certified applications and their versions.

Simplifying Remote Rich Graphics Applications and Remote Office Applications with Citrix

While a multi-socket hosting system uses virtualization to partition its resources, high-density Intel Xeon processor E3 family-based servers can deploy remote workstation and hosted rich graphics applications without virtualization using Citrix XenDesktop with Citrix HDX 3D Pro and Citrix XenApp on physical instances, simplifying IT's burdens (see the sidebar on page 7, *High-Density Virtual Desktops using Citrix XenApp® and Intel® Xeon® Processor E3-1200 Product Family with Intel® Iris™ Pro Graphics*).

Citrix XenApp and Citrix XenDesktop Enable Rich Application Experiences on Any Device

Citrix XenApp and Citrix XenDesktop deliver virtual Windows* apps and desktops as secure applications from hosted servers. XenApp and XenDesktop give IT the flexibility they need to deliver rich graphics applications to remote users and to mobilize the business, while reducing costs.

XenApp and XenDesktop can deliver full desktops or just the apps, including rich applications, to any device—desktop, laptop, tablet, or smartphone—with the same capabilities users expect from their workstation experience. For example, designers can access their applications and data on their desktop in their offices, and then, while on the road, access the same application and data with the same user experience from their tablet or smartphone. The graphics and processing capabilities of the Intel Xeon processor E3-1200 product family with Intel Iris Pro Graphics running XenApp or XenDesktop deliver both desktop and native touch-enabled mobile experiences for rich applications that are optimized for the type of device, as well as the network.

Additionally, these high-density servers are capable of supporting a large number of remote office users through non-virtualized platforms with Citrix XenApp and XenDesktop. This allows IT the flexibility to gain the most productivity out of the same foundation of processor and embedded graphics technologies for both server-hosted workstation users and office users.

Support for Full Virtualization is Still an Option

IT can employ traditional virtualization infrastructure for managing deployments of client and server operating systems running in VMs with dedicated Iris Pro Graphics (on Citrix XenServer®). Or, IT can fully virtualize the high-density resources these servers offer with processor graphics through VSGA (API Forwarding) or VGPU technology with the addition of Intel® GVT-g to Citrix XenServer. Whether with dedicated or virtualized graphics, Citrix solutions with Intel Xeon processor E3 family-based servers offer IT incredible flexibility, great power efficiency, and powerful capabilities to meet the SLAs detailed and final design engineering tasks require.

Citrix HDX Technologies Remove the Network Performance Barrier

Citrix HDX technologies make it possible for hosted, rich graphics application users to enjoy a virtual computing experience that is the same or better than their local PC. Users expect such experiences, whether they are at their desktop or using a mobile device, and whether they are connecting over challenging, low-bandwidth, high-latency WANs, highly variable 3G/4G mobile networks, or reliable corporate networks. With applications adaptable to a wide variety of user environments, companies can continue to leverage productivity under varying conditions, such as the following:

- Architects can access and review plans on site in remote locations using their 4G network.
- Co-workers can have engineers out of the office make critically needed analysis and changes on the fly using their tablets and local available networks.

The Citrix environment maintains a desk-side-like experience by localizing users' rich data files to the hosted application rather than transferring large data sets to the device to be run locally. Citrix HDX and HDX 3D Pro technologies and Citrix Receiver client software offer a set of capabilities that deliver a "high-definition" experience to users on any device and over any network.

HDX technologies are built on top of the Citrix ICA® remoting protocol, which is renowned for best-of-breed networking and representing more than 20 years of innovation. The ICA protocol is based on TCP/IP and RTP/UDP. It is uniquely designed to traverse difficult network topologies, such as mobile networks with high variability and low-bandwidth WANs with high latency characteristics.

Three technical principles provide the foundation for HDX technologies: intelligent redirection, adaptive compression, and data de-duplication. These work in concert to optimize the user experience, decrease bandwidth consumption, and increase the scalability of the hosting server. HDX technologies enable IT to deliver rich applications irrespective of the networks that the applications and data traverse.

Intel and Citrix—Delivering Optimized, Hosted Rich Graphics Applications Solutions

Intel and Citrix are enterprise leaders working together to deliver a seamless, scalable, and secure workspace experience to anyone across any device. Intel and Citrix have been collaborating for years on a wide range of technology initiatives, spanning Windows, Android*, and Chrome* endpoints, mobility, rich application virtualization, and more. Users and enterprises both benefit from the secure and cost-effective delivery of desktops, applications, and data from the data center to the latest Intel® Architecture-based endpoints.

Conclusion

IT now has an alternative to the traditional approach of virtualizing expensive multi-socket servers to deliver server-hosted rich applications to detailed and final design engineers. Using high-density servers based on the Intel Xeon processor E3-1200 product family with Intel Iris Pro Graphics and running Citrix XenApp or XenDesktop with Citrix HDX technologies and Citrix Receiver client software, IT can deliver the level of performance these designers need—on any device, anywhere, anytime—while keeping TCO low.

Intel Iris Pro Graphics integrates multiple resources, including more EUs with each generation, massive on-package eDRAM to accelerate CPU and GPU performance, hardware acceleration for video processing, and support for today's rich application software APIs.

Intel powers the overwhelming majority of data centers across the globe. The new Intel Xeon processor E3-1200 product family with Intel Iris Pro Graphics was optimized for performance with Citrix software to support hosted rich graphics applications. Intel Xeon processor-based servers with Intel Iris Pro Graphics and Citrix technologies deliver rich, hosted services with workstation-level performance to remote users on any endpoint, including Ultrabook™ devices, Chromebooks*, tablets, and new Intel® Next Unit of Computing (NUC) thin state clients.

With Citrix software solutions, Intel and Citrix enable a clear alternative to simplifying delivery of hosted rich graphics applications at low cost. The joint efforts of both companies enable a user experience that customers expect with their applications—from front office to workstation-level—on any device over any network.

For more information and to begin your hosted rich graphics application concept project to understand the flexibility, efficiency, and cost savings you can achieve, contact your Citrix or Intel representative for a demonstration.

High-Density Virtual Desktops using Citrix XenApp® and Intel® Xeon® Processor E3-1200 Product Family with Intel® Iris™ Pro Graphics

Citrix XenApp® and Citrix XenDesktop® on Intel® Xeon® processor E3-1200 product family with Intel® Iris™ Pro Graphics allow IT to easily support hosted rich graphics applications and enable large numbers of users access to hosted office applications at low cost per user. Recently, Tony Sanchez from Citrix looked at how well this combination of hardware and software on an HP Moonshot* chassis with HP ProLiant* m710 cartridges based on the Intel Xeon processor E3-1200 product family with Intel Iris Pro Graphics could support different workloads.

Mr. Sanchez's tests covered both typical office applications (he calls medium workloads) and rich applications that placed more demand on the CPU and GPU. Here is a summary of his results. Note that server-hosted workload demands can vary widely across companies, so readers should contact Intel or their Intel representative to consider benchmarks and proofs of concept in their own environments.

For details of Mr. Sanchez's work, visit his blog at <http://blogs.citrix.com/2014/10/23/the-eagle-has-landed-citrix-xenapp-is-now-available-on-hp-moonshot-with-intel-graphics/>

Test	Medium Workloads	Rich Applications
VSI Max. Users for One Cartridge	50	42
VSI Max. Users for Fully Populated Chassis (45 Cartridges)	2,319	1,859
Scalability: 1 to 45 Cartridges	Linear Response times: 960 ms ±8 percent	Linear Response times: 965 ms ±4 percent
CPU Utilization	100 percent with 50 users on a single cartridge	100 percent with 42 users on a single cartridge
GPU Utilization	N/A	Maximum of 40 to 45 percent with maximum of 42 users
Power Consumption, Single Cartridge	Full Load: ~50 watts for 50 users Per User: ~1 watt	Full Load: ~65 watts for 40 users Per User: ~1.6 watts
Power Consumption, Fully Populated Chassis	Full Load: 2,500 watts for 2,491 users Per User: ~1 watt	Full Load: ~3,313 watts for 1,800 users Per User: ~1.8 watts

Find Out More

Learn more about how Citrix XenDesktop, XenApp, and the Intel Xeon processor E3 v3 product family with built-in Intel Iris Pro Graphics can transform the way your business collaborates, while reducing cost and risk.

- Citrix XenDesktop: www.citrix.com/products/xendesktop/overview.html
- Citrix HDX 3D Pro: www.citrix.com/products/xendesktop/features/high-def-experience/hdx-3d-pro.html
- Intel Xeon processor E3 product family: www.intel.com/content/www/us/en/processors/xeon/xeon-processor-e3-family.html
- Intel Iris Pro Graphics: www.intel.com/content/www/us/en/architecture-and-technology/hd-graphics/hd-graphics-developer.html



¹ Built-in visual features are not enabled on all PCs and optimized software may be required. Check with your system manufacturer. Learn more at <http://www.intel.com/go/biv>.

² http://www.christenseninstitute.org/key-concepts/disruptive-innovation-2/?gclid=CjwKEAiAoo2mBRD20fvlojj5js5JABMSc7jbUusluY69bd34Bevva5jwQ_Mg-FnmGmDNLXVuOpAoxoCq9Dw_wcB

³ Processor graphics performance is calculated as Number of Graphics Execution Units (EU) x FLOPs-per-EU-per-GHz x 1GHz. 2012: 12 EU x 12 x 1GHz. 2013: 16 EU x 16 x 1GHz. 2014: 40 EU x 16 x 1GHz.

⁴ Baseline Configuration: Intel® Xeon® workstation platform (Intel® S1200RP Board) with one Intel® Xeon® processor E3-1286 v3 (quad-core, 3.7 GHz, 6 M cache) BIOS S1200RP.86B.03.01.0002.041520151123, Intel® HT Technology best configuration, 32 GB memory (4x8 GB DDR3-1600 ECC UDIMM), Intel® Iris™ Pro graphics P6300 with driver 10.18.10.3980, Intel SSDSC2BB300G4, Microsoft Windows 8.1*. Source: Intel internal testing as of June 2015. New Config: Intel® Xeon® workstation platform (Intel S1200RP Board) with one Intel® Xeon® processor E3-1285 v4 (quad-core, 3.5 GHz, 6 M cache) BIOS S1200RP.86B.03.01.0002.041520151123, Intel HT Technology best configuration, 32 GB memory (4x8 GB DDR3-1866 ECC UDIMM), Intel Iris Pro graphics P6300 with driver 10.18.10.3980, Intel SSDSC2BB300G4, Microsoft Windows 8.1. Source: Intel internal testing as of June 2015.

⁵ Measured designed for High Performance gaming PCs on 3DMark® (Fire Strike), and Performance Test on all other 3DMark benchmarks. Measurements E3-1285v4 vs E3-1286v3. 3DMark11 scores using E3-1285 v4: 2881; E3-1286 v3: 1524.

Software and workloads used in performance tests may have been optimized for performance only on Intel microprocessors. Performance tests, such as SYSmark and MobileMark, are measured using specific computer systems, components, software, operations and functions. Any change to any of those factors may cause the results to vary. You should consult other information and performance tests to assist you in fully evaluating your contemplated purchases, including the performance of that product when combined with other products.

Intel technologies' features and benefits depend on system configuration and may require enabled hardware, software or service activation. Performance varies depending on system configuration. No computer system can be absolutely secure. Check with your system manufacturer or retailer or learn more at intel.com.

Copies of documents which have an order number and are referenced in this document, or other Intel literature, may be obtained by calling 1-800-548-4725, or go to: <http://www.intel.com/design/literature.htm>

Intel does not control or audit the design or implementation of third party benchmark data or Web sites referenced in this document. Intel encourages all of its customers to visit the referenced Web sites or others where similar performance benchmark data are reported and confirm whether the referenced benchmark data are accurate and reflect performance of systems available for purchase.

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