Mercury Computer Systems & The Cell Broadband Engine

Georgia Tech Cell Workshop
18-19 June 2007
About Mercury

• Leading provider of innovative computing solutions for challenging applications
• R&D centers in U.S., France, and Germany; more than 750 associates with strong concentration in engineering
• Industry focus areas:
  - Aerospace & Defense
  - Energy
  - Life Sciences
  - Semiconductor Equipment
  - Telecommunications
  - Energy
  - Education & Research
  - High Performance Computing
We Solve Some of the World’s Most Challenging Computing Problems

- **Commercial Imaging & Visualization Solutions**
  - Medical imaging and biotechnology
  - Geosciences: energy exploration
  - Engineering and simulation

- **Defense Electronics**
  - Radar and Signals intelligence
  - Data exploitation, smart weapons, imagery and sonar

- **Semiconductor Equipment**
  - Mask generation
  - Wafer inspection

- **High-end Baggage Scanning**

- **Telecommunications**
Mercury, IBM & Cell: A Landmark Agreement

- **Mercury is the first non-gaming company to integrate the Cell Broadband Engine into its products**
  - High-volume gaming market is transforming the technology industry
- **Targeting applications in existing and new markets with optimized Cell Broadband Engine-based products**
  - Medical imaging, inspection, defense, geosciences, telecommunications, etc.
- **Mercury is uniquely capable**
  - The Cell Broadband Engine is designed to solve the same types of problems Mercury has been solving for many years

Cell Broadband Engine is a trademark of Sony Computer Entertainment Inc.
**Mercury / IBM Alliance**

**A strategic alliance to help our clients win through the application of disruptive, game changing Cell BE technology.**

<table>
<thead>
<tr>
<th><strong>IBM Value</strong></th>
<th><strong>Mercury Value</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology:</td>
<td>Standard (COTS) products based on Cell BE technology</td>
</tr>
<tr>
<td>Cell BE processor</td>
<td>Software products offer high performance and ease of use</td>
</tr>
<tr>
<td>Custom development:</td>
<td>Cell BE performance optimization</td>
</tr>
<tr>
<td>Create for clients custom solutions based on Cell BE technology as necessary</td>
<td>Market knowledge</td>
</tr>
<tr>
<td>Cell BE BladeCenter blades</td>
<td>Domain specific applications</td>
</tr>
<tr>
<td>developed with Mercury collaboration</td>
<td></td>
</tr>
</tbody>
</table>

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“Best IBM Embedded Power Architecture™ Solution”

The IBM PartnerWorld team has announced the winners of the 2007 Beacon Awards. Mercury has been recognized for the development of a coprocessor acceleration system based on the Cell BE processor to be used initially in electronic design automation (EDA) solutions.

Judges remarked that Mercury "provided deep insight and delivered a Cell-based solution with superior technical results."
Cell-based Mercury Products
Mercury Cell-Based Hardware Roadmap

2006 | 2007 | 2008
---|---|---

**Blades**
- Dual Cell Based Blade
  - 2 BE, 2 SouthBridges, 1GB XDR
- DCBB 2
  - Single slot, 2 BE, 2 Companion Chips, 2GB XDR, 8 GB DDR2
- DCBB 3
  - Single slot, 2 BE, 2 Comp. Chips, up to 32GB DDR2

**1U Systems**
- 1U Dual Cell Based System
  - 2 BE 2 Southbridges, 1GB XDR
- 1U DCBS 2
  - 2 BE, 2 Comp. Chips, 2GB XDR, 8 GB DDR2
- 1U DCBS 3
  - 2 BE, 2 Comp. Chips, up to 32GB DDR2

**Embedded**
- Cell Accelerator Board
  - PCIe Add-In Card
    - 1 BE, 1 Comp. Chip, 1GB XDR, 4 GB DDR2
- Cell Workstation Development System

**Rugged**
- 2U DCBS 2
  - 2 BE, 2 Comp. Chips, 2GB XDR, 8 GB DDR2
- VITA 46 / 48 Concept
- PowerStream™ Concept

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Dual Cell Based Blade

- Flexible blade solution based on the Cell BE processor
  - Outstanding performance for HPC applications
  - Designed for distributed processing
  - Cell-optimized software available
  - About 11 TFLOPS in 5 feet of rack height

- Dual-width BladeCenter™ blade

- Two PCI Express x4 expansion slots
  - Initially supports sub-rate Infiniband cards

- Evaluation units available since December 2005

- In production since Q4 2006
Dual Cell Based Blade System Example

42U Infiniband System

- 42U (73.5”) high
- 28 blades
- 56 Cell processors
- External 24 port Infiniband switch
- 11.5 TFLOPS
Dual Cell Based Blade 2

- **Single slot blade**
  - Up to twice the density
- **Uses new companion chip**
  - Up to 10x I/O bandwidth
  - Full rate Infiniband
- **DDR2 I/O buffer memory**
  - Up to 10 GB total memory
- **Serial attached SCSI external disk**
- **High Speed I/O Module concept**
  - Single slot module that clips on to blade providing two PCIe 16x card sites
- **Prototypes Q2 2007**
- **Production Q4 2007**
New Cell Companion Chip

- Under design by IBM since May 2005
  - With significant design input from Mercury
- Second spin chips for early production in December 2006
- Third spin chips in Q3 2007

Cell BE Interface
- 5 GB/s each way
- Extends Cell global address space to PCIe, DDR2 etc.
- Non-coherent (non-cached)

PCIe 16x interfaces
Each configurable:
- 16x, 8x, 4x and 1x
- Endpoint or root complex

DDR2 controllers
- 5 GB/s each
- Up to 4 GB each

Low latency, high capacity mailbox

Multichannel, striding DMA engine
**1U Dual Cell Based System**

**Hardware**
- Dual Cell processors at 3.2 GHz
- 1 GB of XDR DRAM
- Integrated dual Gigabit Ethernet
- Serial port
- Dual full size PCI Express x4 slots
  - Initially supports only Infiniband cards
- Convenient 100-240V power input

**Software**
- Toolchain
  - Native (PPE hosted)
  - Cross (x86 hosted)
- GUI via X-Windows over GbE
  - No direct keyboard / video / mouse support

**Prototypes available since April 2007**
1U Dual-Cell Based System 2

- 1U solution using based on companion chip
- Dual 3.2 GHz Cell processors
- Memory
  - 2 GB of XDR
  - 2-8 GB of DDR2
- I/O
  - Dual PCIe daughtercard sites
    - E.g. Infiniband or 10 GbE
  - Dual GigE
- Optional disk
- Production available
  Q4 2007
2U Dual-Cell Based System 2

- **2U form factor**
  - All power and I/O cables front accessible
  - Reduced depth: 18” (457mm)
  - Extended environmental

- **Dual 3.2 GHz Cell processors**

- **Memory**
  - 2 GB of XDR
  - 2-8 GB of DDR2

- **I/O**
  - Dual PCIe daughtercard sites
    - E.g. Infiniband or 10 GbE
  - Dual GigE

- **Production available**
  - Q4 2007
1U Dual-Cell Based System 3

- **1U solution with enhanced memory capacity**
- **Dual 3.2 GHz Cell processors**
  - Improved SPE double-precision performance
- **Memory**
  - 16-32 GB of DDR2 (replaces XDR)
  - 1-2 GB of DDR2 per companion chip for IO buffering
- **I/O**
  - PCIe x8 daughtercards
    - E.g. Infiniband or 10 GbE
  - Dual GigE
- **Optional disk**
- **Production available**
  Q2 2008
Cell Accelerator Board

- PCI Express™ accelerator card compatible with high-end workstations
- More than 180 GFLOPS on a desktop
- 1 GB of XDR and 4GB of DDR2
- Gigabit Ethernet on end bracket

- Uses Cell companion chip
- Volume production of boards began Q1 2007
PCI Express ATX Form Factor

• **PCIe x16 Graphics 150W-ATX Spec 1.0 standard**
  - Designed for high-end GPU boards
  - Requires double slot spacing (1.6” width)
  - Draws 75 W via PCIe connector and additional 75 W via internal cable

• **Cell Accelerator Board is based on this standard**
  - Maximum power is 210 watts
    - CAB uses two internal 75 W cables
  - Qualified on high end workstations with two 150W-ATX slots
Mercury Cell Software Strategy

- **Focus on ease of use without sacrificing performance**
  - Deliver Mercury value-added software that allows programmers to get maximum performance
    - Framework
    - Libraries
    - Tools
    - Custom algorithm implementation
  - Provide migration strategy for existing applications
  - Design software that is portable to future multicore architectures

- **Foster and leverage Cell ecosystem**
  - IBM, Sony & Toshiba enabling software
    - OS, simulators, compilers, debuggers
  - 3rd party middleware and libraries

- **Watch and collaborate with research in multicore software**
Summary

- Cell technology offers order-of-magnitude improvement in performance per processor
- Mercury has been developing computing solutions for applications well suited for Cell technology for many years
- Customers can leverage Cell technology through Mercury to achieve:
  - Unbiased assessment of risks and applicability of deploying Cell-based solutions.
  - Significant improvements in performance and bandwidth for certain applications compared to conventional processors