AMD HPC Product Portfolio Update

Owen Liu, Technical Director, AMD China
October 28, 2009
AMD’s HPC Product Portfolio

Energy efficient CPU and discrete GPU processors focused on addressing the most demanding HPC workloads

Multi-core x86 Processors
- Outstanding Performance
- Superior Scalability
- Enhanced Power Efficiency

Professional Graphics
- 3D Accelerators For Visualization
- See More and Do More with Your Data

Stream Computing
- GPU Optimized For Computation
- Massive Data-parallel Processing
- High Performance Per Watt
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“Istanbul” Processor

Performance
• Six-Core AMD Opteron™ Processor
  6M Shared L3 Cache
  North Bridge enhancements (PF + prefetch)
  45nm Process Technology
• DDR2-800 Memory
• HyperTransport-3 @ 4.8 GT/sec

Reliability/Availability
• L3 Cache Index Disable
• HyperTransport Retry (HT-3 Mode)
• x8 ECC (Supports x4 Chipkill in unganged mode)

Virtualization
• AMD-V™ with Rapid Virtualization Indexing

Manageability
• APML Management Link

Scalability
• 48-bit Physical Addressing (256TB)
• HT Assist (Cache Probe Filter)

Continued Platform Compatibility
• Nvidia/Broadcom-based F/1207 platforms

Red denotes a new or updated feature

48-bit Physical Addressing (256TB)
HT Assist (Cache Probe Filter)

I/O Bridge

South Bridge

SE: 2.8GHz
Std: 2.6GHz
HE: 2.1GHz
EE: 1.8GHz

*NAPML-enabled platform support required.*

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**“Istanbul” Processor**

**Performance**
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  - North Bridge enhancements (PF + prefetch)
  - 45nm Process Technology
- DDR2-800 Memory
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- AMD-V™ with Rapid Virtualization Indexing

**Manageability**
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**STREAM Bandwidth (GB/s)**

<table>
<thead>
<tr>
<th>Product, Freq, Dram</th>
<th>2S</th>
<th>4S</th>
<th>8S</th>
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<tbody>
<tr>
<td>Barcelona, 2.3/2.0, RDDR2-667</td>
<td>17.2</td>
<td>20.5</td>
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<td>Shanghai, 2.7/2.2, RDDR2-800</td>
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<td>24</td>
<td></td>
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<td>Istanbul, 2.4/2.2, RDDR2-800</td>
<td>22</td>
<td>42</td>
<td>81.5</td>
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</table>

*Based on measurements at AMD performance labs. See backup slide for configuration information.

Red denotes a new or updated feature.
HT Assist Improves Two-Socket to Four-Socket Server Performance Scaling

SPEC, SPECint, and SPECfp are registered trademarks of the Standard Performance Evaluation Corporation. The SPECint_rate and SPECfp_rate results for Six-Core AMD Opteron™ processors are based upon data submitted to Standard Performance Evaluation Corporation as of May 12, 2009. The other SPECint_rate and SPECfp_rate results stated above reflect results published on [http://www.spec.org](http://www.spec.org) as of May 12, 2009. The STREAM results are based on measurements at AMD performance labs as of May 12, 2009. The SPECint_rate and SPECfp_rate comparisons presented above are based on the best performing two-socket and four-socket servers using AMD Opteron™ processor Models 2384, 8384, 2435, and 8435. For the latest results, visit [www.spec.org](http://www.spec.org). Please see backup slides for configuration information.
2 Socket HPL Performance

High-Performance Linpack - Two Socket Servers

Six-Core AMD Opteron™ Processor ("Istanbul") Model 2435 (2.6GHz)

Intel Xeon Processor ("Gainestown") Model X5570 (2.93GHz)

HPL Gflops*

*Based on AMD internal performance lab measurements as of June 15th 2009 – see backup slides for configuration
Power Efficient Innovations

**AMD Smart Fetch Technology**
Can reduce power consumption by allowing idle cores to enter a “halt” state

**AMD PowerCap Manager**
Allows IT datacenter managers to set a fixed limit on a server’s processor power consumption

**Dual Dynamic Power Management™**
Enables more granular power management capabilities to reduce processor energy consumption. Separate power planes for cores and memory controller

**AMD PowerNow!™ Technology with Independent Dynamic Core Technology**
Allows processors and cores to dynamically operate at lower power and frequencies, depending on usage and workload to help reduce TCO and to lower power consumption in the datacenter

**Enhanced Performance-per-watt**
50% more compute cores vs. quad-core within the same power envelope*

**AMD CoolCore™ Technology**
Can reduce processor energy consumption by dynamically turning off sections of the processor when inactive

Extends to the L3 Cache

*Compared to Quad-Core AMD Opteron processor codenamed “Shanghai.”*
L3 BLAS improvements
- SGEMM for Istanbul
- New Intel DGEMM and SGEMM kernels
  - Supporting Woodcrest, Penryn, Nehalem - Competitive with MKL
- New DGEMM "fast memory allocation" scheme
  - allows improved performance of other routines (such as LAPACK) which make heavy use of DGEMM

Istanbul tuning for Level 1 BLAS
- xDOT, xCOPY, xAXPY, and xSCAL

3DFFT performance improvements - Competitive with MKL

AMD Family 10h tuning for real-complex FFTs
- csfft, dzfft, scfft and zdfft have been re-tuned for AMD Family 10h processors, providing significant performance increases.

New! - ACML 4.3
New - AMD’s High Performance Compiler

AMD has released a version of C/C++/Fortran compilers based on Open64 technology

- x86 Open64 version 4.2.2.2
  - Release is available for download on AMD Developer Central at [http://developer.amd.com/cpu/open64](http://developer.amd.com/cpu/open64) in source and binary forms
  - No license fee for compiler use
  - Provided with documentation and support

<table>
<thead>
<tr>
<th>File Name</th>
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<th>OS</th>
<th>Bitness</th>
<th>Description</th>
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<td>Linux®</td>
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<td>Host 64-bit Target 32/64-bit</td>
<td>x86 Open64 4.2.2.2-1 Compilers for Linux</td>
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## x86 64-bit Architecture Evolution

<table>
<thead>
<tr>
<th>Year</th>
<th>Mfg. Process</th>
<th>CPU Core</th>
<th>L2/L3</th>
<th>Hyper Transport™ Technology</th>
<th>Memory</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>90nm SOI</td>
<td>K8</td>
<td>1MB/0</td>
<td>3x 1.6GT/s</td>
<td>2x DDR1 300</td>
</tr>
<tr>
<td>2005</td>
<td>90nm SOI</td>
<td>K8</td>
<td>1MB/0</td>
<td>3x 1.6GT/s</td>
<td>2x DDR1 400</td>
</tr>
<tr>
<td>2007</td>
<td>65nm SOI</td>
<td>Greyhound</td>
<td>512kB/2MB</td>
<td>3x 2GT/s</td>
<td>2x DDR2 667</td>
</tr>
<tr>
<td>2008</td>
<td>45nm SOI</td>
<td>Greyhound+</td>
<td>512kB/6MB</td>
<td>3x 4.0GT/s</td>
<td>2x DDR2 800</td>
</tr>
<tr>
<td>2009</td>
<td>45nm SOI</td>
<td>Greyhound+</td>
<td>512kB/6MB</td>
<td>3x 4.8GT/s</td>
<td>2x DDR2 1066</td>
</tr>
<tr>
<td>2010</td>
<td>45nm SOI</td>
<td>Greyhound+</td>
<td>512kB/12MB</td>
<td>4x 6.4GT/s</td>
<td>4x DDR3 1333</td>
</tr>
</tbody>
</table>

### AMD Opteron™

- **2003**: 90nm SOI
- **2005**: 90nm SOI
- **2007**: 65nm SOI
- **2008**: 45nm SOI
- **2009**: 45nm SOI
- **2010**: 45nm SOI

### AMD Opteron™

- **2003**: K8
- **2005**: K8
- **2007**: Greyhound
- **2008**: Greyhound+
- **2009**: Greyhound+
- **2010**: Greyhound+

### Hyper Transport™ Technology

- **2003**: 3x 1.6GT/s
- **2005**: 3x 1.6GT/s
- **2007**: 3x 2GT/s
- **2008**: 3x 4.0GT/s
- **2009**: 3x 4.8GT/s
- **2010**: 4x 6.4GT/s

### Memory

- **2003**: 2x DDR1 300
- **2005**: 2x DDR1 400
- **2007**: 2x DDR2 667
- **2008**: 2x DDR2 800
- **2009**: 2x DDR2 1066
- **2010**: 4x DDR3 1333
Dramatic Back-to-back Gains

**Magny-Cours**

12 core

"Istanbul"

6 core

"Magny-Cours"

12 core

Future silicon

Performance relative to original AMD Opteron™ Processor

Floating Point  Integer

2003  2004  2005  2006  2007  2008  2009  2010  2011

Single Core  Dual Core  Quad Core  "Istanbul"  Future silicon

"Magny-Cours" and Future silicon data is based on AMD projections
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Harnessing the Computational Power of GPUs

- GPU architecture increasingly emphasizes programmable shaders instead of fixed function logic
- Enormous computational capability for data parallel workloads
- Potential to balance system performance
- New math for datacenters: high performance/watt and performance/$
ATI Stream Technology is...

**Heterogeneous:** Developers leverage AMD GPUs and CPUs for optimal application performance and user experience.

**Industry Standards:** OpenCL™ and DirectCompute 11 enable cross-platform development.

**High performance:** Massively parallel, programmable GPU architecture delivers unprecedented performance and power efficiency.
GPGPU Processing Power Trend

* Peak single-precision performance; For RV670, RV770 & Cypress divide by 5 for peak double-precision performance.
ATI Radeon™ HD 5870 GPU

The World’s Most Powerful and Advanced GPU

- Ultimate immersion with DirectX® 11 and ATI Eyefinity Technology
- Accelerating PCs with nearly 3 teraFLOPS of compute power
- Extreme game play at high resolutions and maximum settings*

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compute Power</td>
<td>2.72 TFLOPS</td>
</tr>
<tr>
<td>Core Clock Speed</td>
<td>850 MHz</td>
</tr>
<tr>
<td>Stream Processors</td>
<td>1600</td>
</tr>
<tr>
<td>Frame Buffer</td>
<td>1GB, 4.8Gbps</td>
</tr>
<tr>
<td>Max/Idle Board Power</td>
<td>188W/27W</td>
</tr>
<tr>
<td>Max Res.</td>
<td>3x 2560x1600</td>
</tr>
</tbody>
</table>

*Subject to monitor resolution
Moving Past Proprietary Solutions for Ease of Cross-Platform Programming

- **Open and Custom Tools**
  - High Level Tools
  - Application Specific Libraries

- **Industry Standard Interfaces**
  - OpenCL
  - DirectX®
  - OpenGL®

- **AMD GPUs**
- **AMD CPUs**
- **Other CPUs/GPUs**

- **Cross-platform development**
- **Interoperability with OpenGL and DX**
- **CPU/GPU back-ends enable balanced platform approach**
Delivering Industry Standards

Shipping first OpenCL CPU implementation

- OpenCL 1.0 compliant and available for download to members of the ATI Stream SDK beta program – includes documentation, samples, and developer support

OpenCL GPU implementation submitted to Khronos

- Announced 9/21

DirectX 11 / DirectCompute Support

- First and only driver to support DirectCompute 11 with Shader Model 5.0. Fully Microsoft WHQL certified
- Planned availability with ATI Radeon™ HD 5000 Series and upcoming ATI Catalyst™ driver release
ACML-GPU 1.0
Released March 2009

Selected BLAS routines enabled for GPU
- DGEMM, SGEMM will run on GPU if present
- Small problems (N,M,K < 200) run on CPU
- Supports AMD Shanghai and Istanbul
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AMD ATI Eyefinity
Eyefinity Supports 24 Screen Display with 4 HD5860 in one system
THANK YOU!