Intel 64-bit Enterprise Architectures for the Data Center

Intel® Itanium® processor-based platforms and Intel® Xeon™ processor-based platforms with EM64T

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Digital Enterprise Group

Fujitsu Summit
February 23rd 2005
Future of the Enterprise

Hardware Infrastructure

Software Infrastructure

Common Customer Requirements

- Performance: threads, I/O to support numerous processes
- Virtualization: dynamically allocate resources
- RAS: many devices, high integrity, easily serviceable
- Common management: data center power mgmt, interfaces
- Flexibility: Support for flexible operating costs and sourcing

Other names and brands may be claimed as the property of others.
Intel’s 64-bit Technology Platforms

› Evolution path from RISC / mainframe platforms
  • Premier performance, reliability and scalability for the most demanding applications
  • Cost effective vs. RISC

› 64-bit support via Intel® EM64T
  • Grow data set size > 4GB while protecting IA-32 investment
  • Outstanding price/performance and reliability for mainstream applications

Select based on key platform capabilities:
Performance, TCO, Reliability, Scale
Which Is The Right Architecture?

General Guidelines for Today

<table>
<thead>
<tr>
<th>Platform</th>
<th>Intel® Xeon™ processor family</th>
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<td>Front-end Servers/WS</td>
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Processor Scalability Comparison

Transaction Processing (TPC-C)

- 4P: +50%
- 16P: +64%
- 32P: +128%

Source: [www.tpc.org](http://www.tpc.org)

SAP SD 2-tier

- 4P: +63%
- 8P: +67%
- 16P: +90%

Source: [www.sap.com/benchmark](http://www.sap.com/benchmark)

Xeon™ Processor MP
2.8GHz 2MB L3

Itanium® 2 Processor
1.5GHz 6MB L3

Itanium® 2 processor – Intel’s most scalable processor

Other names and brands may be claimed as the property of others.
Itanium® Architecture RAS Leadership

☑ More extensive hardware error coverage
  - Deep coverage for all cache levels, TLBs, system bus
  - New for 2005: Pellston technology; parity protection for register file, branch history table, bus queue

☑ Detailed logging for detected / corrected errors
  - Standardized logging of platform errors

☑ Firmware / OS involvement in correction and recovery

☑ Extensible framework
  - Well defined flows and APIs for system developers
## Advanced Error Correction & Recovery

### Error Handling

<table>
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<th>Category</th>
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<tr>
<td><strong>System reset</strong>&lt;br&gt;2-bit error in kernel</td>
<td>Non-recoverable</td>
</tr>
<tr>
<td><strong>OS recoverable</strong>: System available&lt;br&gt;2-bit error in application</td>
<td>Recoverable</td>
</tr>
<tr>
<td><strong>OS corrected</strong>: Execution continues&lt;br&gt;Translation register error</td>
<td>Corrected</td>
</tr>
<tr>
<td><strong>Firmware corrected</strong>: Execution continues&lt;br&gt;Pellston cache reliability technology</td>
<td>Corrected</td>
</tr>
<tr>
<td><strong>Hardware corrected</strong>: Execution continues&lt;br&gt;Most 1-bit errors</td>
<td>Corrected</td>
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### Enhanced Machine Check Architecture:

**Multilevel advanced error handling for extended availability**

Other names and brands may be claimed as the property of others.
Intel Investments in Itanium® Architecture

**Focused Resources**
- Design teams working on more than 6 future processors
- Large Software & Solutions Group continuing major effort to drive software ecosystem
- Dedicated team managing effort to steadily increase availability of software applications
- Dedicated team driving broad effort to accelerate sales

**Marketing investment**
- Intel® Inside for Itanium® 2 processor
- Itanium 2 processor advertising
- Montecito launch
- Co-marketing with fellow travelers
- Whitepapers, case studies, and other marketing collateral

Intel is accelerating Itanium® architecture growth with new products, ecosystem enabling, and marketing

*Other names and brands may be claimed as the property of others.*
Innovation in Itanium® 2-Based Platforms

2004 & Prior Enhancements
- EPIC architecture
- Enhanced Machine Check Architecture
- FMAC for floating-point leadership
- Largest on-die resources for demanding workloads

2005 Planned Enhancements
- Dual-core; Multi-threading
- Virtualization
- Foxton
- Demand Based Switching (DBS)
- PCI Express, DDR II
- Enhanced System Bus Bandwidth, cache reliability, and processor performance

Future Enhancements
- Common platform architecture with Intel® Xeon™ processor family
- Multi-core
- Enhanced Virtualization
- Enhanced I/O, memory & RAS

Innovations deliver Intel’s highest performance, reliability and scalability solutions for the enterprise

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Montecito Status

- **Montecito: Next Itanium® Processor Family product**
  - Dual core, Multi-threading, 24MB cache
  - Platform compatible with Itanium® 2 processor
  - First 1.72 billion transistors processor
  - Significant performance jump with lower power
    - 1.5-2x over Madison-9M
    - 100W
  - Demo’d last year, first samples in Sept’04
  - OEMs currently testing Montecito platforms
  - Montecito shipping in 2005

- Montecito also brings new technologies
  - **Foxton:** Performance boost while maintaining power
  - **Demand Based Switching:** Server power savings
  - **Pellston:** Cache reliability
  - **Vanderpool:** Robust virtual partitioning
Dynamic Performance Optimization

Foxton Technology

- Performance boosted dynamically based on application power consumption
- Up to 10% frequency increase
- Largest performance gains expected on transaction processing

Foxton optimizes frequency for maximum performance
Dynamic Power Optimization
Demand Based Switching (DBS)

- Dynamically reduces speed & energy consumption during lower CPU utilization
- Estimate most users would save up to 25% in reduced power & cooling
- Montecito enables support for P states, power-performance policy, & OS directed changes
- Enabled by Foxton Technology

DBS optimizes power efficiency for lower TCO
Cache Reliability

Pellston Technology

Benefits

- Automatically disables cache lines in the event of hard cache memory error
- Removes impact of 2-bit ECC errors in L3 cache that have single bit hard failures
- Allows processor and system to continue normal operation

How it works

1) Cache line access with error detected
2) Cache line is tested for hard error
3) If hard error is detected, cache line is disabled while processor and system continue normal operation

Pellston helps improve reliability and uptime
Other names and brands may be claimed as the property of others.

Hardware Assisted Virtualization

Vanderpool Technology

VM1
App
App
MRTE
OS(1)

VM-n
App
App
MRTE
OS(N)

Virtual Machine Monitor

New Virtualization Technology

Virtualization benefits
- Reliability
- Efficiency & flexibility
- Security

VT benefits
- Choice
- Robustness
- Performance

Vanderpool Technology enables OSVs and ISVs to make virtualization better.

virtualization, VT, OS, ISV, reliability, efficiency, flexibility, security, choice, robustness, performance.
Market Progress

Itanium is growing much faster than RISC (IDC Nov’04):

- Itanium 2-based server shipments have grown >2.5x from 1H’03 to 1H’04 (vs. 15% for RISC)
- Itanium server shipments are now 30% of what IBM ships on Power
- >2700 applications available today (vs. 300 in 1H’03)

Itanium is ramping aggressively in the marketplace
Other names and brands may be claimed as the property of others.

Migration to Itanium® Processor Family
Partial list, newer additions in blue, * represents Global 100 companies

Financial
- Citistreet
- ING
- First American Ins.
- Bank of New York
- Thomson Financial
- Nedbank
- First Trust

Healthcare
- Blue Cross/Blue Shield
- Merck
- Premera Blue Cross
- Pfizer HC Solutions *

Automobile
- Fiat*
- Volvo
- Toyota*
- BMW

Manufacturing
- Total Oil
- Audi*
- Occidental Petroleum
- Marico
- Saacke
- Airbus UK

Retail – consumer goods
- Procter & Gamble*
- Philips-Van Heusen
- The Body Shop
- Fuji Film

Energy
- Total Oil*
- BP
- PetroChina*
- Marathon Oil

Govt / Education
- CDC / LLNL
- NASA

Communications
- The Weather Channel
- CBS Broadcasting, Inc
- Korea Telecom
- Motorola
- Telecom Italia

40 of Global 100 run Itanium®-based systems

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**Platform Value: Database**

### Business Value

<table>
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<tr>
<th>30% Price/Performance Advantage Over RISC</th>
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<tbody>
<tr>
<td>161K</td>
</tr>
<tr>
<td>194K</td>
</tr>
<tr>
<td>$5.62</td>
</tr>
<tr>
<td>$3.94</td>
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</tbody>
</table>

4P tpmC Performance  (lower is better)

- Itanium® 2 processor 9M
- Leading RISC result

Source: [tpc.org](http://tpc.org)

### Choice

Database Software from Leading ISVs Including:

- DBassociatesIT
- e1525
- FirstSQL
- InterSystems
- MySQL AB
- New Athena
- Openlink Software
- Shenzhen Yinhetong Information Technology
- StataCorp
- Sybase

- Teratext
- TimesTen

**Plus**

- 32-bit application support with IA-32 Execution Layer
- OS choice: Windows*, Linux*, Unix*

### End User Success

Why Customers Choose Itanium Architecture

- OLTP performance
- Cost effective/ consolidation
- High reliability & availability
- Non-proprietary solution

**Case Study Example**

- 3X performance gain & increased maximum portfolio size 5X for equity trading
- 100% ROI in 3 months

**Additional Case Studies**

- Clalit Health Services
- CNA Insurance
- Grupo Eroski
- JetBlue Airways
- First Trust
- Thomas Financial
- The Weather Channel

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### Platform Value: ERP/ SCM

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<th>Choice</th>
<th>End User Success</th>
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<tr>
<td>Performance: First-ever 100K SAP 3-tier result</td>
<td>ERP/ SCM Software from Leading ISVs Including:</td>
<td>Why Customers Choose Itanium Architecture</td>
</tr>
<tr>
<td>~100K+</td>
<td>ABAS Software, Datadec, Intentia, Kingdee, Lawson Software, PeopleSoft, UFSoft, Webplan</td>
<td>Cost effective/ consolidation, OLTP performance, Non-proprietary solution</td>
</tr>
<tr>
<td>SAP SD 3-tier Best single system result with Itanium® 2 processor 9M</td>
<td>32-bit application support with IA-32 Execution Layer</td>
<td>Overall 50-60% performance improvement using SAP BW*</td>
</tr>
<tr>
<td>Value</td>
<td>OS choice: Windows*, Linux*, Unix*</td>
<td>Consolidated servers for improved TCO</td>
</tr>
<tr>
<td>Saake reduced ongoing maintenance &amp; software licensing fees by 30% through server consolidation</td>
<td>Plus</td>
<td>Estimate ~200% ROI</td>
</tr>
<tr>
<td>Source: <a href="http://www.sap.com">www.sap.com</a></td>
<td></td>
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<tr>
<td></td>
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<td>- CompUSA</td>
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<td>- Telefonica Argentina</td>
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Platform Value: Business Intelligence

**Price / Performance**

- Industry Leading TPC-H 10TB Result
  - QphH Performance
    - Itanium® 2 processor 9M
    - Leading RISC result
  - $/QphH (lower is better)
    - $161
    - $243

**Choice**

- BI Software from Leading ISVs Including:
  - AVS
  - Chroma Energy
  - Epistemic
  - Flow Science
  - Genalytics
  - Informatica
  - ITI
  - Kx Systems
  - Manhattan Routing
  - Microsoft
  - ProClarity
  - Sybase
  - Visual Mining
  - Visual Numerics

**End User Success**

- Why Customers Choose Itanium Architecture
  - OLTP & analytics performance
  - Application choice
  - Huge on-die cache for large workloads

**Case Study Example**

- Increase data processing capability by factor of 10
- Improved service quality
- Increased availability

**Additional Case Studies**

- American Healthways
- CISER (Cornell)
- Eckerd
- Premera Blue Cross

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Summary / Call to Action

- **Deploy Itanium® 2-based solutions TODAY for the business-critical data tier**
  - Standard business-critical architecture available and supported by production software
  - Robust business critical performance including excellent scalability, availability, and reliability
  - Roadmap strength: Long-term roadmap & upgrade path planned through 2007+

- **Deploy Xeon™ processor family today as the standard general purpose IT infrastructure**
  - Proven price/performance leadership and the Xeon brand promise
  - Deploy new technologies with confidence