White Paper

Dual-Core Intel® Itanium® Processor

Data Center Planning

Mission-Critical Infrastructure

Mainframe Reliability on Industry-Standard Servers

Intel® Itanium®-based Servers are Changing the Economics of Mission-Critical Computing

Downtime costs are skyrocketing in today's real-time, 24/7 business world. Intel® Itanium®-based servers offer a cost-effective solution, with enterprise-class systems that rival mainframes and high-end RISC systems for availability, yet are more flexible, affordable and widely supported.

Table of Contents

Executive Summary

Companies around the world are moving toward real-time business models 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 more and more processes are integrated, and as timelines are compressed from weeks or days, to hours, minutes or even seconds, the risks and associated costs of downtime skyrocket.

Itanium®-based solutions offer a cost-effective answer to this challenge by delivering mainframe-class scalability and availability on flexible, industry-standard servers. Systems are available today that support an industry-leading 7-nines availability (99.99999 percent), and multiple vendors offer Itanium-based systems designed specifically to provide 5-nines and higher availability.

This gives IT organizations a much needed alternative to costly mainframe and high-end RISC systems for mission-critical applications. They can consolidate Linux,* Windows* and UNIX* applications onto a single widely supported hardware architecture, and they can choose from dozens of server vendors and more than 12,000 applications as their needs evolve.

Market share for Itanium-based servers is strong and growing, and businesses can expect to benefit from rapid, ongoing innovation and increasing hardware, software and vendor options. As the era of real-time business computing gains momentum, Itanium-based solutions can help businesses keep pace with rising requirements more quickly and at lower cost – so they can be more competitive as business models and computing needs continue to evolve.

The Growing Importance of High Availability

"IT is being pushed to deliver mainframe-class RAS, but without a mainframe budget."

– Barb Goldworm, Focus Consulting[1]

Large businesses are investing in real-time computing solutions that help them respond more quickly and effectively to volatile markets, global competitors and changing regulatory requirements. The ultimate goal is for the marketplace, the supply chain and internal operations to be monitored in real time, and for appropriate information to be instantly available to decision-makers at all levels.

As businesses move toward this real-time model, the cost of application downtime escalates, especially for the core solutions that coordinate the business, such as enterprise databases, enterprise resource planning (ERP), supply chain management (SCM), customer relationship management (CRM) and business intelligence (BI). Of course, with sufficient investment, any level of availability can be achieved. But cost can be prohibitive as businesses move from 3-nines availability (99.9 percent), to 4-nines, 5-nines and beyond.[2]

Constant changes in today's business and IT requirements add to the challenge. High availability, alone, is not enough. Solutions must be scalable, flexible and affordable so organizations can grow and adapt quickly to stay competitive. For an increasing number of businesses worldwide, Itanium-based solutions are providing an answer to these challenges – a standards-based architecture that is built to enable the highest levels of availability, while providing greater flexibility and better cost models than proprietary RISC and mainframe architectures.

[1] See the white paper Increasing Availability Through Dynamic Hardware Partitioning by Anne Skamarock and Barb Goldworm, Focus Consulting, June 2007. Available for download at www.necam.com/servers/Contacts/?ItemID=175&wp=1

[2] 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.

Virtualization for Flexible Availability

Virtualization is an essential technology for optimizing the utilization, availability and flexibility of mission-critical systems. Dual-Core Intel® Itanium® processor-based systems provide silicon-level support for virtualization via Intel® Virtualization technology, and Itanium-based system and software vendors offer a wide range of advanced solutions, including.

- Physical Partitions — for consolidating multiple workloads onto the same system with the highest levels of availability and workload isolation.
- Virtual Partitions — for greater flexibility in allocating system resources among diverse operating systems and applications.
- OS Virtualization — for consolidating multiple applications onto a single OS to provide the highest levels of utilization, flexibility and dynamic control.

The Itanium Advantage

High Availability for Scale-Up Computing

High availability depends on redundancy of hardware, software and support. Clustering offers one approach to providing redundancy at the hardware level, and can be an appropriate choice for applications with easily distributed workloads. However, many applications involve complex transactions that do not scale well across multiple servers. This includes most of today's database, data warehouse, BI, ERP, SCM and CRM applications. It is generally more advantageous to deploy these applications on large, shared memory systems designed for high single-system availability.

Though capital costs are typically higher for this scale-up approach, total costs are usually lower, and IT organizations experience many additional benefits (see Figure 1, below):

- Applications and workloads can be consolidated to simplify the environment (fewer systems and software images).[3]
- Data center requirements, including space, power and cooling, are reduced.

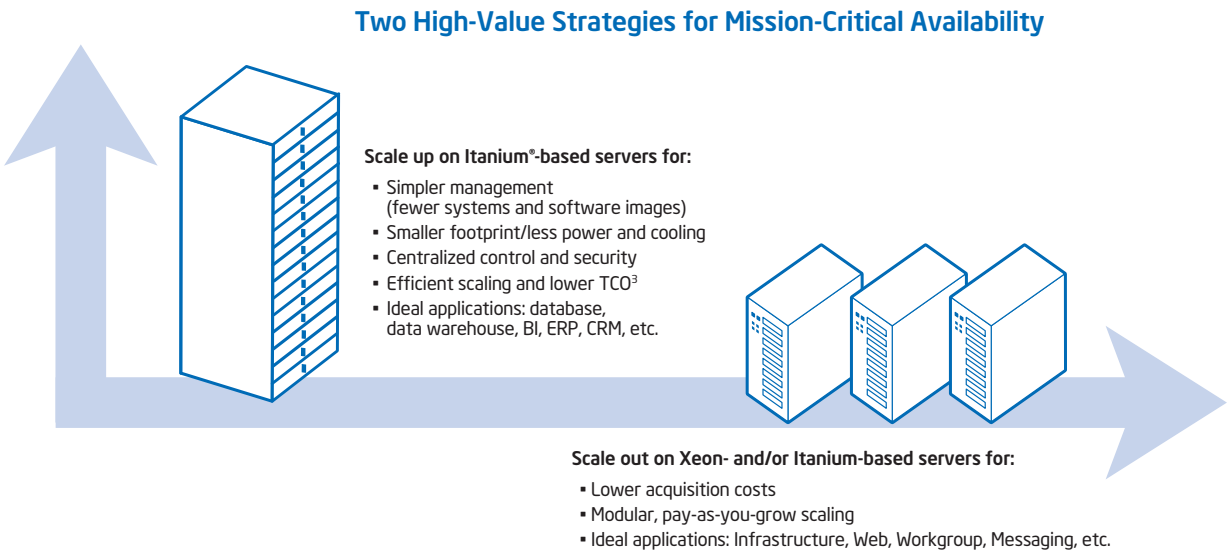

Figure 1. Though both scale-up and scale-out solutions can be architected to deliver virtually any level of availability, they are best suited to different application types and have different impacts on IT costs and operations.

[3] According to a recent report by Alinean, consolidating Microsoft SQL Server instances on Itanium-based servers can reduce TCO by 33 percent compared with consolidating on Intel Xeon processor-based servers. Read the full report at: www.itaniumsolutions.org/files/temp/DA59CA88-D46E-85B2-0BB5975729BE0B02/SQL%20Server%20on%20HP%20Integrity%20-%20TCO%20White%20Paper.pdf

- Capacity can be scaled very easily, by adding processors, memory and I/O to existing systems.
- Centralized management provides better control of the hardware, software and security environment.

These are critical advantages in today's complex and over-crowded data centers, and many organizations are moving toward larger individual servers even for their scale-out implementations (see the sidebar, Virtualization for Flexible Availability on the previous page).

Mainframe Reliability at Mainstream Prices

For many years, the mainframe was the gold standard for scale-up computing. But traditional mainframes are based on expensive, proprietary hardware and software technologies that can severely limit a company's options. High-end RISC systems offer a somewhat more flexible and cost-effective alternative, but they are also based on proprietary hardware and software that can restrict options and increase costs.

Itanium-based systems represent the next wave in mission-critical computing. They are more flexible and affordable than RISC and mainframe systems; and they are based on an industry-standard architecture that was designed from the ground up to support mainframe-class availability and scalability.

A wide range of today's leading platform vendors — Bull, Fujitsu, Fujitsu Siemens Computers, Hitachi, HP, NEC, SGI, Unisys and many others — are building on this foundation to deliver comprehensive systems, software, services and support for business-critical applications. These vendors are using their extensive experience in mainframe computing to design highly redundant platform architectures that are tightly integrated with stable and resilient operating environments. With multiple vendors now delivering fault-tolerant systems on a common hardware architecture, IT organizations can achieve virtually any level of availability and scalability, at lower cost and without the vendor or technology lock-in of mainframe or RISC architectures.

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 Itanium®-based servers. 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-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 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

Better Security for Enterprise Networks

High availability requires high security in today's Internet-connected enterprises, and Itanium®-based servers deliver breakthrough capabilities for improving the security of systems and applications, including:

- Hardware authentication of firmware, to ensure the integrity and security of the system when first booted.
- Unique memory compartmentalization, which can be used to prevent the insertion of foreign code into a running system.
- Fast data encryption, to enable strong security at all levels, without excessive overhead that can drive down performance.

For an example of how these advanced capabilities are being used to deliver transformative levels of security, visit the Secure64 Web site at www.secure64.com

Flexible Solutions for Diverse Needs

Itanium-based systems are available today that deliver an industry-leading 7-nines availability out of the box. That means an average system will run 20 years without scheduled or unscheduled downtime.[4] Many other systems are available that target the more standard 5-nines availability. These Itanium-based systems are being used for a variety of purposes.

- **Mainframe Replacement —** Multiple system vendors offer high-end Itanium-based servers that support mainframe-class RAS, scalability, manageability, partitioning and workload management capabilities. These systems are ideal for modernizing mainframe environments and simplifying integration with today's open, standards-based solutions.

"We migrated our SAP R/3 ERP solution from the mainframe to the Itanium architecture and couldn't be happier. Not only did the migration go smoothly, but the performance is outstanding — the new platform runs up to 5 times faster than our old mainframe and is rock solid."

— Glenn Beck, Air Products VP Enterprise Operations and CIO

- **RISC/UNIX Replacement —** Itanium-based system vendors are also delivering systems that support a wide variety of UNIX environments, including HP-UX,* HP Open VMS,* HP NonStop* and others. Extensive resources and proven methodologies are available to help companies migrate existing applications and efficiently manage mixed environments.[5]
- **Scaling Up Windows and Linux Solutions —** Windows and Linux operating systems are finding their way into increasing numbers of business-critical environments.[6] Windows Server 2003* for Itanium-based servers scales up to 64 processors and 1 terabyte of memory,[7] and new Microsoft Windows Server 2008 introduces a number of mainframe-class features that provide unprecedented flexibility and resilience for mission-critical Windows solutions (see the sidebar, Mainframe-Class Availability in a Windows Environment on next page). Leading Linux distributions for Itanium-based servers now scale up to 128 processors and 4 TB of memory[8] (and up to 512 processors and 128 TB of memory on specified systems).[9] Integrated virtualization support is also available, and vendors are adding a number of enhancements that harden and extend the OS for mission-critical applications (e.g., device driver enhancements, improved OS dump and diagnostic capabilities, error recovery and retry features, and more).

[4] HP NonStop* systems also scale to more than 4,000 processors, which provides tremendous scalability. 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

[5] For more information, see the Itanium Solutions Alliance white paper, Migrating from UNIX/RISC to Linux or Windows on Itanium 2-Based Systems. www.itaniumsolutions.org/files/resource_media/6BE0A04B-9D4E-200F-4B071BD5518C7A1D.pdf

[6] 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.

[7] For more information about Windows* running on Itanium®-based systems, visit the Microsoft Web site at www.microsoft.com/servers/64bit/itanium/overview.mspx

[8] For more information, visit the Novell Web site at www.novell.com/products/server/techspecs.html; then click on "Kernel Limits."

[9] SGI currently offers Itanium®-based servers with up to 512 Dual-Core Intel® Itanium® 2 processors and 128 TB of globally-shared memory that can all run under a single instance of Linux.* www.sgi.com/products/servers/altix/4000/

- **Scaling Out on Itanium-based Systems —** 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. Systems are available today that support Intel® Itanium® and Intel® Xeon® processor-based blades in the same enclosure, providing IT organizations with 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.

Beyond RAS — Performance, Scalability and Choice

Itanium-based systems are available from many vendors and in a wide range of configurations. They support more than 10 operating systems and over 12,000 applications from more than 2,000 software vendors. As a result, they provide unprecedented choice for enterprise implementations.

"The performance of Itanium-based servers is industry leading, as is their reliability and availability."

— Servers Based on the Dual-Core Intel Itanium Processor Easily Deliver for Mission-Critical Computing, Ideas International white paper, June 2007.[10]

Performance for Itanium-based systems continues to increase. The Dual-Core Intel Itanium processor doubled performance over its single-core predecessor, and Intel has three future processor generations already in development.

- **Quad-core Intel Itanium processor (code-name Tukwila) —** This processor will be equipped with more than two billion transistors and can be expected to deliver more than double the performance of today's Intel Itanium processors (based on system performance benchmark projections). It will also include the Intel® QuickPath Architecture, a new system architecture that will help increase the performance of future generations of multi-core Intel Itanium (and Intel Xeon) processors. Tukwila processor shipments will ramp in 2009, and systems for IT evaluation and software certifications (seed units) will be available in the first part of the year.
- **Many-core Intel Itanium processor (code-name Poulson) —** This processor will be based on a new ultra parallel micro-architecture and will be manufactured on Intel's 32 nm process technology. It will include more cores, and support more threads and more instructions per clock cycle.
- **And Beyond —** This future Intel Itanium processor (code-name Kittson) is in definition today and can be expected to provide additional and substantial gains.

As progress continues, Itanium-based system vendors will have an increasingly robust foundation for delivering the highest levels of performance, availability and scalability in the industry.

[10] Read the full white paper at www.itaniumsolutionsalliance.org/news/whitepapers_brochures/07_06_27_IDEAS_ISA_white_paper_Final_Draft.pdf

Mainframe-Class Availability in a Windows* Environment

Microsoft has been successfully supporting mission-critical environments for years with its Enterprise and Data Center Editions of Windows Server 2003.* Windows Server 2008 takes availability to new heights with a variety of mainframe-class features, including Microsoft's Advanced Hardware Error Architecture, Dynamic Hardware Partitioning and hot-replace support for CPUs (as well as memory).

These new features enable proactive monitoring of CPU and memory components in selected Itanium®-based systems, and enable failed components to be replaced without downtime. They also enable dynamic addition, replacement and allocation of processor, memory and I/O resources during runtime to avoid downtime and to manage expected and unexpected workload surges. Combined with high-end Itanium-based systems, these capabilities provide unprecedented flexibility and resilience in the Windows operating environment.

For more information, see the white paper, *Increasing Availability Through Dynamic Hardware Partitioning*, by Anne Skamarock and Barb Goldworm, Focus Consulting, June 2007. www.necam.com/servers/Contacts/?ItemID=175&wp=1

High Availability in Action

Chevron Corporation

- Second-largest energy company in the U.S.
- Conducts business in more than 180 countries
- Multiple Oracle databases growing at more than a terabyte per year

Chevron needed a more scalable and adaptable SAP environment to keep pace with its rapid global expansion and ongoing mergers and acquisitions. Simplifying and consolidating the distributed environment was essential, but the company also required the highest levels of availability. **"These are large and critical assets,"** says systems analyst Paul Brody of Chevron. **"They integrate information throughout our entire enterprise. They can't be down."** The company turned to Itanium®-based servers running the HP-UX* operating system to consolidate more than 50 SAP instances into a single data center.

The new servers tripled the performance and capacity of the ERP infrastructure, and reduced the total data center footprint by two thirds. According to Brody, **"We've improved performance to the end users, improved reliability, supported a number of additional systems, and at the same time not really increased our costs."** Improved scalability is another major benefit. According to Paul Wilson, Technical Architect for Chevron, **"We run multiple SAP instances and Oracle databases on a single server using just 50 percent of capacity. So we have plenty of room for growth."**

Read the complete case study at http://h71028.www7.hp.com/ERC/downloads/4AA0-9123ENW.pdf

High Availability in Action
Müller Martini

- Global leader in the field of print finishing equipment
- Nine production plants in four countries
- Dedicated sales and service companies on 5 continents

Like many companies, Müller Martini had a complex SAP environment that had grown over time to control all major aspects of the business. It was mission-critical, yet was in need of simplification and consolidation to pave the way for continuing growth. Improving flexibility and reducing costs were primary considerations, but high availability, disaster recovery and 24x7 operations were also critical to success.

After careful evaluation, the company chose to migrate off its UNIX*-based systems. According to Daniel Nydegger, IT head of group for Müller Martini, **"It was a strategic decision to switch to Itanium and SUSE Linux, because what matters in the end to an entrepreneur are costs and reliability."** The migration to open systems was smooth. Most important to Müller Martini, the company reduced its IT maintenance and operating costs by about 30 percent. According to Nydegger, **"We have reached our objective, even exceeded it a somewhat. We would make the same decision again any time."**

Read the full case study at http://h71028.www7.hp.com/ERC/downloads/4AA0-9559EEW.pdf

RAS Technology in Itanium-based Servers

Mainframe-Class RAS in the Processor

The Intel Itanium processor was designed from its inception to deliver mainframe-class availability. It incorporates leading RAS capabilities for detecting, correcting and containing the kinds of unavoidable hard and soft errors that can bring down systems or corrupt data (Table 1 on next page).

Earlier Intel Itanium processors provided advanced error correction and containment across all major data arrays. The latest Dual-Core Intel Itanium processor also offers support for Core-Level Lockstep, which enables error coverage to be extended across the entire processing core. One core is used to mirror the operations of the other, and a built-in arbiter detects and contains errors (Figure 2).[11] This new level of error correction is unprecedented in industry-standard processors.

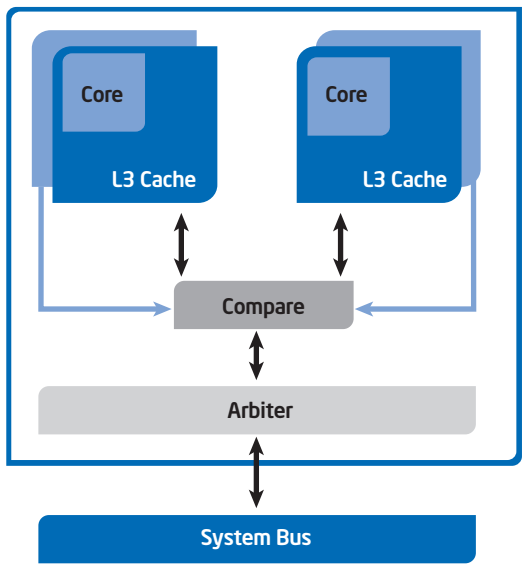

Figure 2. With new Core-Level Lockstep technology, one core in a Dual-Core Intel® Itanium® processor can be used to mirror the operations of the other, enabling new levels of processing and data integrity for today's most demanding environments.

[11] Core-Level Lockstep is currently supported in selected Dual-Core Intel® Itanium® processors. Implementation requires an enabled system BIOS, so check with your vendor regarding support for lockstep technologies.

RAS Capability[a]	Intel® Itanium® Processor-based Systems	Mainframe	RISC
Enhanced Machine Check Architecture	√	√	√
Cache Reliability	√ (Intel® Cache Safe Technology)	√	√
Processor Lockstep Support	√ (Socket Level and New Core Level)	√	
Hard Partitioning	√	√	√
Cache ECC or Parity Coverage	√	√	√
System Bus ECC	√	√	√
I/O Error Recovery	√	√	√
Memory Single Device Data Correction	√	√	√
Memory Scrubbing	√	√	√
Processor and Memory Hot Swap	√	√	√
Component[b] Redundancy/Hot Swap	√	√	√

[a] Listed feature is supported by one or more systems vendors.
[b] I/O cards, fans, power supplies, etc.

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

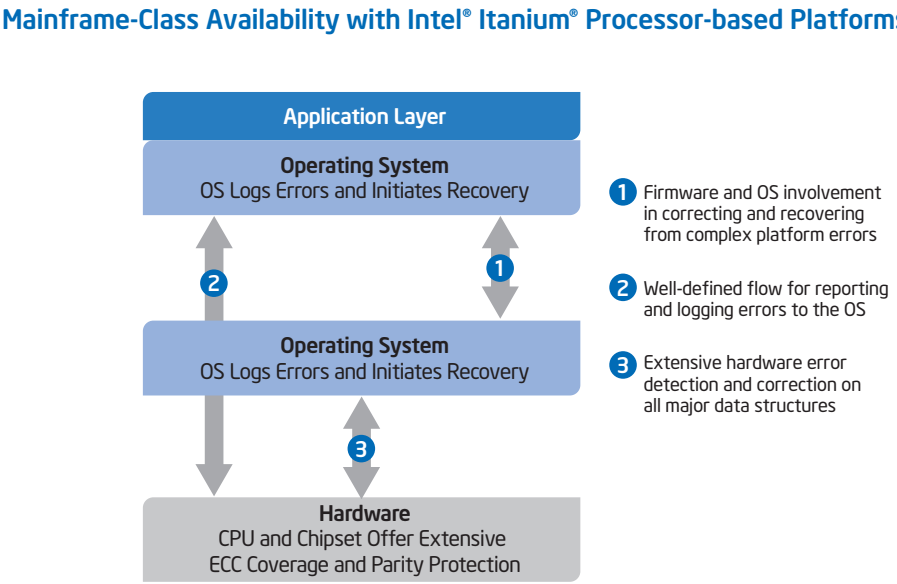

Figure 3. The Enhanced Machine Check Architecture of Intel® Itanium® processor-based servers supports mainframe-class availability, by enabling integrated, multi-level error handling across the hardware, firmware and OS. As a standards-based framework, it simplifies vendor collaboration and will help to enable increasing levels of availability in future platforms.

Coordinated Error Handling at the Platform Level

The Intel Itanium processor includes an Enhanced Machine Check Architecture, which provides well-defined interfaces for coordinated error handling at the hardware, firmware and OS levels (Figure 3 on page 10). This architecture 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. It also provides a standards-based foundation that makes it easier for component, platform, firmware and OS developers to coordinate their efforts in enhancing current and future error-handling solutions.

Complete High Availability Solutions

Vendors have taken advantage of the advanced RAS features of the Intel Itanium processor to develop fault-tolerant systems that are scalable, flexible, manageable and highly resilient. Features and capabilities vary by vendor, and include:

- Modular, cell-based designs for improved scalability and availability.
- Extensive redundancy and hot-plug components for fast scaling and repair.
- Integrated monitoring, diagnostics and failure prediction.
- Rapid failover capabilities.
- System mirroring for operational redundancy and data integrity.
- Static and dynamic hard partitioning for flexible consolidation with complete workload isolation.
- Advanced virtualization and workload management for more granular and dynamic allocation of resources in consolidated environments.

Never before have such an extensive range of high-availability options been available on industry-standard servers. IT organizations can now meet virtually any availability requirements, without resorting to costly RISC and mainframe architectures.

For more information about high availability on Itanium-based systems, see the Ideas International white paper, Servers Based on the Intel Dual-Core Itanium Processor Easily Deliver for Mission-Critical Computing. Available at www.itaniumsolutions.org/files/temp/02EAFBC7-9706-6416-84601C93563241FC/IDEAS_ISA_white_paper_Final.pdf

Conclusion

As the transition to real-time business computing accelerates, the cost of downtime continues to grow – and so does the importance of flexible and affordable servers that can be adapted easily as requirements change. For an increasing number of businesses worldwide, Itanium-based solutions are filling this need. By supporting the highest levels of availability and scalability on a flexible and widely supported hardware architecture, they are enabling businesses to substantially mitigate risk and decrease total costs, while avoiding vendor and technology lock-in that limit their options going forward.

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

Appendix A: Error Handling on Industry-Standard Servers

Itanium-based servers take error handling to the next level for industry-standard servers, enabling more errors to be handled without downtime or data corruption. This provides a solid, standards-based foundation that multiple vendors are using to build mainframe-class systems.

Increasing Severity/Risk ⟶		Error Handling	
	Error Type	**Itanium®-based Servers**	**Xeon® processor-based Servers**
	2-bit error in kernel	Fatal[a]: Automatic system reset	Fatal[a]: Automatic system reset
	2-bit error in application	OS recoverable: Execution continues	
	Translation errors	OS corrected: Execution continues	
	1-bit error in write through cache; Hard error in L3 cache with Intel® Cache Safe Technology	Firmware corrected: Execution continues	
	Most 1-bit errors	Hardware corrected: Execution continues	

[a] A 2-bit kernel error is typically fatal and requires the system to be reset in virtually all of today's widely deployed computing architectures.

Appendix B: Glossary of RAS Technologies

Data Center-Enabling Technologies

Intel® Itanium® Processor	Intel® Xeon® Processor	
√	√	Intel® Virtualization Technology[12]: Provides hardware support for virtualization, which enables today's software-only solutions to be more robust, secure and supportable.

Platform Error Handling and Containment

Intel® Itanium® Processor	Intel® Xeon® Processor	
√+	√	√ Machine Check Architecture: Provides integrated capabilities for logging, reporting, and handling errors. √+ Enhanced Machine Check Architecture: Provides more advanced error-handling capabilities, with well-defined interfaces at the hardware, firmware and OS levels.
√	√	Data Bus Error Checking and Repair: System supports parity or Cyclic Redundancy Checking (CRC) on the data bus to detect errors.
√	√	Cache ECC Coverage: 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.
√ (Core and Socket Level)		Socket-Level Lockstep Support: 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. Core-Level Lockstep Support: Lockstep can be implemented on two cores of the same processor, with built-in arbitration to greatly simplify platform-level implementation.
√		Bad Data Containment: 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.
√		Cache Reliability (Intel® Cache Safe Technology): Goes beyond ECC to further enhance the reliability of processor cache memory.
√	√	Memory Single Device Error Correction (SDEC): Enables the system to correct all memory errors if a single DRAM device fails.[a]
√	√	Memory Retry on Double-bit Error Detect: ECC can detect double-bit errors, but can only correct 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.
√+	√	Partitioning: 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. √ All Intel® processor-based server platforms support logical partitioning using third-party software virtualization solutions (see Intel® Virtualization Technology, above). √+ Hardware partitioning is supported by several platform vendors.
√		Electrically isolated partitions: 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.
Future[b]		The next-generation Intel® Itanium® processor (code named Tukwila) will include additional RAS features to enhance reliability and enable greater resilience in response to both soft and hard errors in key processor components, such as processor cores and caches, interconnect and memory. New features will also bolster key system functions, such as resource management and virtualization.

[a] Called "chipkill" by IBM.
[b] Targeted for release in 2009.

[12] 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.

Appendix C: Additional Resources

Find information about:

- Itanium-based Software and Solutions: www.itaniumsolutionsalliance.org/home
- Windows on Itanium-based servers: www.microsoft.com/servers/64bit/itanium/overview.mspx

Find information about specific vendor offerings for fault-tolerant Itanium-based solutions:

- Bull NovaScale*: www.bull.com/novascale
- Fujitsu PRIMEQUEST*: www.fujitsu.com/global/services/computing/server/primequest
- Fujitsu PRIMERGY*: www.shopfujitsu.com/www/products_primergy.shtml?products/servers/primergy/PRIMERGY
- Fujitsu Siemens PRIMEQUEST: www.fujitsu-siemens.com/products/mission_critical/index.html
- Fujitsu Siemens PRIMERGY: www.fujitsu-siemens.co.uk/products/standard_servers/index.html
- Hitachi BladeSymphony* – English: www.hitachi.co.jp/products/bladesymphony_global
- Hitachi BladeSymphony – Japanese: www.hitachi.co.jp/products/bladesymphony/index.html
- Hitachi HA8500* – English: www.hqrd.hitachi.co.jp/crle/news_pdf_e/ha8500.pdf
- Hitachi HA8500/9000 – Japanese: www.hitachi.co.jp/products/it/server/ha8500/index.html
- HP Integrity*: www.hp.com/products1/servers/integrity
- HP NonStop Advanced Architecture*: h20223.www2.hp.com/NonStopComputing/cache/77119-0-0-0-121.html
- Microsoft Windows Server 2003*, Datacenter Edition: www.microsoft.com/windowsserver2003/evaluation/overview/datacenter.mspx
- Microsoft Windows Server 2008*: www.microsoft.com/windowsserver2008/default.mspx
- NEC: www.necam.com/servers/products
- SGI: www.sgi.com/products/servers/altix
- Unisys ES7000*: www.unisys.com/products/enterprise__servers/high_d_end__servers/index.htm

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