

White Paper  
Dual-Core Intel® Itanium® 2  
Processor  
Data Center Planning  
Business-Critical Infrastructure

# Mainframe Reliability at Mainstream Prices

## **Itanium® 2-based Servers Are Changing the Economics of Business-Critical Computing**

As companies worldwide move toward a real-time computing model for core business applications, the cost of downtime is growing. Itanium-based solutions provide a cost-effective way to meet rising requirements, with enterprise-class solutions that are more flexible, affordable and widely supported than those based on proprietary RISC and mainframe architectures.

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*"The Intel-based servers give us great performance and responsiveness—and the reliability is well beyond 99.999 percent."*  
- Michael E. Smith, vice president and general manager of operations, *Forbes.com*

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# Executive Summary

The pace of business is accelerating around the globe, as leading companies in compute-intensive industries, such as financial trading, manufacturing, and retail, move toward a real-time business model in which transactions and information sharing are near-instantaneous. This transition is putting increasing demands on the performance, capacity and availability of enterprise databases and core business applications. As processes are integrated and timelines are compressed from weeks or days, to hours, minutes or even seconds, the cost of downtime skyrockets.

Itanium-based solutions offer an answer to this challenge by delivering mainframe-class availability on a flexible and scalable architecture specifically designed to support business-critical environments. The Intel® Itanium® 2 processor provides extensive reliability, availability and serviceability (RAS) features, and many of today's most respected system vendors are building on this foundation to deliver comprehensive solutions for demanding, data-intensive applications. As one example, an Itanium 2-based system now supports an industry-leading 7-nines availability (99.99999 percent uptime), and multiple Itanium 2-based system vendors offer robust and highly redundant systems that deliver 5-nines and higher availability.

With these resources, IT organizations have a more flexible and affordable alternative to mainframe and high-end RISC systems for consolidating their infrastructure and hosting business-critical applications. Whether they choose to scale up on large, multi-processor servers or scale out on clustered smaller systems, they have a wide range of vendor options, and can choose from over 8,000 optimized applications and more than 10 operating systems (OSs), including Linux, Windows and UNIX.

The Itanium-based solutions community is growing worldwide, and the new Dual-Core Intel® Itanium® 2 processor is fueling that growth by doubling performance and compute density compared with previous generations, while simultaneously reducing power consumption. Meanwhile, future processors and platforms are already in development that will continue to take performance, scalability and availability to new levels. As the era of real-time business computing gains momentum, Itanium-based solutions can help businesses keep pace with rising requirements, so they can stay competitive in today's rapidly changing business environment.

## The Growing Need for High Availability

Volatile markets and global competition are putting intense pressure on large businesses to respond more quickly to emerging opportunities and challenges. At the same time, today's complex regulatory requirements are demanding new levels of transparency across the organization. These and many other factors are driving a broad move toward the real-time enterprise in which the marketplace, the supply chain and internal operations are monitored in real time, and appropriate information is available to decision-makers at all levels.

As businesses move toward this real-time computing model, the cost of application downtime escalates, especially for the core solutions that coordinate the organization, such as enterprise databases, enterprise resource planning (ERP), supply chain management (SCM), customer relationship management (CRM) and business intelligence (BI) applications.

Delivering necessary levels of IT service availability in this environment requires a comprehensive approach that takes into account people and processes, as well as technology. It requires:

- Highly trained staff
- Extensive hardware and software testing
- Rigorous change management
- Well-established emergency procedures
- Redundant architectures
- Highly reliable platforms

With sufficient investment, any level of availability can be achieved. But cost has traditionally been prohibitive as businesses move from 3-nines availability (99.9 percent), to 4-nines (99.99 percent), to 5-nines (99.999 percent) and beyond.<sup>1</sup>

The constant change in today's IT and business environment adds to the challenge. High availability, alone, is not enough. Solutions must be scalable, flexible and affordable so IT organizations can adapt to growing workloads, changing business needs and new technologies. This requires a flexible, standards-based architecture that is built for the highest levels of availability. For an increasing number of businesses worldwide, Itanium-based solutions are providing the answer, enabling them to tailor their systems and infrastructure designs to deliver virtually any level of availability at substantially lower cost than proprietary RISC and mainframe architectures.

### Case Study: High-Availability in Action

#### Forbes.com

- World's leading business Web site
- 14-15 million unique visitors each month
- More than 2,000 stories published daily

Forbes.com delivers news, information, analysis and advice to a demanding audience of affluent and influential business leaders, along with precisely targeted advertising from some of the world's leading companies. Success depends on fast, uninterrupted delivery of media-rich content, and on sophisticated data-mining tools that help channel the right advertising to the right visitors. To make it work, Forbes.com has standardized much of its infrastructure on Intel processor-based servers running the Linux operating system, with Itanium-based systems handling the most demanding, business-critical workloads.

***"The Intel-based servers give us great performance and responsiveness—and the reliability is well beyond 99.999 percent,"*** says Michael E. Smith, vice president and general manager of operations. ***"Whatever our advertisers want to try, our Intel server platforms give us the confidence that we can deliver."*** They also give Forbes.com the flexibility to scale quickly and cost-effectively as workloads grow, while maintaining 24/7 service delivery that keeps their readers—and their advertisers—happy.

Read the Intel case study at:

[www.intel.com/business/casestudies/forbes.pdf](http://www.intel.com/business/casestudies/forbes.pdf)

## Fundamental Strategies for High Availability

High availability depends on redundancy of hardware, software and support. At the hardware level, there are basically two ways to provide this redundancy. One is by scaling out applications on multiple servers via clustering. The other is by scaling up on large, multi-processor servers that have been built with a high degree of internal redundancy.

Itanium-based systems support both approaches. However, the breakthrough value of Itanium architecture is most pronounced in scale-up implementations, since it provides a standards-based computing architecture specifically designed to scale effectively

<sup>1</sup> 99.9 percent availability implies potential downtime of up to 8.75 hours per year; 99.99 percent implies up to 52.5 minutes per year; 99.999 percent up to 5.25 minutes per year; etc.

in large, shared-memory systems (8-way and beyond).<sup>2</sup> This makes Itanium-based systems excellent alternatives to expensive, proprietary architectures for enterprise-class, scale-up computing.

**When to Scale Up on Itanium-Based Systems**

The first step in choosing a scale-up versus scale-out computing strategy is to understand application requirements (Figure 1). Scale-up is ideal for most enterprise-class data-tier solutions (database, data warehouse, business intelligence, etc.), since the majority of these applications are architected to scale effectively on large, shared memory systems. This is also true for most large ERP, SCM and CRM applications.

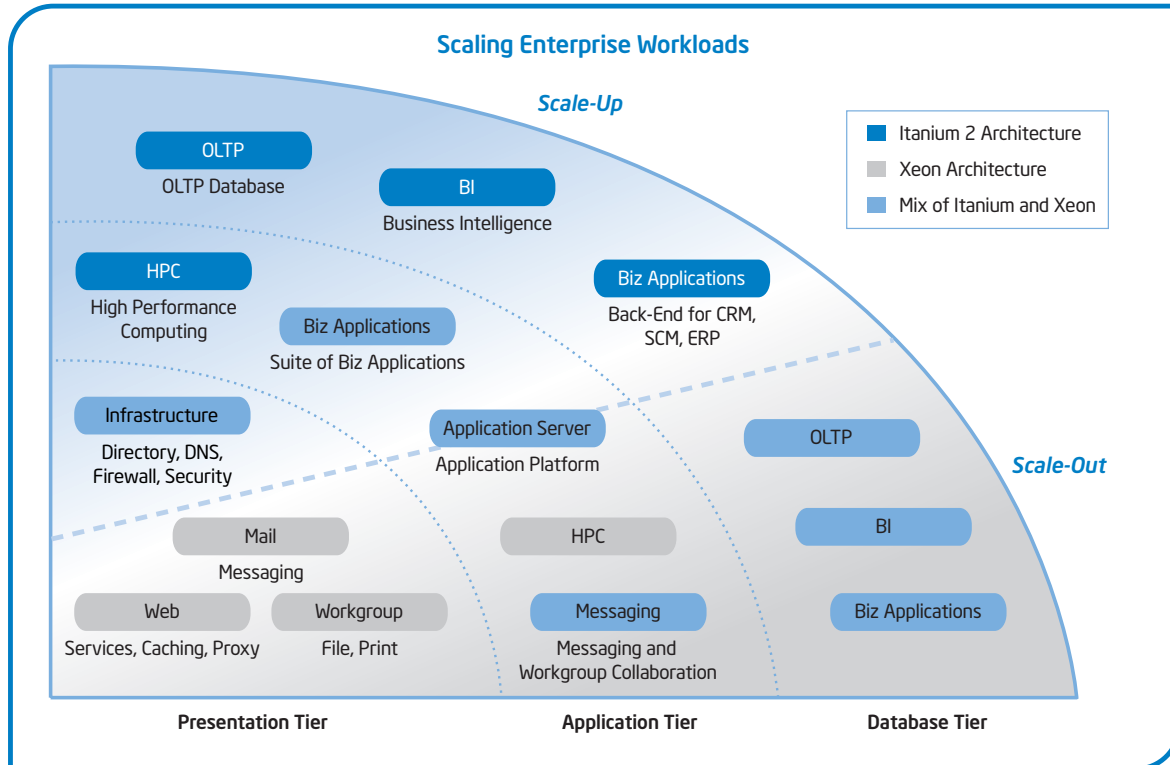
The simpler workloads of front-end and network edge applications, on the other hand, tend to scale very effectively across multiple systems in scale-out clusters, as do many applications in the application tier of the data center. Tasks and transactions for these applications are typically more self-contained, so workloads are easily distributed across multiple, identical servers.

**Advantages of Scaling Up**

Workloads are not the only factor in choosing scale-up versus scale-out computing solutions (Figure 2). In general, scale-out computing has a lower entry cost. It also enables very modular, pay-as-you-grow scaling, since servers can be added to the cluster as needed.

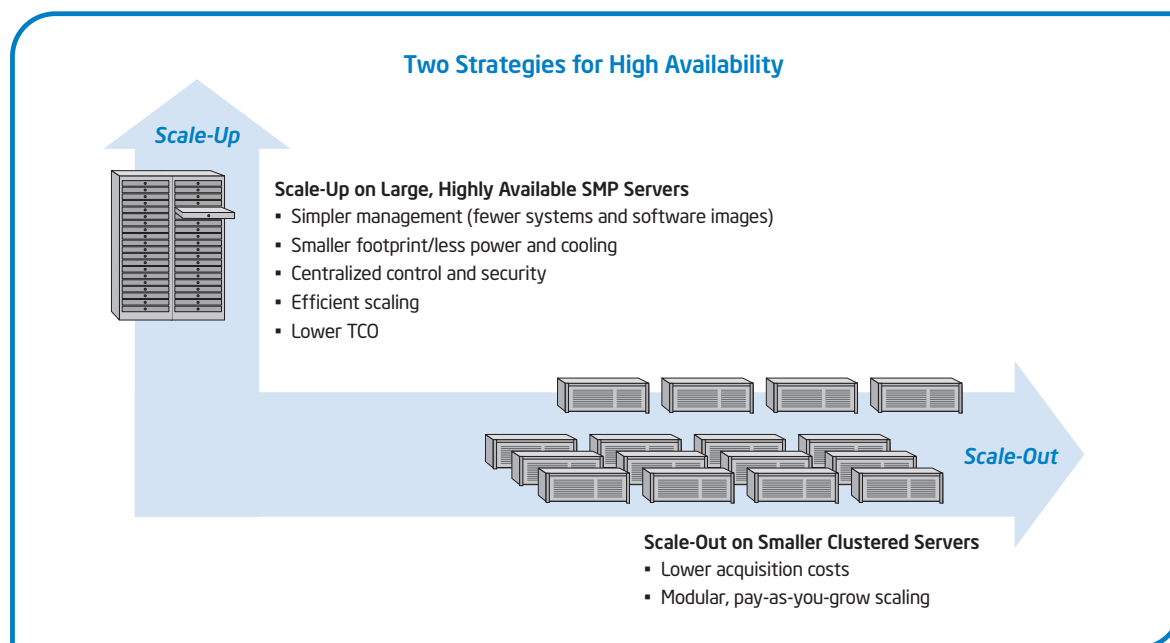
However, scale-up solutions typically provide lower total cost of ownership (TCO). With fewer systems and software images, they are easier to manage and they consume less space, power and cooling resources in the data center. They also tend to scale more efficiently, through the addition of processors, memory and I/O to the existing system. Centralized, single-system management brings additional benefits, including better control of the hardware, software and security environment. These are critical advantages in today's complex and overcrowded data centers, and many organizations are even moving toward larger, individual servers for their scale-out implementations (see the sidebar, Virtualization for Flexible Availability).

**Figure 1.** High availability for some enterprise applications is best provided by scaling up on large, highly available, shared-memory servers. For other applications, it is best achieved by scaling out on clusters of 4-way and smaller servers.



<sup>2</sup> Intel® Xeon® processor-based servers also scale beyond 8-way configurations. In general, Itanium-based systems are a better choice for data-intensive and business-critical applications, and the performance advantages tend to increase in larger SMP configurations. For more information, see the Itanium Solutions Alliance white paper, Itanium 2-based Solutions and the x86 Architecture: Optimizing IT Value by Mixing and Matching Industry-Standard Server Platforms: [www.itaniumsolutionsalliance.org/news/whitepapers\\_brochures/Itanium\\_and\\_x86\\_white\\_paper.pdf](http://www.itaniumsolutionsalliance.org/news/whitepapers_brochures/Itanium_and_x86_white_paper.pdf)

**Figure 2.** Though both scale-up and scale-out solutions can be architected to deliver virtually any level of availability, they have different impacts on IT costs and operations.



### Virtualization for Flexible Availability

Virtualization is a key technology that helps IT organizations optimize utilization, improve availability and consolidate large numbers of smaller applications to reduce both capital and operational costs. New Dual-Core Intel Itanium 2 processor-based systems provide silicon-level support for virtualization via Intel® Virtualization technology, to improve the robustness, interoperability and supportability of virtualization solutions.

Current options for virtualization on Itanium-based systems include Xen\*, SWSoft's Virtuozzo\* and a number of vendor-specific solutions from leading server manufacturers, such as Bull, Fujitsu, Fujitsu-Siemens, Hitachi, HP, Unisys and others. Many of these solutions are ideal for consolidating multiple operating environments (Windows, Linux, UNIX, etc.) on a single system, and support both hard and soft partitioning to dynamically align IT infrastructure with business workloads. With the growing market success of Itanium-based solutions, software development is accelerating, and new solutions and capabilities can be expected to emerge over the next few years.

### Mainframe Reliability at Mainstream Prices

*"IDC believes that Intel has now closed the gap between the high-end system vendors..."<sup>3</sup>*

When it comes to scaling up enterprise applications, the mainframe was the gold standard for many years. But traditional mainframes are based on expensive, proprietary hardware and software technologies that can severely limit a company's options. This has become an increasingly important issue in recent years as business and technology cycles have accelerated. Many companies today feel trapped on their mainframes, caught between excessive operating costs and the high costs of migrating complex, custom applications.

Because of these limitations, thousands of businesses turned to high-end RISC systems for enterprise computing. These systems were less expensive than a mainframe, and somewhat more flexible. But they were still proprietary, and much more expensive than industry-standard servers.

With Itanium-based systems, companies now have a more flexible and affordable alternative to both RISC and mainframe systems. Intel Itanium microarchitecture was designed from the ground up to

<sup>3</sup> Source: "Intel's Itanium 2 9000 Series Brings an Industry-Wide Inflection Point to the Data Center," by Vernon Turner, IDC, July 19, 2006, Document # Icus20262506.

support mainframe-class availability and scalability at relatively low cost. It incorporates a wide range of built-in RAS features to support advanced availability and data integrity.

#### Case Study: High-Availability in Action

##### Mobiltel

- Bulgaria's leading telecommunications company
- More than 60 percent market share
- Over 2.5 million subscribers

A rapidly growing subscriber base was placing increasing pressure on Mobiltel's customer service organization, and on the company's CRM and billing systems. To accommodate this growth while providing better customer service and simplifying the IT infrastructure, the company migrated to Intel Itanium 2 processor-based servers running HP-UX\* and Microsoft Windows Datacenter\* in a virtual server environment. The solution has helped the company move forward with greater confidence, not only by improving performance but by providing a more scalable, reliable and affordable IT environment.

***"Our databases are now continuously available to support customers,"*** says Simeon Dimitrov, Mobiltel's department manager for IT Resources and Administration. ***"With Itanium® 2-based microarchitecture, our enterprise-level applications can rapidly analyze terabytes of data. In addition, Mobiltel has saved 60 percent on software licenses and technical support, because we're using fewer CPU resources and strong Intel Itanium 2 processors. This strategy allows us to apply several hundred thousand dollars in savings to acquire more resources that will enable further business growth."***

Read the Intel case study at:

[www.intel.com/business/casestudies/mobiltel.pdf](http://www.intel.com/business/casestudies/mobiltel.pdf)

Of course, high solution availability requires far more than advanced RAS features in the processor. It requires a complete, highly redundant platform architecture that is closely integrated with a stable and resilient operating environment. A wide range of today's leading platform vendors are filling this need, including Bull, Fujitsu, Fujitsu Siemens Computers, Hitachi, HP, NEC, SGI, Unisys and many others. Using the Intel Itanium 2 processor as the foundation, these vendors are using their extensive experience in mainframe and high performance computing to deliver comprehensive systems, software, services and support for business-critical environments. With these resources, IT organizations can achieve virtually any level of availability and scalability required by their business environment.

#### Flexible Solutions for Diverse Needs

An Itanium-based system is available today that delivers an industry-leading 7-nines availability (99.99999%) out of the box.<sup>4</sup> That means an average system will run 20 years without scheduled or unscheduled downtime.<sup>5</sup> Many other systems are available that target the more standard 5-nines (99.999%) availability. Most important, these solutions typically enable substantially lower total cost of ownership (TCO) than today's proprietary systems, and are available across a wider range of applications and operating environments.

- **Mainframe Modernization**—Itanium-based systems are available today that can run the IBM z/OS\* and OS/390 operating systems—in addition to Linux, UNIX and Windows—while providing mainframe RAS, scalability, management and partitioning capabilities. These systems provide an ideal strategy for modernizing mainframe environments and simplifying integration with today's increasingly open, standards-based solutions. Legacy applications can be consolidated alongside new applications, and migrated to standards-based operating systems if and when appropriate. For more information, visit the Platform Solutions Incorporated Web site, at: [www.platform-solutions.com](http://www.platform-solutions.com)
- **RISC Replacement**—Itanium-based systems support a variety of UNIX environments, including HP-UX, HP Open VMS and HP NonStop. In addition, binary translation solutions from Transitive Corporation ([www.transitive.com/](http://www.transitive.com/)) will soon enable leading vendors to deliver Itanium-based systems that can run applications compiled for Sun Solaris and other RISC-based operating environments—

<sup>4</sup> 99.99999 percent availability is supported off-the-shelf by the HP Integrity Non-Stop\* family of servers. For more information, see the HP Web site, at: <http://h20223.www2.hp.com/NonStopComputing/cache/121352-0-0-0-121.html>

<sup>5</sup> HP Non-Stop systems also scale to more than 4,000 processors, which provides tremendous scalability, in addition to unsurpassed availability. These systems have proven their value in many of today's most demanding and business-critical environments. For details, see the HP product brochure, at: <http://h71028.www7.hp.com/ERC/downloads/4AA0-0557ENw.pdf>

with no code changes and near native performance. This will further simplify migration for companies that are looking for a more flexible, affordable and widely supported architecture.

- **Scaling Up Windows and Linux Solutions**—Windows and Linux OSs are finding their way into increasing numbers of business-critical environments.<sup>6</sup> Combined with Itanium-based systems, they provide businesses with robust and affordable alternatives for scaling up existing applications—without the cost and risk of an OS migration. With the growing popularity of Itanium-based systems, the integration of business-critical capabilities into these OSs has accelerated, and future versions will be even more robust and include an increasing number of mainframe-inspired features.<sup>7</sup>
- **Scaling Out on Itanium-based Systems**—As already mentioned, Itanium-based systems are not limited to scale-up strategies. They are widely available in 2-way and 4-way servers and blades that can be clustered to support virtually any level of scalability and availability for data-intensive applications in scale-out environments. Systems are available today that support Intel Itanium 2 and Intel Xeon processor-based blades in the same enclosure, providing a dense, manageable, and flexible way to run the full range of enterprise applications on a preferred mix of Windows, Linux, and UNIX operating systems. With this approach, IT organizations can support all their data center computing needs on a highly consolidated and consistent hardware architecture.

## A Standards-Based Foundation

The Intel Itanium 2 processor was designed from its inception to deliver mainframe-class availability for the most demanding, data-intensive workloads. It incorporates extensive RAS capabilities for detecting, correcting and containing the kinds of unavoidable errors that can bring down systems or corrupt enterprise data. This includes soft errors, which occur when an alpha particle or cosmic radiation changes the state of a transistor. It also includes hard errors, such as a failed memory bit, line or device.

Intel does much to address these issues during the design process, using circuit design methods, design tools, and simulation to identify and address potential errors. Extensive RAS technologies are also built into Intel Itanium 2 processors to take this protection to the next

### Case Study: High-Availability in Action

#### First American Title Insurance Company

- Second largest title insurance company in the U.S.
- Manages more than 25 percent of the country's title insurance business
- Relies on a 1.7 TB database to support up to 15,000 daily users

With a single title and escrow application supporting more than 1,300 offices nationwide, uninterrupted operation was a primary concern for First American Title Insurance Company. As workloads grew beyond its 32-way solution, the company evaluated various RISC and open-source alternatives and decided to migrate to Intel Itanium 2 processor-based servers running the Windows operating system. According to Larry Godec, CIO for First American, ***"This is our core system to produce our product. We have close to 15,000 people banging on it over the course of the day, especially during month end, when we are inundated with closings. It is absolutely critical that the system be available. With the Itanium 2-based solution, we have consistently exceeded our service level agreement to our users."***

The migration also allowed the company to take advantage of existing in-house skills in Microsoft and Intel solutions, and has delivered the performance and scalability they need to improve productivity and support continuing growth. Says Godec, ***"In our industry, there is always more pressure to produce our products faster and cheaper. The FAST Transaction System and the Intel® Itanium® 2 processor enable us to do exactly that. They allow us to optimize our work processes and create our title products much quicker and much more seamlessly for much less money."***

Read the Intel case study at:

[www.intel.com/business/casestudies/first\\_american\\_title.pdf](http://www.intel.com/business/casestudies/first_american_title.pdf)

<sup>6</sup> In a report on Microsoft Windows Server 2003\*, Datacenter Edition, for example, Gartner cites *"a proven track record of 99.99% and higher availability."* Source: Microsoft Windows Server 2003, Datacenter Edition Operating System, by Mary I. Hubley and MaryAnn Richardson, Gartner Research, Inc., March 10, 2005.

<sup>7</sup> As one example, future versions of both Linux and Windows are expected to include the ability to dynamically reconfigure hardware resources during runtime, in response to workload variations or component failures.

level by continually monitoring critical functions. These technologies can detect a wide range of hard and soft errors, and automatically correct or work around many of them (Table 1).

**Enhanced Machine Check Architecture**

The Intel Itanium 2 processor also includes an Enhanced Machine Check Architecture, with well-defined interfaces for error handling at the hardware, firmware and OS levels (Figure 3). This enables efficient coordination throughout the platform, with appropriate handoffs to escalate corrective action as needed and to initiate reporting functions. It greatly reduces the likelihood of data corruption, and virtually eliminates the chances of a hung server, since it can automatically reset the system in response to an otherwise fatal error.

In combination with the advanced RAS features incorporated by Itanium-based system vendors, this enables a level of availability that was previously possible only with high-end proprietary platforms. It also provides a robust, standards-based foundation that makes it easier for component, platform, firmware and OS developers to coordinate their efforts in enhancing current and future availability solutions. Each vendor can optimize error handling capabilities in its

own hardware and software components, and know that the standards-based interfaces will enable seamless integration.

Vendors have used this framework to integrate a wide range of high availability features. Examples include memory mirroring and processor lock-step support, which go beyond hardware redundancy and failover to provide redundancy in data and processing, which enables even higher levels of data integrity and application resiliency.

**Built-in Security Support**

High availability requires strong security in today's internet-connected computing environments, and Intel Itanium 2 microarchitecture includes advanced security features that offer fundamental advantages for protecting business systems, applications, data, and transactions. These features include 4 privilege levels (versus only 2 in RISC architectures), support for more than 16 million memory protection keys, and ultra fast parallel throughput for encryption algorithms. Software solutions are on the way that will help businesses take advantage of these capabilities to enhance the security of existing applications and networks (see the sidebar, Better Security for Enterprise Networks).

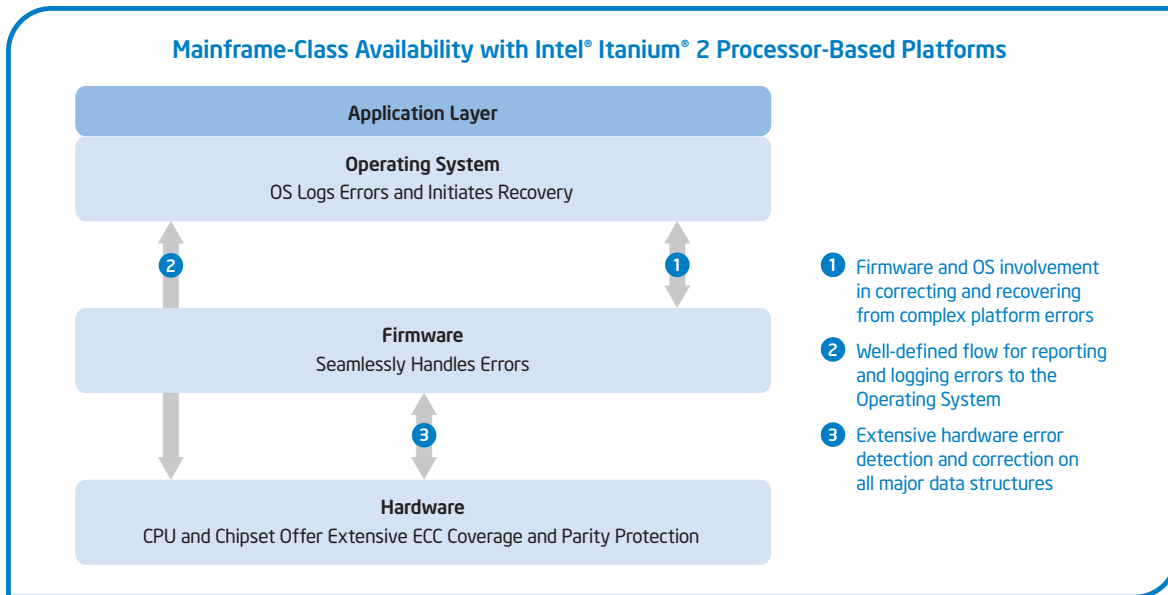
**Table 1.** The RAS features of leading Itanium-based servers rival those of traditional mainframes, but at much lower cost and with greater choice and flexibility (see Appendix A for an explanation of RAS technologies).

RAS Capability <sup>a</sup>	Intel® Itanium® 2 Processor-Based Systems	Mainframe	RISC
Cache Reliability	✓ (Intel® Cache Safe Technology—New <sup>b</sup> )	✓	✓
Processor Lockstep Support	✓ New <sup>b</sup>	✓	
Recovery From Data Bus Error	✓	✓	✓
Cache ECC Coverage	✓	✓	✓
Enhanced Machine Check Architecture	✓		
Bad Data Containment	✓	✓	✓
Memory Single Device Error Correct	✓	✓	✓
Memory Retry on Double-Bit Error Detect	✓	✓	✓
Memory Spares	✓	✓	✓
Hardware Partitioning	✓ Node	✓ Core	✓ Node
Electrically Isolated Partitions	✓ Node	✓	✓ Node

<sup>a</sup> Listed features are supported by one or more system vendors.

<sup>b</sup> Available in selected systems based on the new Dual-Core Intel Itanium 2 processor.

**Figure 3.** The Enhanced Machine Check Architecture of Intel Itanium 2 processor-based servers supports mainframe-class availability for enterprise-critical applications. As a standards-based framework, it will simplify vendor collaboration and help drive increasing levels of availability in future platforms.



### Better Security for Enterprise Networks

*"Itanium is ideal for solving the security problems associated with delivering mission-critical content on the Web edge."<sup>a</sup>*

The core security architecture in today's most popular operating systems and hardware architectures has been around for decades, and was never designed for the openness of the Internet. The Intel Itanium 2 microarchitecture was designed for these needs, and Secure64 ([www.secure64.com](http://www.secure64.com)) is developing software that takes advantage of its advanced capabilities to deliver mainframe-class security on industry-standard, Itanium-based servers.

Secure64's SourceT Platform Control Software\* supports guest operating systems to enable substantially higher security and better performance for existing enterprise applications (applications can also be written directly to the Secure64 OS kernel). Through incremental migration, businesses will be able to fundamentally improve the security, scalability, and performance of their business-critical, Internet-connected systems, and begin reducing the heavy burden of today's patchwork security solutions.

<sup>a</sup> Source: The 64-bit Inflection Point, by Bill Worley, Jr., PhD and Peter J. Cranstone: [www.secure64.com/products/64-Bit\\_Inflexion\\_Paper-FINAL1.pdf](http://www.secure64.com/products/64-Bit_Inflexion_Paper-FINAL1.pdf)

### Beyond Availability—Performance, Scalability, and Choice

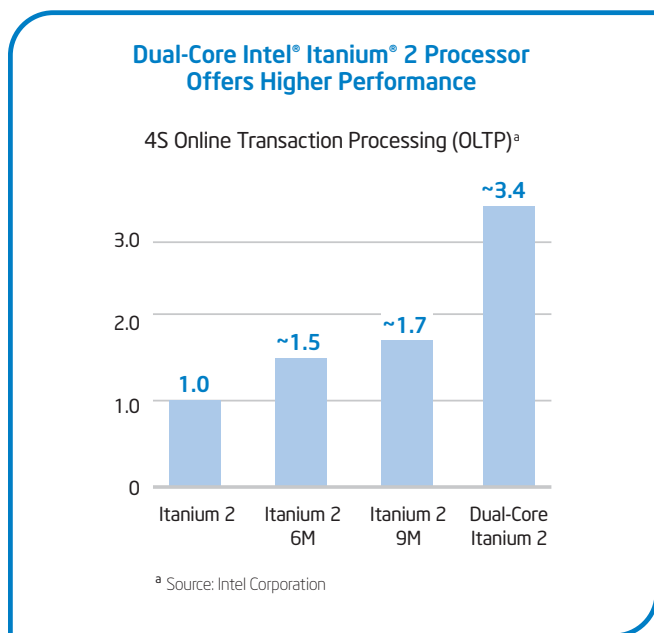
In addition to mainframe-class RAS, Itanium-based systems offer exceptional performance and scalability, along with unprecedented choice for enterprise implementations. Currently available systems range in size from 2-way servers and blades; to SMP servers with as many as 512 processors and 128 terabytes of globally shared memory; to clusters with up to 10,000 processors.

In addition, the architecture supports more than 10 operating systems and more than 8,000 optimized tools and applications. This more than doubles the number of applications available a year ago, and the rate of porting continues to increase. Soon-to-be-released binary translation products will add many thousands of additional applications, by enabling Itanium-based systems to run software that was compiled for Sun Solaris and other RISC-based operating systems—with no code changes and near native performance. With these options, Itanium architecture now offers unprecedented flexibility for supporting diverse solutions on a consistent hardware platform.

Performance for Itanium-based systems has been increasing steadily over the past few years, and the new Dual-Core Intel Itanium 2 processor provides another dramatic leap, delivering twice the performance of the previous generation, and up to 2.5 times the energy efficiency (Figure 4).<sup>8</sup>

The new processor also includes built-in, silicon-level support for virtualization, and a number of new RAS features, including Intel® Cache Safe Technology. This technology provides sophisticated error detection and correction across the large Level 3 cache architecture (up to 24 MB). It also can disable defective cache lines without interrupting operation. This advanced cache protection provides an important safeguard in today's data-dense environments, and is just one part of Intel's long-term roadmap for enhancing the fundamental RAS capabilities of Intel Itanium microarchitecture. As progress continues, Itanium-based system vendors will have an increasingly robust foundation for delivering the highest levels of availability and scalability on a flexible, cost-effective and widely supported architecture.

**Figure 4.** The new Dual-Core Intel Itanium 2 processor delivers another critical step in the ongoing performance ramping of Itanium-based systems. It also provides new RAS features, reduced power consumption, and advanced, silicon-level support for virtualization.



**Case Study: High-Availability in Action**

**Bank of New York**

- The oldest bank in the U.S.
- \$103.6 billion in assets
- 23,500 employees; over 33 locations worldwide

Growth brought challenges for G-Trade, a division of the Bank of New York, when orders submitted by traders began to exceed the memory capacity of a core trading application. Better performance and scalability were essential, as was the highest level of availability: ***“We have no patience for failure or downtime when it comes to hardware,”*** says Joe Wiseboard, head of technology for G-Trade. To eliminate problems and support cost-effective growth, G-Trade migrated its application from eight 32-bit RISC-based systems to just two Intel Itanium 2 processor-based servers running a Microsoft Windows OS.

The migration was smooth, involving seven IT staff members for a total of two person-months. ***“We just plugged it in and brought it up,”*** said Gerry Verdone, head of infrastructure for G-Trade. ***“All of our problems simply went away. I wish all of our implementations could go as smoothly as this did.”*** The migration has continued to deliver high value. The company estimated the move has saved them more than \$1 million in costs, and has had a positive impact on revenue. When asked to discuss negative aspects, Verdone had little to add: ***“After all, how can you argue with 100% uptime, staff time, and cost savings, together with 400%-500% improvement in our ability to handle transaction volume?”***

Read the Meta Group case study at: [www.intel.com/business/casestudies/bny\\_trading.pdf](http://www.intel.com/business/casestudies/bny_trading.pdf)

<sup>8</sup> Performance measured using OLTP (NT/SQL), SPECjbb2005, SPEC CPU, Linpack, and SAP-SD. Intel Internal Measurement (March, 2006) comparing system configurations of Dual-Core Intel® Itanium® 2 processor 1.6GHz with 24MB L3 cache to Intel® Itanium® 2 processor 1.6GHz with 9MB L3 cache. Actual performance may vary. See: [www.intel.com/performance/server/itanium2](http://www.intel.com/performance/server/itanium2).

# Conclusion

As the transition to real-time business computing accelerates, the cost of downtime continues to grow—and so does the importance of a flexible and affordable infrastructure that can be adapted easily as requirements change. For an increasing number of businesses worldwide, Itanium-based solutions are filling this need. By supporting mainframe-class availability and scalability on a flexible and widely supported hardware architecture, they are enabling businesses to substantially decrease total costs, and to avoid locking themselves into proprietary architectures that limit their options going forward.

Some of the world's most respected system vendors are delivering Itanium-based solutions designed for today's most demanding, business-critical environments. As companies continue to modernize and consolidate their critical business applications, they will increasingly find that Itanium-based solutions offer unprecedented value and long-term investment protection.

## Appendix A: Glossary of RAS Technologies

Intel® Itanium® 2 Processor	Intel® Xeon® Processor MP	Intel Xeon Processor	
<b>Data Center Enabling Technologies</b>			
✓	✓	✓	<b>Intel® Virtualization Technology:</b> Provides hardware support for virtualization, which enables today's software-only solutions to be more robust, secure and supportable.
<b>Platform Error Handling and Containment</b>			
✓+	✓	✓	<ul style="list-style-type: none"> <li>✓ <b>Machine Check Architecture:</b> Provides integrated capabilities for logging, reporting, and handling errors.</li> <li>✓+ <b>Enhanced Machine Check Architecture:</b> Provides more advanced error-handling capabilities, with well-defined interfaces at the hardware, firmware, and OS levels.</li> </ul>
✓+	✓+	✓	<p><b>Data Bus Error Checking and Repair:</b></p> <ul style="list-style-type: none"> <li>✓ System supports parity or Cyclic Redundancy Checking (CRC) on the data bus to detect errors.</li> <li>✓+ System supports Error Correction Code (ECC) and has the ability to retry the transaction. It can both detect and correct errors without downtime.</li> </ul>
✓	✓	✓	<b>Cache ECC Coverage:</b> Cache arrays are protected with ECC, so a soft error in a memory cell can be detected and corrected. Without this capability, the program would have to be terminated, and the whole system would most likely have to be reset.
✓ (Processor Level)	✓ <sup>a</sup>		<b>Lockstep Support:</b> The same program can be run on two processors using the same data. Outputs are checked every clock cycle to assure data has not been corrupted.
✓			<b>Bad Data Containment:</b> The system can tag a memory location that contains corrupted data (this is sometimes called "data poisoning"). The impact of the corrupted data is limited to the program using it at the time, and the bad data is eliminated when the program is finished or when it overwrites the location. This capability greatly reduces the need to reset a system if data is corrupted.
✓	✓		<b>Cache Reliability (Intel® Cache Safe Technology):</b> Goes beyond ECC to further enhance the reliability of processor cache memory.
✓	✓	✓	<b>Memory Single Device Error Correction (SDEC):</b> Enables the system to correct all memory errors if a single DRAM device fails. <sup>b</sup>
✓	✓	✓	<b>Memory Retry on Double-bit Error Detect:</b> ECC can detect double-bit errors, but can correct only single-bit errors. In the event of a double-bit error, this enables the memory controller to retry the memory read, which may correct the error.
✓	✓	✓	<b>Memory Spares:</b> Allows a failed memory device to be transparently replaced by a spare device. This improves performance, by eliminating the performance loss caused by ECC correction. It also improves reliability, since it can correct multiple soft errors in a memory device (ECC can correct only single errors).
✓+	✓+	✓	<p><b>Partitioning:</b> A large computing system can be divided into multiple smaller partitions. The partitions have dedicated resources (which can often be shifted among them), can run different operating systems, and are isolated from software or resource faults in other partitions. Partitioning reduces overall cost of ownership, since the partitions are managed as a single system.</p> <ul style="list-style-type: none"> <li>✓ All Intel processor-based server platforms support logical partitioning using 3rd party software virtualization solutions (see Intel® Virtualization Technology, above).</li> <li>✓+ Hardware partitioning is supported by several platform vendors.</li> </ul>
✓	✓		<b>Electrically Isolated Partitions:</b> Electrical isolation prevents hardware faults in one partition from affecting another. This enables multiple applications to be run on a single system, while maintaining a level of isolation comparable to running them on physically separate systems. It is also necessary to allow resources (such as a new processor board or memory board) to be added to a partition while other partitions continue running.

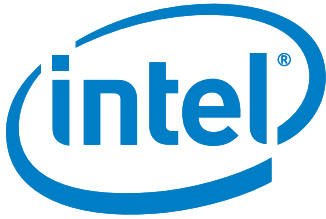
<sup>a</sup> Lockstep is supported by selected vendors via enabled chipsets and platforms.

<sup>b</sup> Called "chipkill" by IBM.

## Appendix B: Enterprise-Critical Solutions on Intel Architecture

The following Web sites offer information about specific vendor offerings for fault-tolerant Itanium-based solutions:

- Bull (NovaScale\*): [www.bull.com/novascale/](http://www.bull.com/novascale/)
- Fujitsu (PRIMEQUEST\*): [www.fujitsu.com/global/services/computing/server/primequest/](http://www.fujitsu.com/global/services/computing/server/primequest/)  
(Primergy\*): [www.shopfujitsu.com/www/products\\_primergy.shtml?products/servers/primergy/PRIMERGY](http://www.shopfujitsu.com/www/products_primergy.shtml?products/servers/primergy/PRIMERGY)
- Fujitsu Siemens (PRIMEQUEST): [www.fujitsu-siemens.com/products/mission\\_critical/index.html](http://www.fujitsu-siemens.com/products/mission_critical/index.html)  
(Primergy): [www.fujitsu-siemens.co.uk/products/standard\\_servers/rack/primergy\\_rxi600.html](http://www.fujitsu-siemens.co.uk/products/standard_servers/rack/primergy_rxi600.html)
- Hitachi (BladeSymphony–English): [www.hitachi.co.jp/products/bladesymphony\\_global/](http://www.hitachi.co.jp/products/bladesymphony_global/)  
(BladeSymphony–Japanese): [www.hitachi.co.jp/products/bladesymphony/index.html](http://www.hitachi.co.jp/products/bladesymphony/index.html)  
(HA8500–Japanese): [www.hitachi.co.jp/Prod/comp/OSD/pc/ha8500/index.html](http://www.hitachi.co.jp/Prod/comp/OSD/pc/ha8500/index.html)  
(HA8500–English pdf): [www.hqrd.hitachi.co.jp/crle/news\\_pdf\\_e/ha8500.pdf](http://www.hqrd.hitachi.co.jp/crle/news_pdf_e/ha8500.pdf)
- HP (Integrity\*): [www.hp.com/products1/servers/integrity/](http://www.hp.com/products1/servers/integrity/)
- HP (NonStop Advanced Architecture\*):  
<http://h20223.www2.hp.com/NonStopComputing/cache/77119-0-0-121.html>
- Microsoft (Windows Server 2003\*, Datacenter Edition):  
[www.microsoft.com/windowsserver2003/evaluation/overview/datacenter.msp](http://www.microsoft.com/windowsserver2003/evaluation/overview/datacenter.msp)
- NEC: [www.necam.com/servers/products/](http://www.necam.com/servers/products/)
- SGI: [www.sgi.com/products/servers/altix/](http://www.sgi.com/products/servers/altix/)
- Unisys (ES7000\*): [www.unisys.com/products/enterprise\\_servers/high\\_d\\_end\\_servers/index.htm](http://www.unisys.com/products/enterprise_servers/high_d_end_servers/index.htm)



[www.intel.com/go/itanium](http://www.intel.com/go/itanium)

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