New Horizons in Technology, Products, and Services

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**Power Consumption**

- In computing platform procurement, power consumption (not performance - nor space) dominates considerations.

- Green, or eco-friendliness, is good.

- "Clean" technologies are good.
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**Multi-core, multi-thread microprocessors**

- Technology capabilities in different foundries are converging.
- CPU frequencies are “hitting the wall” - Law of Physics.
- Finer grain of parallelism sought versus SMP platforms.
- New challenge in software programming paradigm.
- Virtualization provides a "soft landing".
The Big Bang Is Happening — Four Converging Trends

**Network Computing Is Thread Rich**
Web services, Java™ applications, database transactions, ERP . . .

**Moore’s Law**
A fraction of the die can already build a good processor core; how am I going to use a billion transistors?

**Worsening Memory Latency**
It’s approaching 1000s of CPU cycles! Friend or foe?

**Growing Complexity of Processor Design**
Forcing a rethinking of processor architecture – modularity, less is more, time-to-market
CMT – Multiple Multithreaded Cores

Core 8
- Thread 4
- Thread 3
- Thread 2
- Thread 1

Core 7
- Thread 4
- Thread 3
- Thread 2
- Thread 1

Core 6
- Thread 4
- Thread 3
- Thread 2
- Thread 1

Core 5
- Thread 4
- Thread 3
- Thread 2
- Thread 1

Core 4
- Thread 4
- Thread 3
- Thread 2
- Thread 1

Core 3
- Thread 4
- Thread 3
- Thread 2
- Thread 1

Core 2
- Thread 4
- Thread 3
- Thread 2
- Thread 1

Core 1
- Thread 4
- Thread 3
- Thread 2
- Thread 1

Memory Latency

Compute

Time
It’s No Longer a Point Vision

Relative Performance Per Core

Core Size vs. Die Usage

Traditional Decision Point
Figure I.1  The Impact of Sustaining and Disruptive Technological Change

Performance demanded at the high end of the market

Progress due to sustaining technologies

Disruptive technological innovation

Progress due to sustaining technologies

Performance demanded at the low end of the market

Product Performance

Time

The Third Dimension of the Disruptive Innovation Model

- **Sustaining Strategy**: Bring a better product into an established market.
- **Low-End Disruption**: Address overserved customers with a lower-cost business model.
- **New-Market Disruption**: Compete against nonconsumption.

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Christensen, Clayton M. and Michael E. Raynor. 2003

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Virtualization

• An effective way to save power, too!

• The pursuit of utilization and manageability leads to virtualization.

• Not a new concept; but, it's the right technology, at the right time.

• From virtual memory, to virtual file systems, to virtual machines.

• Eventually, virtual processor (or processor ISA) is also going to happen.
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