Benefits of the AMD Opteron™ Processor for LS-DYNA

Dawn Rintala
Sr. Developer Engineer
Computation Products Group
Advanced Micro Devices, Inc.

Demands on System from Explicit/Implicit Analysis

- **Explicit**
  - Quick Communication between processors
  - Good FPU

- **Implicit**
  - Low memory latency
  - High memory bandwidth

AMD Opteron™ delivers:
1. Breakthrough 64-bit performance
2. Complete 32-bit compatibility
3. Industry leading price/performance
Benefits of AMD Opteron™ for LS-DYNA

• Performance
  – Raw Performance
  – Price Performance

• Scalability
  – On-Chip Cache
  – HyperTransport™

• Low Memory Latency

• Memory Addressability

AMD Opteron™ SOC Architecture Overview

• First AMD64 processor

• Aggressive out-of-order, 9-issue superscalar processor

• Integrated DDR memory controller

• Leading performance in integer, floating point and multimedia
  – AMD64, x87, MMX™, 3DNow!™, SSE, SSE2

• Glueless multiprocessing through HyperTransport™

• Expandable IO through HyperTransport
AMD Opteron™ Processor
Technology Overview

- Processor Core Overview
  - Support for AMD’s 64-bit technology
  - 12-stage int, 17-stage fp pipelines
  - Enhanced TLB structures
  - TLB flush filter
  - Enhanced branch prediction
  - 1MB L2 cache
  - ECC protection

- Memory Controller Overview
  - Dual-channel DDR memory
  - PC2700, PC2100, or PC1600 DDR memory support
  - Registered or Unbuffered DIMMs
  - ECC and Chip Kill
  - High bandwidth (up to 6.4GB/s)

- HyperTransport™ Technology Overview
  - One, two, or three links
  - 2, 4, 8, 16, or 32-bits full duplex
  - Up to 6.4 GB/s bandwidth per link
  - 19.2 GB/s aggregate external bandwidth

HT = HyperTransport™ technology

AMD Opteron™ processor-based
4P Server
The Rewards of Good Plumbing

**High Bandwidth**
- 2P system is designed to achieve 7 GB/s aggregate memory Read bandwidth
- 4P system is designed to achieve 10 GB/s aggregate memory Read bandwidth

**Low Latency**
- Average 2P unloaded latency (page hit) is designed to be < 120 ns
- Average 4P unloaded latency (page hit) is designed to be < 140 ns
- Latency under load increases slowly due to excess Interconnect Bandwidth
- Latency shrinks quickly with increasing CPU clock speed and HyperTransport™ link speed

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### Integrated Memory Controller

**Latency (Local Memory Access, Registered Memory, CAS2)**

**Read Latency Accessing Local Memory, PC2100**

- AMD Athlon™ latency = 180ns

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22 May 2003  |  LS-DYNA Users Conference 2003  |  7

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### Floating-Point Performance

<table>
<thead>
<tr>
<th>Processor</th>
<th>SPECfp®_rate2000 Performance (Peak, 4P)</th>
<th>SPECfp®_rate2000 Performance and Scalability (Peak, 2-4P scaling)</th>
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<tbody>
<tr>
<td>Itanium 2 1.0GHz</td>
<td>49.3%</td>
<td>45% 160%</td>
</tr>
<tr>
<td>AMD Opteron™ 844</td>
<td>49.2%</td>
<td>30.3% 100%</td>
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<tr>
<td>AMD Opteron 842</td>
<td>45%</td>
<td>26.7% 100%</td>
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<td>AMD Opteron 840</td>
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<tr>
<td>Xeon MP 2.0GHz</td>
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<td>Itanium 2 1.0GHz (2P)</td>
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<td>45% 160%</td>
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<td>AMD Opteron™ 844 (4P)</td>
<td>45%</td>
<td>30.3% 100%</td>
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<td>Xeon MP 2.0GHz (2P)</td>
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<tr>
<td>Xeon MP 2.0GHz (3P)</td>
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www.amd.com/opteronperformance

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### The Result

**AMD Opteron™ delivers:**

1. Breakthrough 64-bit performance
2. Complete 32-bit compatibility
3. Industry leading price/performance
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