Intel Volume Platforms Technology Leadership

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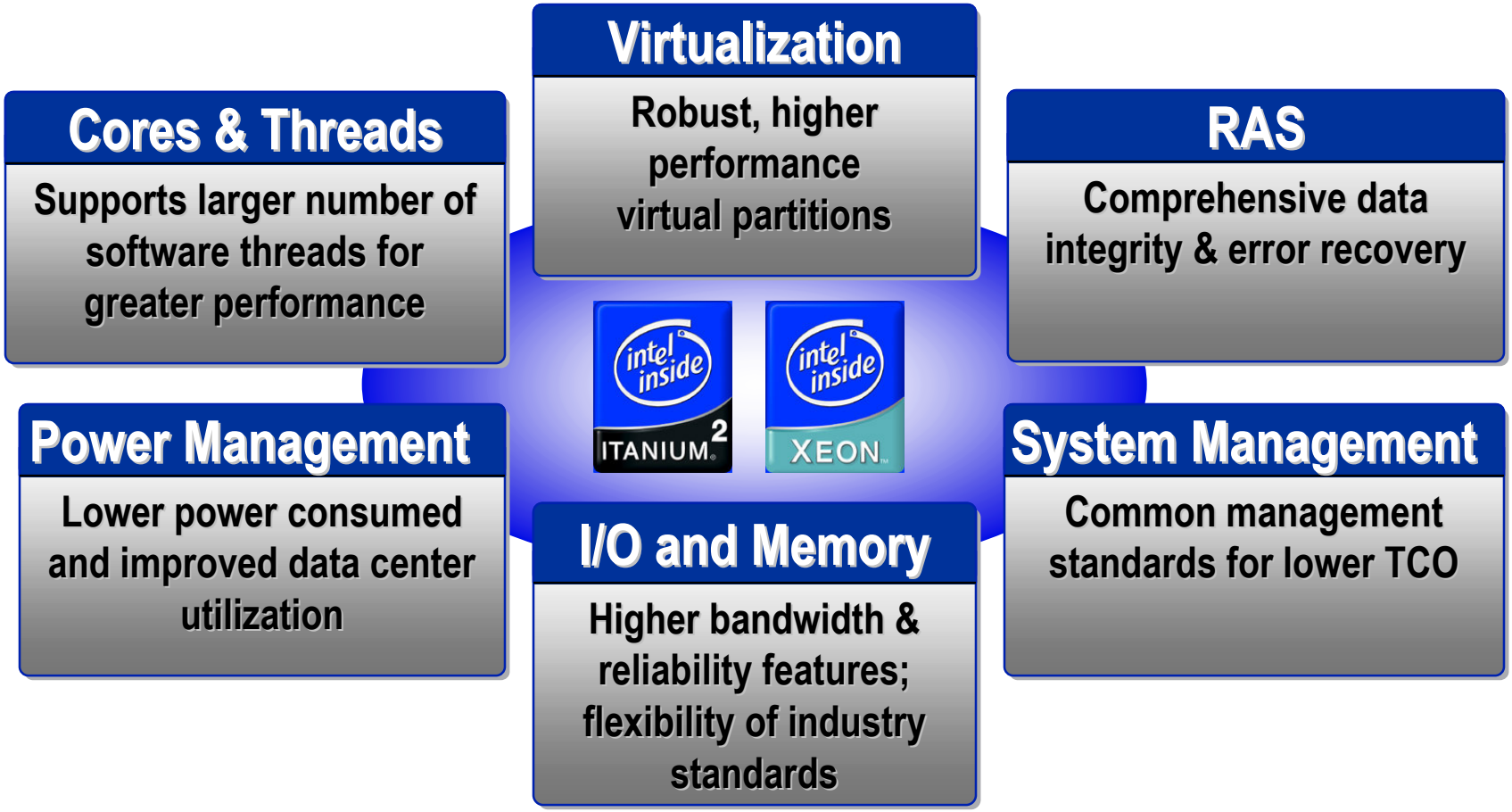
Agenda

- Intel's Enterprise Strategy
  - Roadmap & Technology Vision
- Intel® Xeon™ Processor for DP Platforms
  - Roadmap & Platform Overview
  - Power Management Technology
  - Intel® Extended Memory 64 Technology
- Future Technology Preview

Intel Enterprise Technology Vision



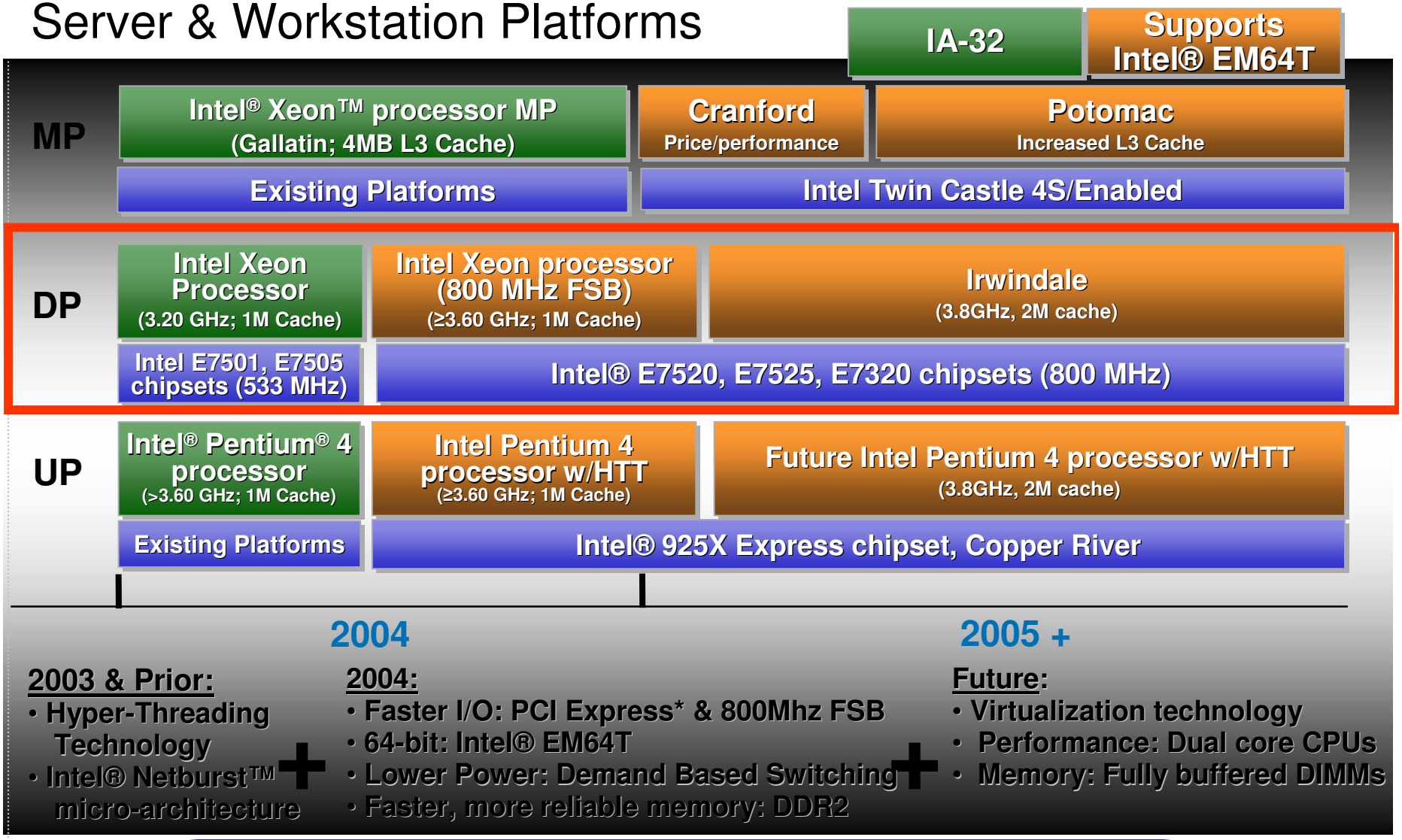
Server Advancements Led by Intel

Comparisons referenced are in relation to Intel product offerings today (as of May 2004)

All products, dates, comparisons and information are preliminary and subject to change without notice.

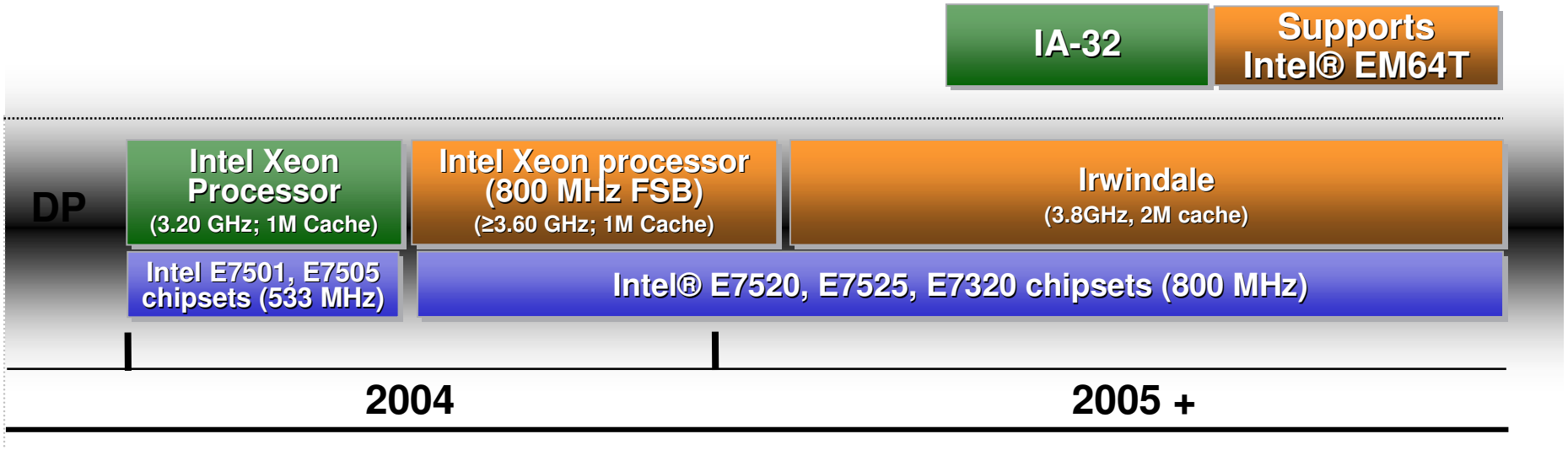
Intel® Xeon™ Processor Family Roadmap

Server & Workstation Platforms



Increasing Performance, Better TCO & New Technologies to Solve IT Business Challenges

Intel® Xeon™ Processor Family Roadmap
DP Platforms



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Power Management

Lower power consumed and improved data center utilization

+

Headroom

Supports larger number and variety of software threads for greater performance

Enterprise Proven DP Platforms Enhanced with New Power Management, I/O and 64-bit Extension Technology

New Intel® Xeon™ Server Platform

RAS
Reliability
Availability
Serviceability

Advanced new chipsets
Intel® E7520 and E7320: New RAS features at mainstream price points

Intelligent RAID
Intel® IOP332 IO processor 15% faster RAID5 writes compared to previous generation of I/O processors

Next Generation I/O BUS
PCI Express*: reduces system latency with up to 3.8x bandwidth vs PCI-X at 8GBs; x16 graphics for workstations

64-bit Extensions
Intel® EM64T extends memory addressability beyond 4 gigabytes

Headroom

Power Consumption

Demand Based Switching
DBS enables up to 25% power consumption savings

Faster Memory
DDR2: 50% memory bandwidth increase, up to 40% power

Faster System Bus
800 MHz system bus enables balanced platform – 50% faster than previous generation

Major Architectural Enhancements
SSE3 & HT Technology Enhancements enable up to 30% increase server application performance

Enterprise Processor
Intel® Xeon processor 3.60 GHz based on 90 nm process

Performance

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

Performance disclaimer: Data source is Intel Corporation, July 2004. Customer results may vary depending on hardware and software configuration.

RAS
Reliability
Availability
Serviceability

Advanced RAS features help to keep platforms up-and-running

Detects and corrects memory problems automatically

- Memory mirroring**
- DIMM sparing
- Automatic fail-over dual channel to single channel
- ECC, DIMM scrubbing

Improves data reliability and protection

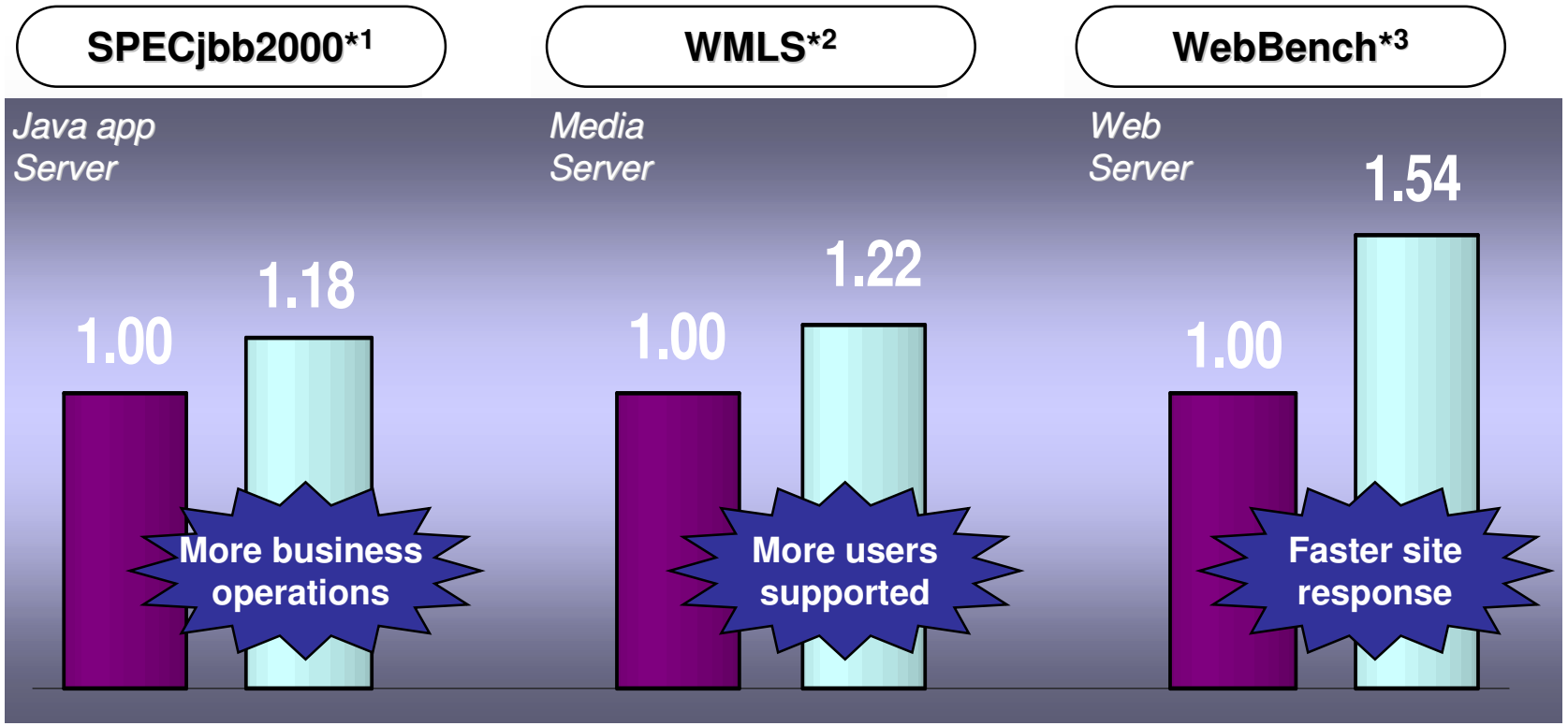
- 32-bit CRC on PCI Express*
- Intelligent RAID with Intel® IOP332 Storage I/O Processor

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

**Feature of Intel® E7520 chipset only

Performance

Up to 54% improvement in DP Server Platforms Performance



Source: Veritest Labs (Aug '04)

Relative Performance – Higher is better

Compares Intel® Xeon™ Processor 3.60 GHz with 800MHz system bus to previous generation Intel Xeon processor based platforms

Intel® Xeon™ processor 3.20 GHz, 1MB cache, 533MHz bus

Intel® Xeon™ processor 3.60 GHz, 1MB cache, 800MHz bus

System configuration details and legal disclaimers in backup. Customer results may vary depending on hardware and software configuration.

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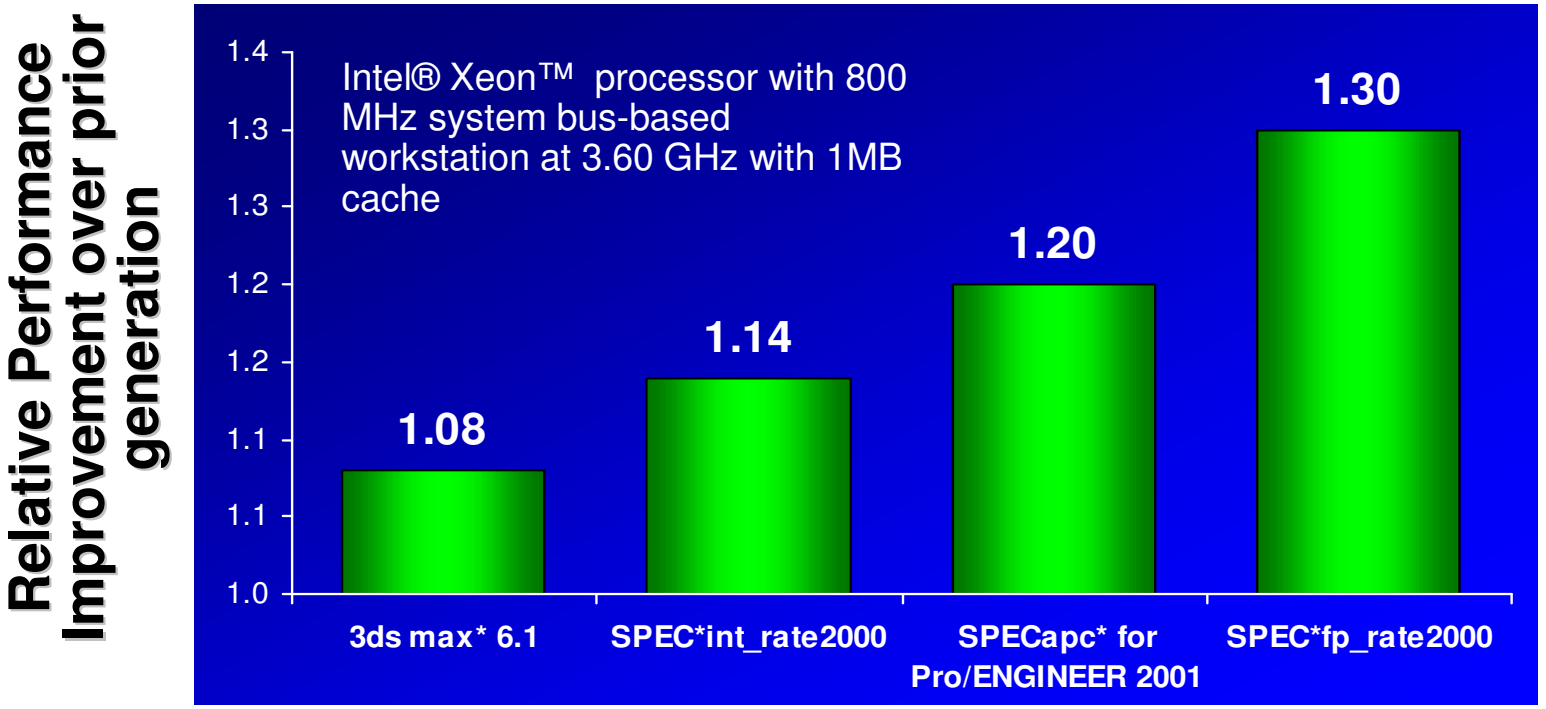
Performance

Up to 30% Improvement in DP Workstation Performance



Significant gain for workstation applications due to new platform innovations

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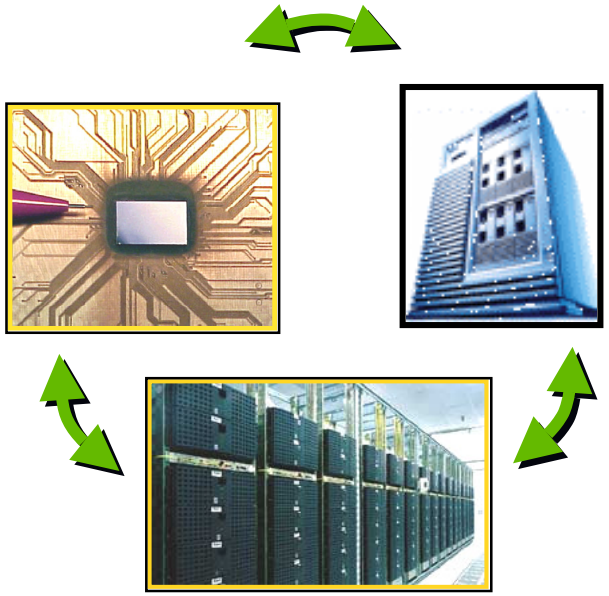
Server Power Management

- Issue: increasing power requirements for Enterprise data centers
- Objectives
  - Reduce active power consumption to maximize performance per Watt
  - Provide user access and prediction of power consumption
  - Maximize facilities ROI
- Comprehensive strategy to support these objectives
  - Platform energy management
  - Silicon improvements
  - Data center power and thermal management

Intel's Power Management Strategy

Silicon

- Power Efficient Cores
- Advanced materials and Fabrication



Platform Energy Management

- Demand Based Switching
- Power config utilities
- Power supply monitoring (PSMI)

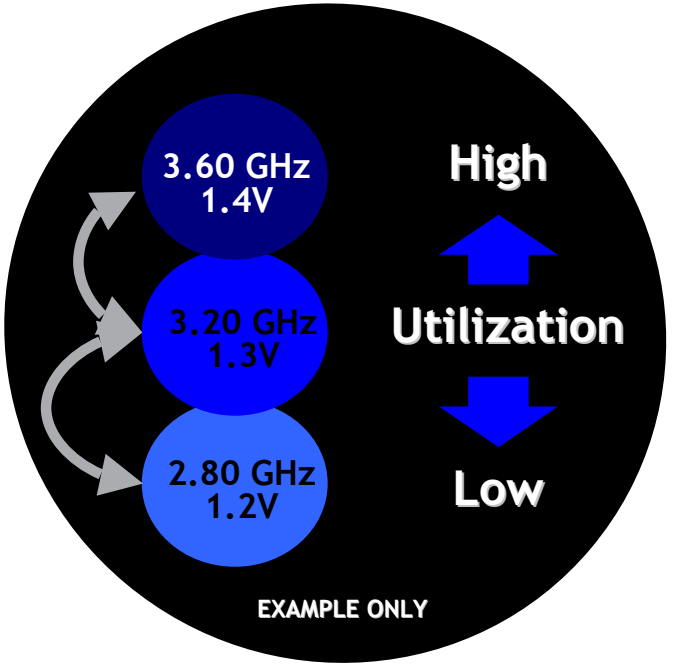
Datacenter Power and Thermal Management

- Standard-based Instrumentation and Control
- Integration with Existing Framework/Consoles

Complementary Technologies to Address Data Center Power Issues

Demand Based Switching

- Utilizes Enhanced Intel SpeedStep® Technology
- Dynamically reduces processor speed/power based on demand
- Reduces system power up to 28% for typical CPU utilization**

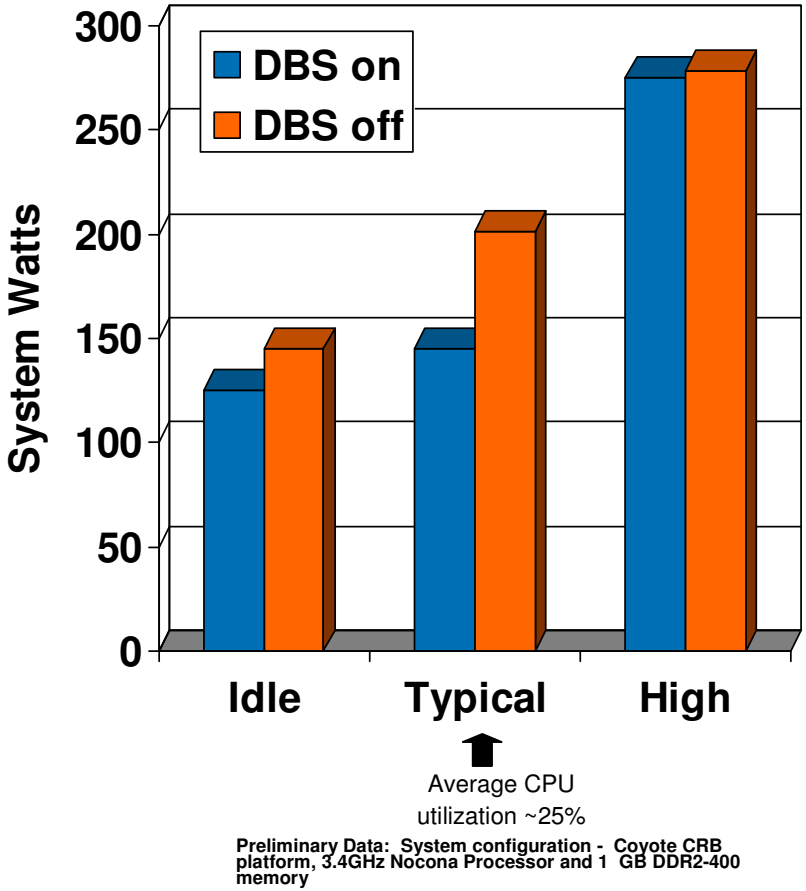


Energy savings, improved acoustics

** Preliminary Intel internal evaluation System configuration: Coyote CRB platform 3.4 GHz with 1GB DDR2 memory. Typical average CPU utilization is approximately 30%. Customer results may vary depending on hardware and software configuration.

DBS Benefits: On vs Off

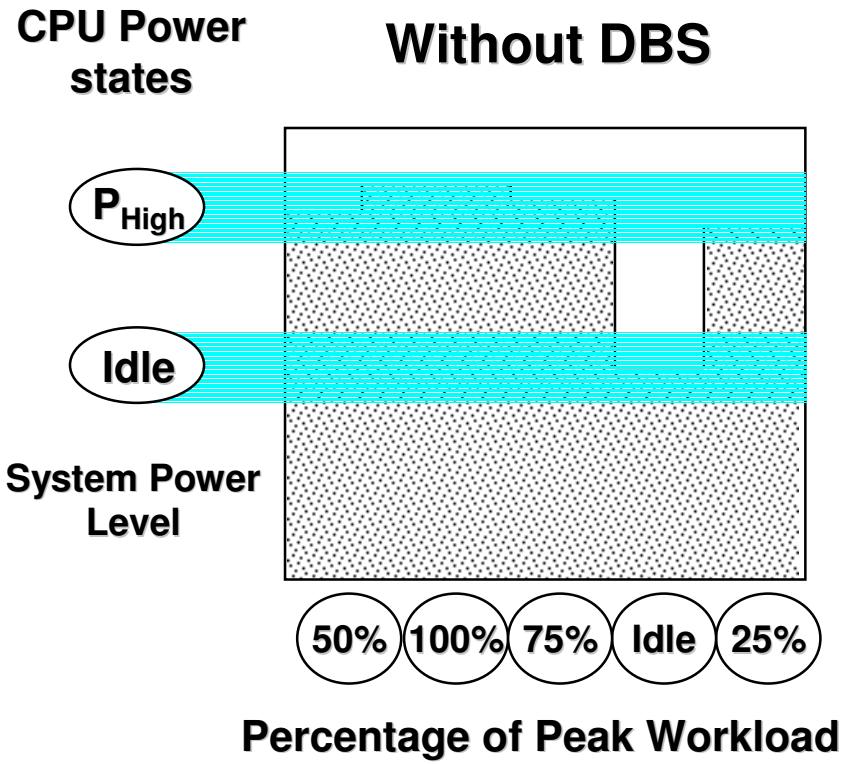
- Significant system level benefits with DBS on
  - 28% power advantage for typical utilization
- Projecting minimal performance impact
  - SPECjbb ~ 0%
  - WMLS ~ 0%
  - WebBench ~ 2%

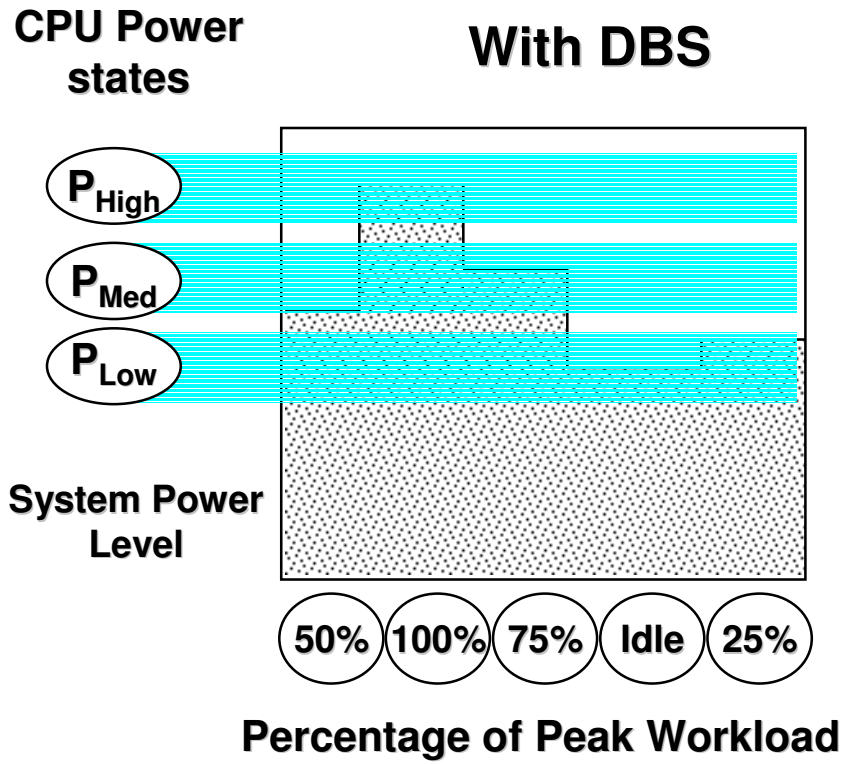


Preliminary Data: System configuration - Coyote CRB platform, 3.4GHz Nocona Processor and 1 GB DDR2-400 memory

DBS directly addresses key data center issue

DBS Power Consumption Savings





Without DBS

Processor is always set to its highest power state

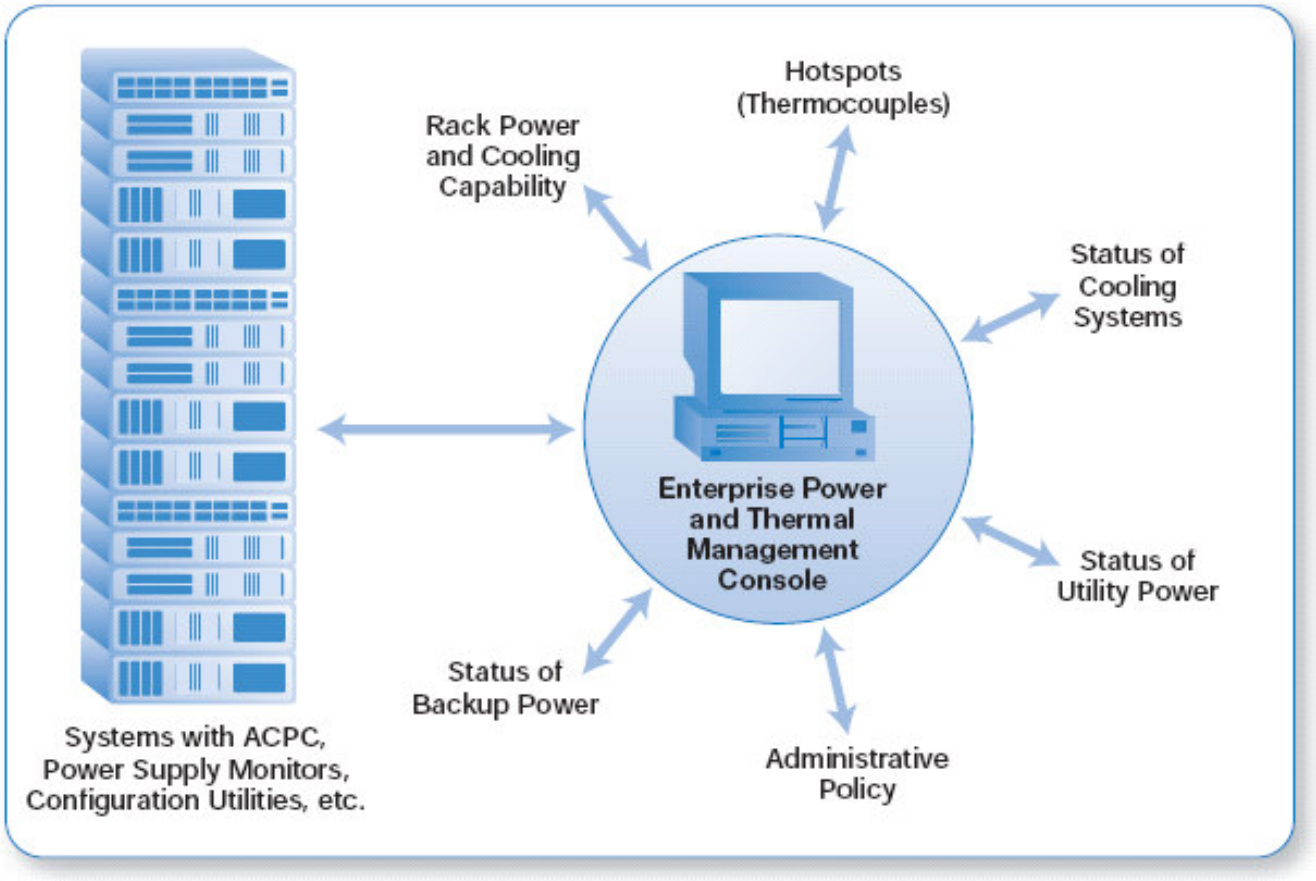
With DBS

Processor consumes less power when processing less intensive workloads

DBS Platform Requirements

1. Processor & Platform HW
   - All Intel® Xeon™ processors (3.40 GHz and higher)
   - Separate CPU power planes & Dynamic VID
2. BIOS
   - BIOS detects and enables the DBS feature
   - BIOS algorithm sets up ACPI P-state tables
3. OS
   - Windows support aligned with new service packs
     - WinXP SP2; WinXP Professional 64-bit edition
     - Svr2003 SP1 (production availability 1H'05, beta now)
   - Linux trending to late '04 / early '05
     - General 2.6 Kernel trending Q3'04
     - SUSE – SLES 9.0 SP1; Red Hat – RHEL4 Update 1

Longer Term: Integrated Power and Thermal Management



Platform Headroom

- Address the industry's growing appetite for server bandwidth
  - Underlying building block:

    Industry-proven Intel® Xeon™ processor with Intel NetBurst® microarchitecture

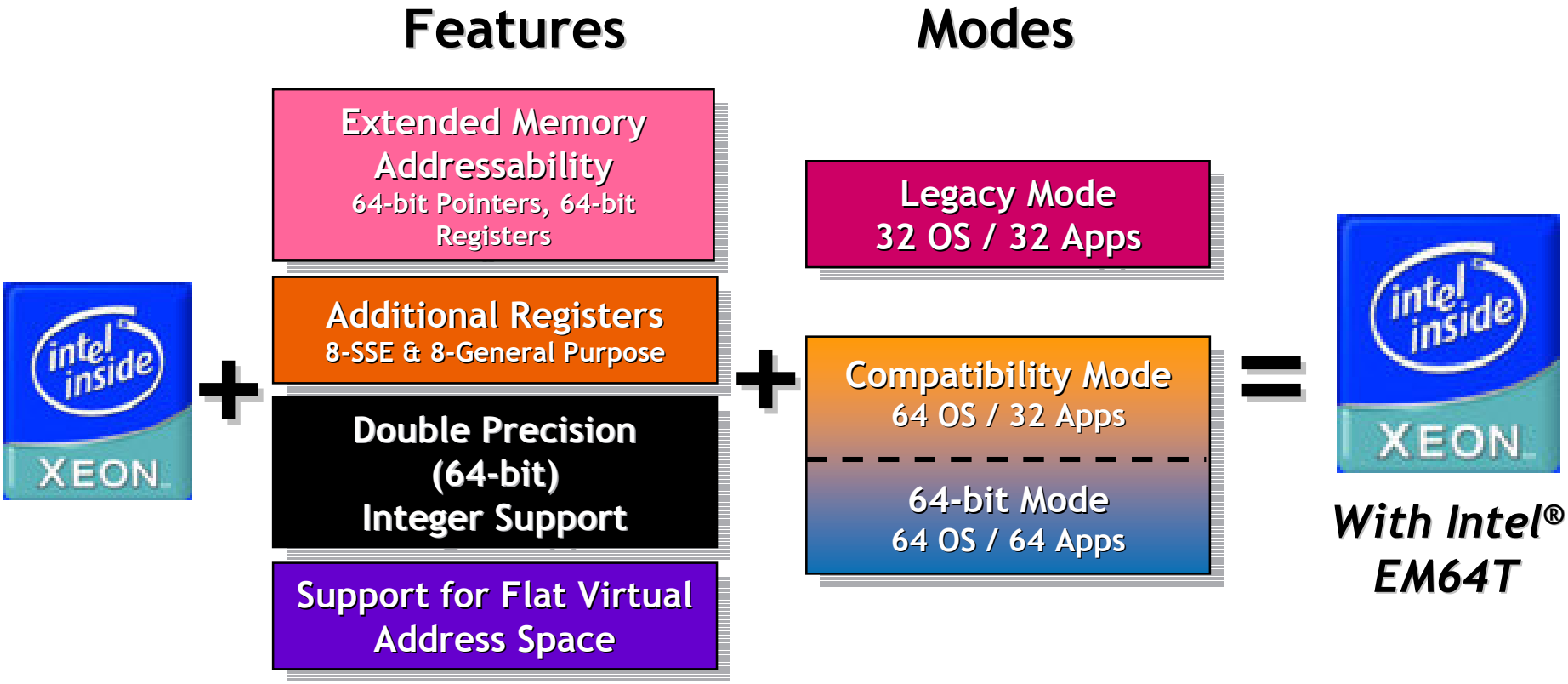
  - Incorporates new 64-bit extension technology with Intel® EM64T

  - Maximize platform-level performance in the future with dual cores per socket

Intel® Extended Memory 64 Technology

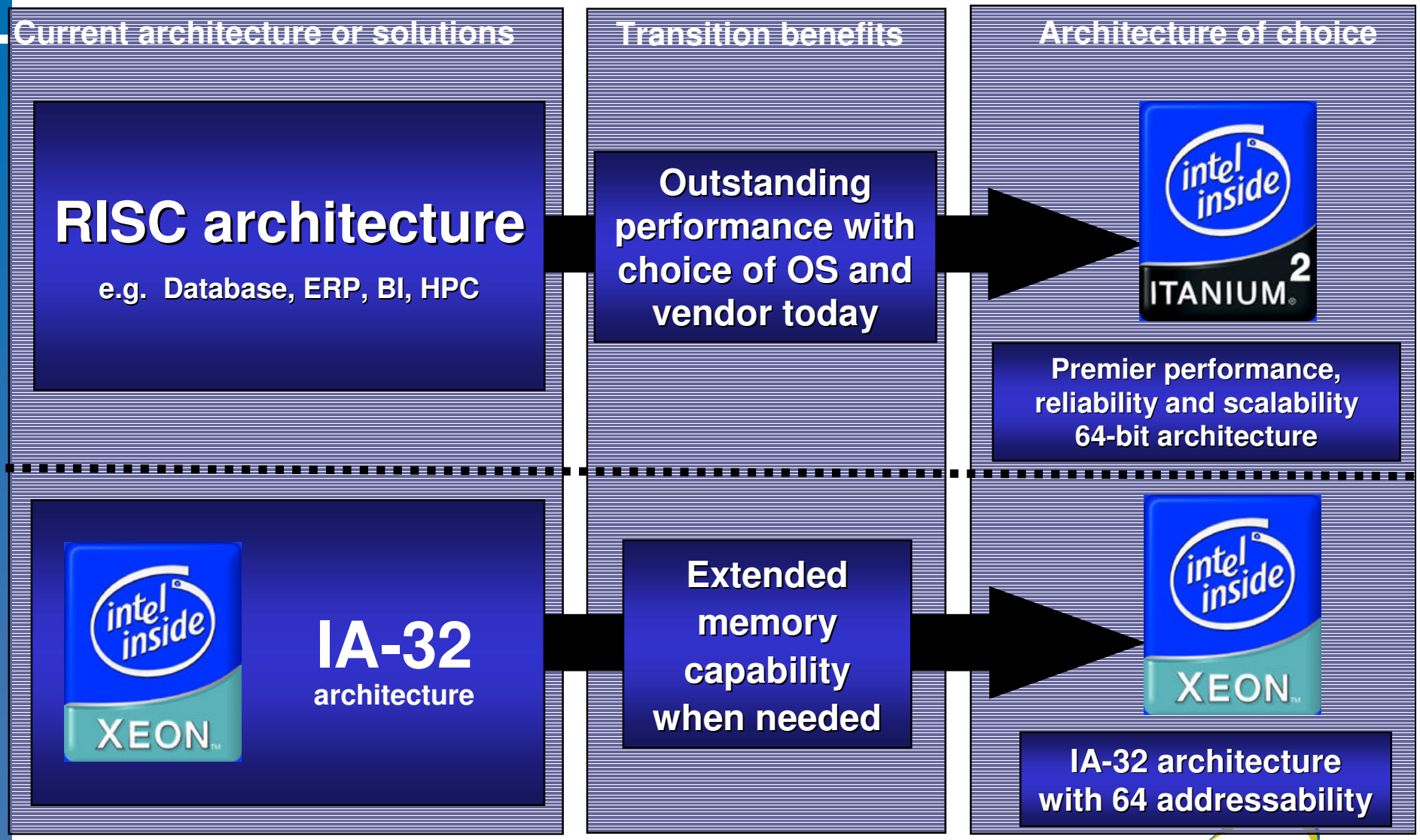
- Enables physical addressing of >4 GB of memory
- Proactive industry enabling from Intel
  - Broadly enabling ISVs, IHVs and end users
  - Over 3000 development systems shipped
  - Production Intel® EM64T support for Intel compilers and Intel VTune™ in August ’04
- Initial deployments focused on workstation, HPC and core software market segments
  - Appropriate for some HPC verticals such as Energy
    - Including Abaqus, Insteinet, Landmark, LSTC, MSC.Software
  - Early adopter workstation apps include Digital Content Creation, EDA, CAD

What is Intel® EM64T?



By mid next year the vast majority of workstation and server processors Intel ships will be 64-bit capable

Intel Provides Architectural Choice & Flexibility for Evolving 64-bit Server Computing



* Performance tests and ratings are measured using specific computer systems and/or components and reflect the approximate performance of Intel products as measured by those tests. Any difference in system hardware or software design or configuration may affect actual performance.

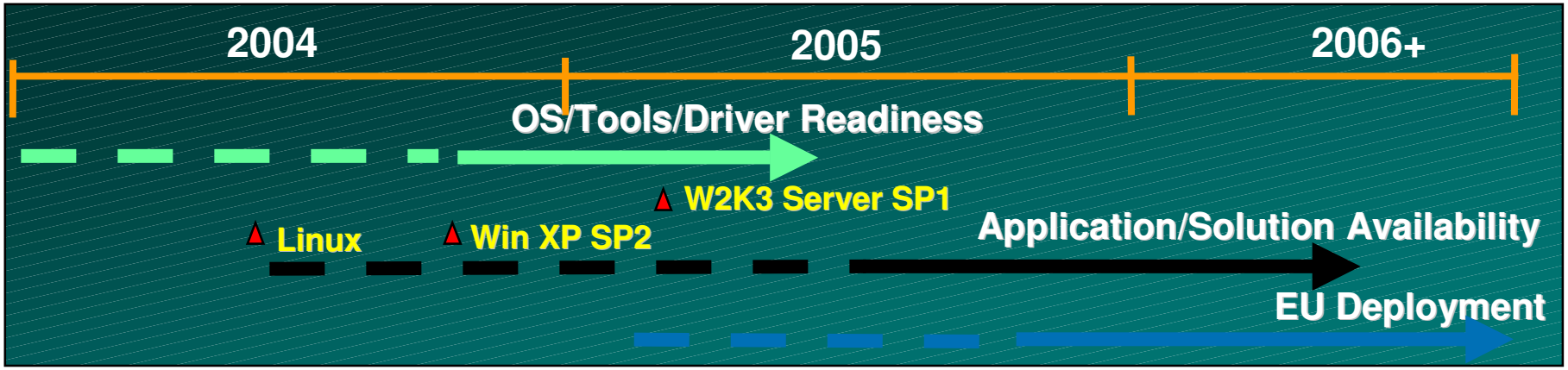
Ecosystem Readiness Summary
Intel® Extended Memory 64 Technology

- Over 3000 seed platforms planned
- Platform support enabled in OEM systems
- Intel® EM64T OS support currently available through Microsoft, RedHat & SuSE
  - Microsoft in pre-production (production 1H'05)
  - RedHat and SuSE in production
- Intel compiler in production August '04

Intel® EM64T Supported by ALL Major OS Vendors

The 64-bit Transition Will Take Time

- Evolutionary transition to Intel® EM64T will begin with segments which most benefit from 64-bit architecture
  - Intel® Xeon™ processor-based platforms provide outstanding performance for 32-bit applications
  - In the near term, majority of apps expected to remain 32-bit
- End-User (EU) deployment increases after OS, tools and applications are mature and hit critical mass



Intel® EM64T Software Ecosystem in Early Formative Stages, Volume EU Adoption will Take Time

Future Intel Technologies

- Process technology
- Power management
- Virtualization
- Dual core

Moore's Law is Alive and Well

Timeline	1997	1999	2001	2003	2005	2007	2009	2011
Process Generation	0.25µm	0.18µm	0.13µm	90 nm	65 nm	45 nm	32 nm	22 nm
Wafer Size (mm)	200	200	200/300	300	300	300	300	300
Inter-connect	Al	Al	Cu	Cu	Cu	Cu	Cu	?
Channel	Si	Si	Si	Strained Si	Strained Si	Strained Si	Strained Si	Strained Si
Gate dielectric	SiO_2	SiO_2	SiO_2	SiO_2	SiO_2	High-k	High-k	High-k
Gate electrode	Poly-silicon	Poly-silicon	Poly-silicon	Poly-silicon	Poly-silicon	Metal	Metal	Metal

Power efficiency technologies/processes

Driving High Volume Leadership with Silicon Process Technology

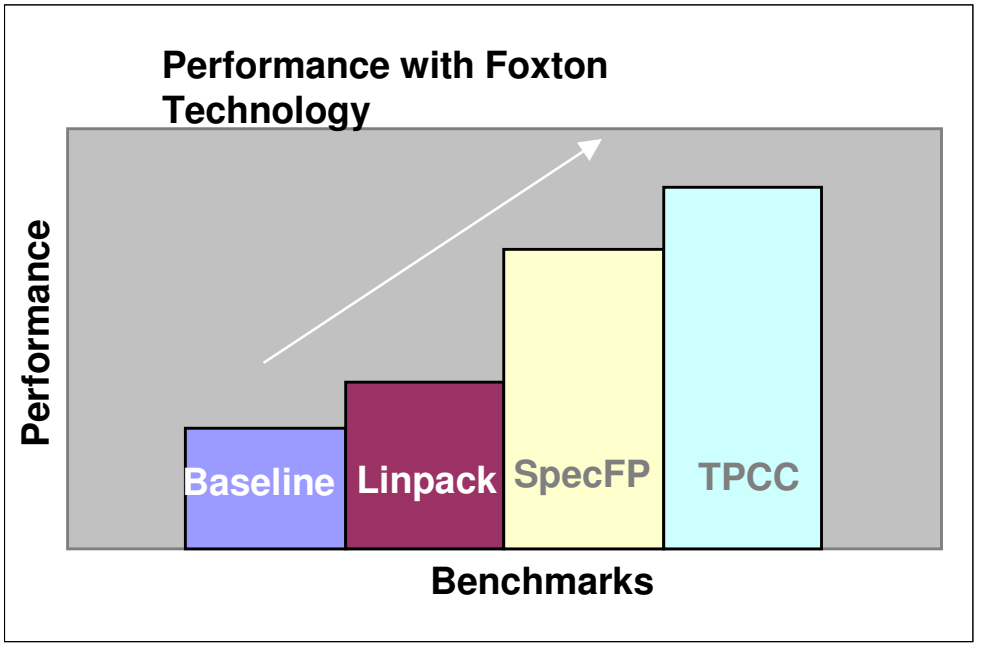
New Performance Technology: Foxton Technology

- Boosts enterprise performance dynamically based on application power consumption
- Example:
  - Processor = 2.0 GHz
  - Processor with Foxton = 2.0GHz + up to 10% (depending on application)
- On Intel® Itanium® 2 processor family (Montecito) in 2005
- Particularly applicable to dual core processors

Foxton Technology Performance Benefits

Foxton Technology:

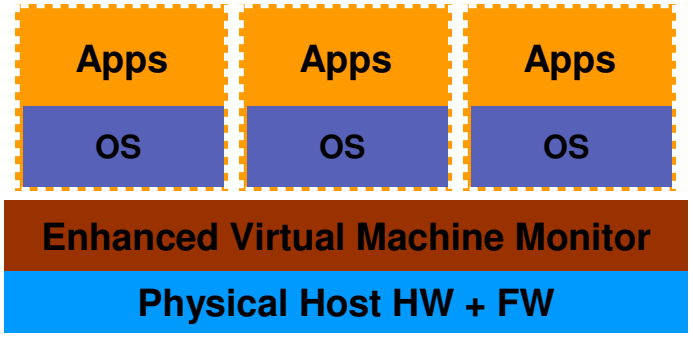
- Largest performance boost on transaction based applications
- No additional platform requirements



Performance boost varies by application

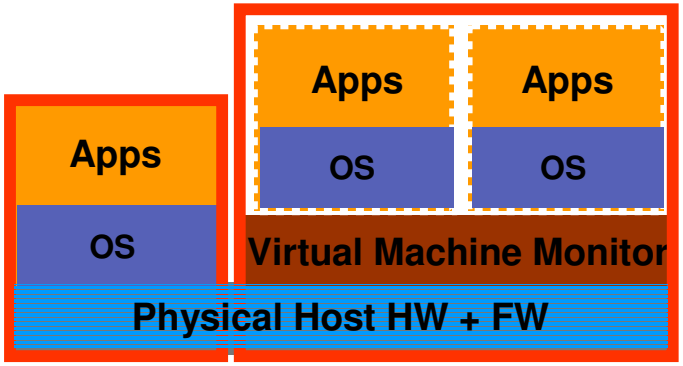
Silvervale Technology - Virtualization

Today: Virtual (Soft) Virtualization



- Uses: App consolidation, OS deployment assistance, dynamic resource allocation
- Increases server utilization

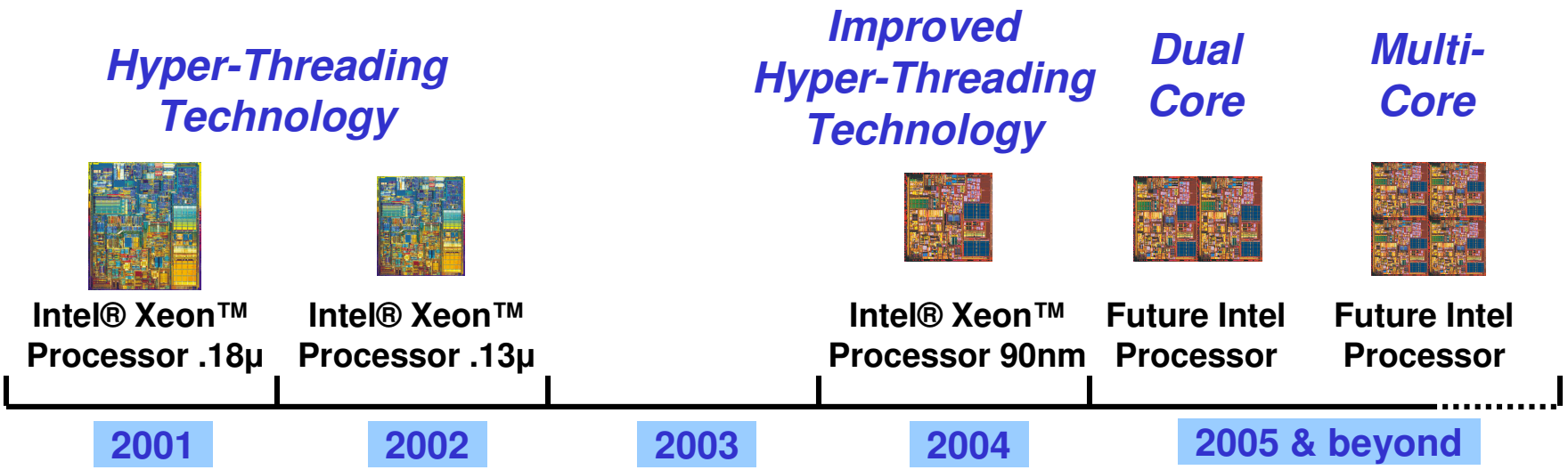
Future: Silvervale Technology: Physical (Hard) Partitioning



- Partitioning built directly in HW
- Number / size of partitions set by configurations supported in HW
- Brings high end Enterprise class server technology to IA

Planned for Montecito and future Intel® Xeon™ Processor

Increased Parallelism
Maintaining the Performance Curve



- Continuing trend towards increased parallelism beginning with Hyper-Threading technology
- Dual/multi-core processors will continue to provide Moore's law performance scaling
- Applications providing increasing support for parallel execution threads

Summary: Intel = Volume Platform Technology Leadership

- Breakthrough performance in Intel's new volume platforms
  - 90nm Intel® Xeon™ Processor
  - Intel® E7520, E7525, E7320 chipsets
  - EM64T 64-bit extensions, PCI Express*, DDR2, DBS power management, Intelligent RAID
- Key new technologies deliver end user value
  - Increased performance
  - Power management
  - Platform headroom

Thank You!

Q&A

Backup

System Configuration Details & Performance Legal Disclaimers

DP Server Platform

System Configuration Details:

SPECjbb2000. This benchmark measures the number of eCommerce transactions a java application server can handle. Measured in Operations per Second

1. Intel® Xeon™ processor 3.20 GHz with 1MB L3 cache, Intel® Server Board SE7501WV2 with Intel® E7501 chipset, 3 GB DDR PC2100, Microsoft Windows* 2000, BEA JRockit 8.1 JVM
2. Intel® Xeon™ processor 3.60 GHz with 1MB L2 cache, Intel® Server Board SE7520AF2 with Intel® E7520 chipset, 3 GB DDR2 400, Microsoft Windows* 2000, BEA JRockit 8.1 JVM

WMLS (Windows* Media Load Simulator). This benchmark measures a server's ability to send simultaneous media streams. Measured in Number of Simulations Streams

1. Intel® Xeon™ processor 3.20 GHz with 1MB L3 cache, Intel® Server Board SE7501WV2 with Intel® E7501 chipset and 533MHz system bus, 3 GB DDR PC2100, Microsoft® Windows* Server 2003 Enterprise Edition, 2 Intel® PRO/1000 XF Server Adapters, Adaptec AIC-7899 Ultra 160 SCSI disk subsystem; Windows* Media Load Simulator (WMLS) version 9.
2. Intel® Xeon™ processor 3.60 GHz with 1MB L2 cache, Intel® Server Board SE7520AF2 with Intel® E7520 chipset and 800MHz system bus, 3 GB DDR2 400, Microsoft® Windows* Server 2003 Enterprise Edition, 2 Intel® PRO/1000 XF Server Adapters, Intel 82801EB Ultra ATA disk subsystem; Windows* Media Load Simulator (WMLS) version 9.

WebBench. This benchmark measures a server's ability to handle dynamic requests from the internet. Measured in Requests per Second.

1. Intel® Xeon™ processor 3.20 GHz with 1MB L3 cache, Intel® Server Board SE7501WV2 with Intel® E7501 chipset and 533MHz system bus, 3 GB DDR PC2100, Microsoft® Windows* Server 2003 Enterprise Edition, 2 Intel® PRO/1000 XF Server Adapters, Adaptec AIC-7899 Ultra 160 SCSI disk subsystem; WebBench 4.0.1 (128 bit US version) NT ISAPI ecommerce suite.
2. Intel® Xeon™ processor 3.60 GHz with 1MB L2 cache, Intel® Server Board SE7520AF2 with Intel® E7520 chipset and 800MHz system bus, 3 GB DDR2 400, Microsoft® Windows* Server 2003 Enterprise Edition, 2 Intel® PRO/1000 XF Server Adapters, Intel 82801EB Ultra ATA disk subsystem; WebBench 4.0.1 (128 bit US version) NT ISAPI ecommerce suite.

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Relative performance for each benchmark is calculated by talking the actual benchmark result for the first platform tested and assigning it a value of 1.0 as a baseline. Relative performance for the remaining platforms tested was calculated by dividing the actual benchmark result for the baseline platform into each of the specific benchmark results of each of the other platforms and assigning them a relative performance number that correlates with the performance improvements reported.

System Configuration Details & Performance Legal Disclaimers

DP Workstation Platform

System Configuration Details:

All platforms: 36GB SCSI Seagate ST336753LW 15K hard drive, Microsoft Windows* XP Professional SP1.

- Intel® XeonTM processor with 533 MHz system bus-based workstation at 3.2 GHz with 1 MB Additional Cache; Dell* Precision* 650, 4GB DDR-266 – 1 GB Samsung M312L2920BG0-CCC, Adaptec 29320 SCSI adapter, Intel Chipset Software Utility INF version 5.00.1012, nVidia* Quadro* 4 Pro 980XGL 128 MB AGP 8x video card using driver 52.14.
- Intel® XeonTM processor with 800 MHz system bus-based workstation at 3.60 GHz; Intel* WS400 pre-release reference board, 4 GB DDR2-400 – 512 MB Samsung M393T6553BG0-CCC, Adaptec AIC7902 Ultra320 SCSI adapter, Intel Chipset Software Utility INF version 5.20.1006, nVidia* Quadro* FX 1300 128 MB PCIe video card using driver 60.30.

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