



The AMD Opteron 6000/4000 Series Platform

More Cores, More Memory, Better Value

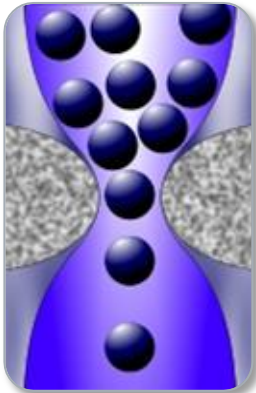
Kevin Lai
AMD Taiwan



Today's Challenges

Hyper-growth of Core & Memory Bandwidth Needs

- Virtualization
- Database
- Consolidated Infrastructure
- HPC & Cloud



Slow
Response
Time

Application demand
outstrips core &
memory capability



Budget
Challenges

4P servers alleviate,
but harder to afford



Goals for AMD Server in 2010-2011: Server Sweet Spot Strategy



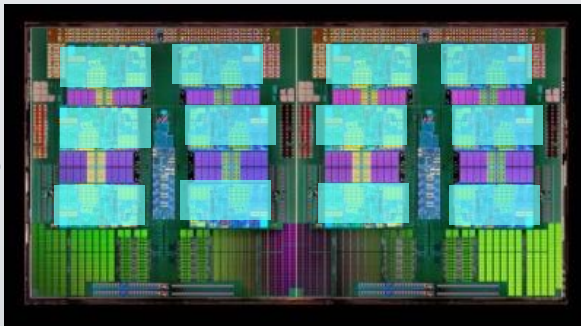
AMD Opteron™ 6100 Series Processor

The Industry's First 12-Core x86 Processor

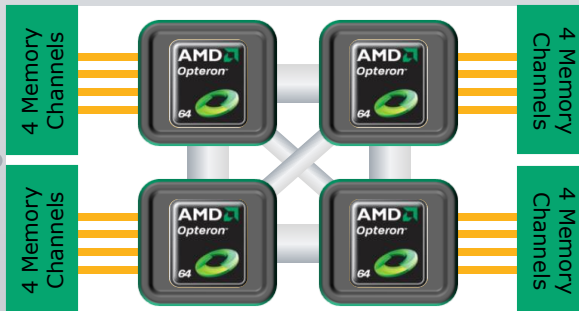
Redesigned for More Cores

Up to **2X performance¹** for core & memory-sensitive apps

8 or 12
Cores



Direct
Connect
Architecture
2.0 for
2P & 4P



More of everything, same price²

- 12 cores for the price of 6
- Higher memory scale
- More I/O bandwidth

Easy Integration

- Common features across power bands
- Consistent images and drivers
- Compatible with future generations

Headroom For Intense Workloads³

Virtualization: More cores per VM

HPC: More parallel threads

Web & Cloud: Support larger user loads

Database: More simultaneous requests

Footnotes 1, 2 and 3 see Footnote slide in backup



4 April 2010

AMD
The future is fusion

AMD Opteron™ 4100 Series Processor

The world's lowest power-per-core server processor¹

Low Power Breakthrough



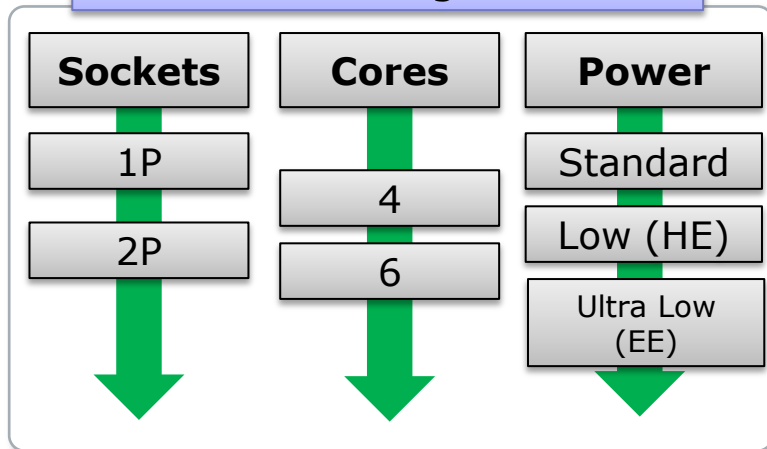
Below 6 Watts
Per Core¹



Starting @ \$99²



Flexible Configurations



Easy to Purchase

	AMD	Intel
Full memory speed on all models	✓	✗ ³
Full I/O speed on all models	✓	✗ ³
Same chipset on all platforms	✓	✗ ⁴



¹ As of March 15, 2010, AMD Opteron™ processor Models 4162 EE /4164 EE have the lowest known power per core of any server processor, at 5.83W (35W/6 = 5.83W/core). Intel's L5609 is 10W/core (40W/4 cores). See

² http://www.intel.com/p/en_US/products/server/processor/xeon5000/specifications. 2 AMD Opteron™ processor Model 4122 planned \$99 1ku pricing at time of introduction. 3 http://i.cmpnet.com/crn/graphics/web/embedded/xeon_roadmap.JPG. 4

http://www.intel.com/products/server/chipsets/index.htm#s1=Server&s2=all&s3=all?iid=chipsets_body+server

AMD
The future is fusion

Direct Connect Architecture 1.0

Balanced and Scalable Design to Support up to 6 Cores



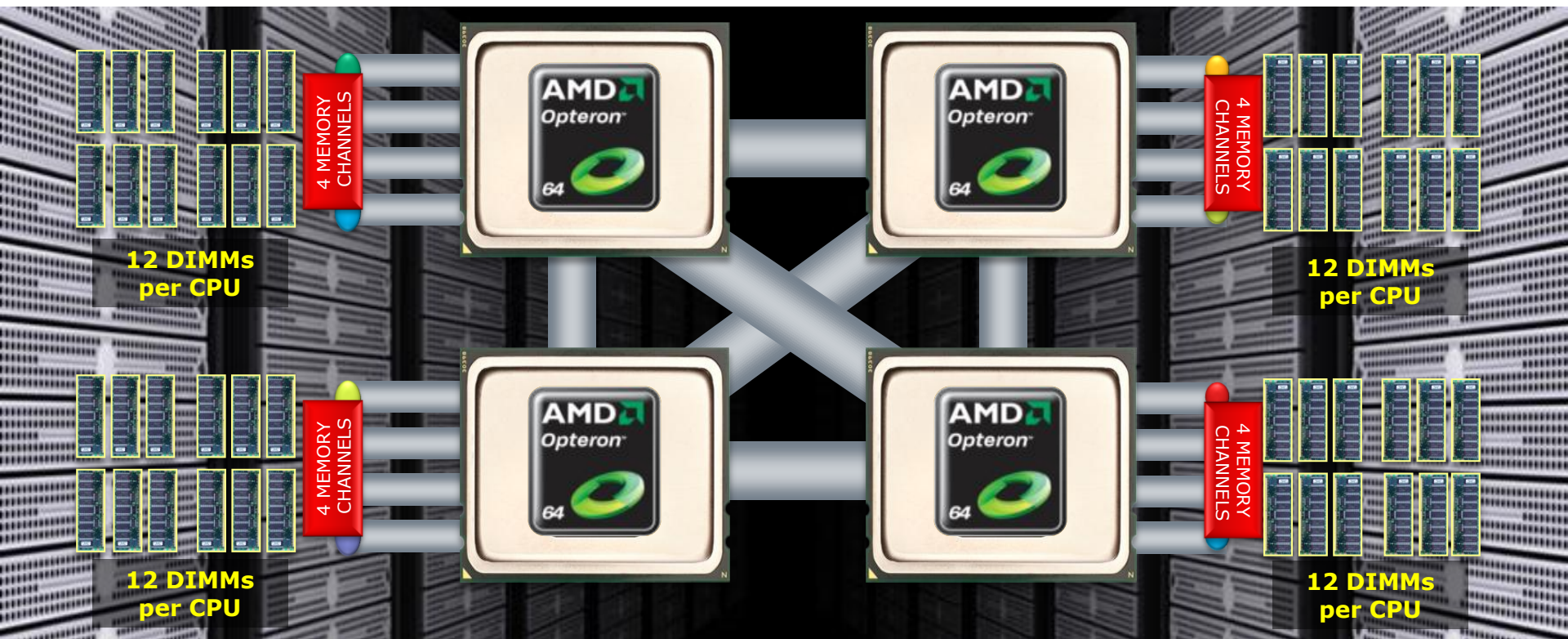
- ✓ No front side bus
- ✓ Integrated memory controller

- ✓ HyperTransport™ technology
- ✓ NUMA memory architecture



Direct Connect Architecture 2.0

Balanced and Scalable Design to Support up to 16 Cores* per CPU



✓ 1-hop between processors

✓ Up to 50% more DIMMs**

✓ Four memory channels per CPU

✓ Up to 33% increase in CPU to CPU communication speed***

*16-core configuration planned for upcoming AMD processor core codenamed "Bulldozer."

**Compared to Six-Core AMD Opteron™ processor formerly codenamed "Istanbul."

***Based on HyperTransport™ technology links @ up to 4.8 GT/s for Six-Core AMD Opteron™ processor vs. 6.4 GT/s for AMD Opteron™ 6100 Series processor



Outstanding Value

First 2P-Capable Server Processor at Sub-\$100 Price¹

Pricing Reset²

1300/2400

4100

\$112
(1P only)

Standard

\$99
(two-way capable)

\$455

HE

\$174

\$989

EE

\$316

Supports up to **2x** more servers within the same power budget⁴



As little as
\$10 per 42U
rack³



Low Overall Server Cost

Enables simpler design for lower power consumption



Fans & Heatsinks



Mother board



Power Supply



1 AMD Opteron™ processor Model 4122 planned \$99 1ku pricing at time of introduction. 2 Based on 1Ku price for lowest-priced processor for each thermal band within AMD Opteron 2400 Series, and planned 1ku pricing for AMD Opteron 4100 Series, as of 3/15/10. 3 Source: AMD internal platform power measurements and estimates using a java-based workload. Assumes 20% load-point and \$0.11/KWh. Any difference in system hardware or software design or configuration may affect actual performance. For detailed calculations, configurations and assumptions refer to slides 11, 12. 4 Internal measurements of Supermicro 2021M-UR with Quad-Core AMD Opteron™ processor Model 2380 processors vs. Tyan 8228 with AMD Opteron™ processors Model 4162 EE running java-based workload @ 100% load-point. Power measurements taken at the wall. Any difference in system hardware or software design or configuration may affect actual performance. For detailed calculations, configurations and assumptions refer to backup slide 10.

AMD
The future is fusion

AMD Opteron™ 4000 Series Platform

Infrastructure Cost Savings

• AMD Opteron™ 4000 Series platforms are designed around low power consumption to enable lower costs and increased value over 6000 series*

Chipset savings

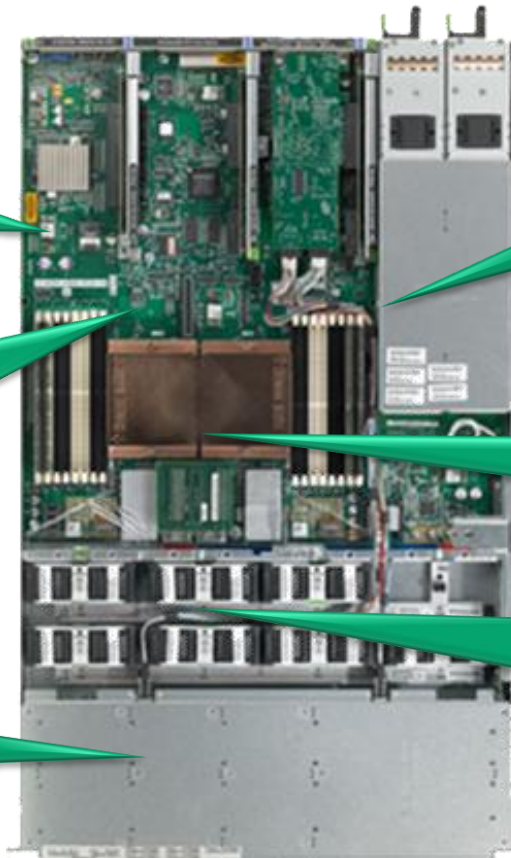
- Lower cost chipset options (SR5670/SR5650)

Board savings

- Low board layer count
- Low complexity routing
- Low cost VRMs (core and DDR)

Validation savings

- Common image with G34 platforms



Power supply savings

- Lower wattage power supplies

Processor savings

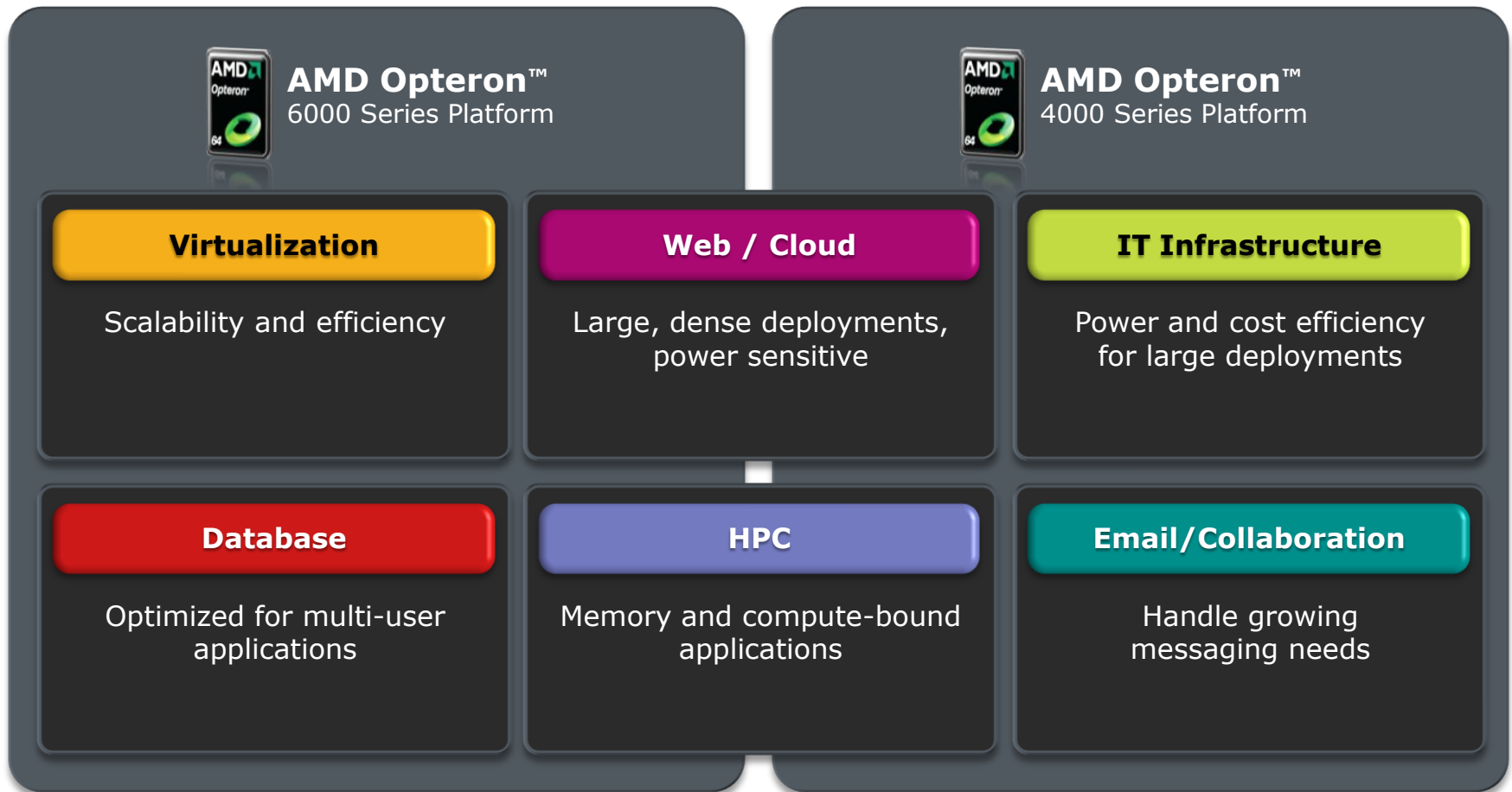
- Lower cost processors
- Lower cost socket

Thermal solution savings

- Standard & low power
- Lower fan cost
- Lower heatsink cost

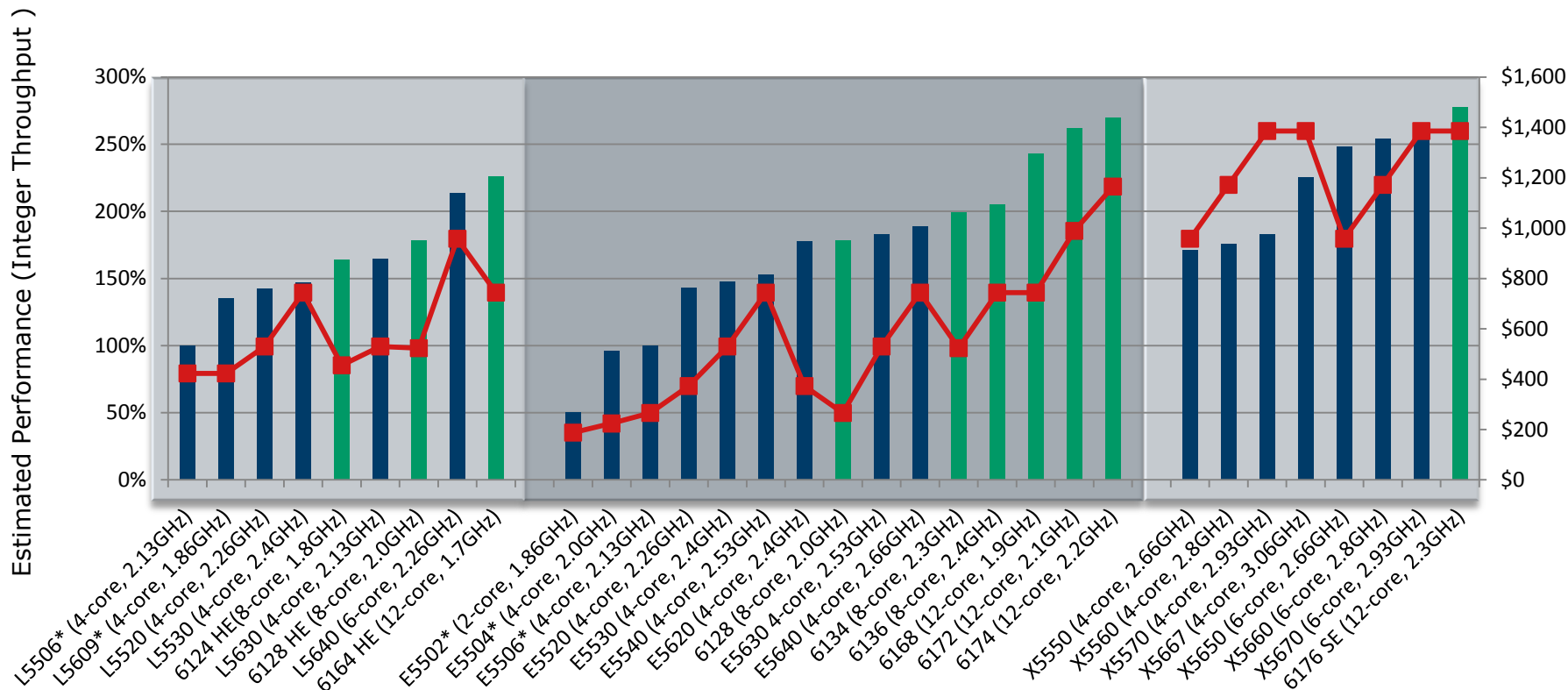


Workload-based Platform Targeting



Price/Performance Comparison

"Magny-Cours" vs. "Westmere"/"Gainestown"

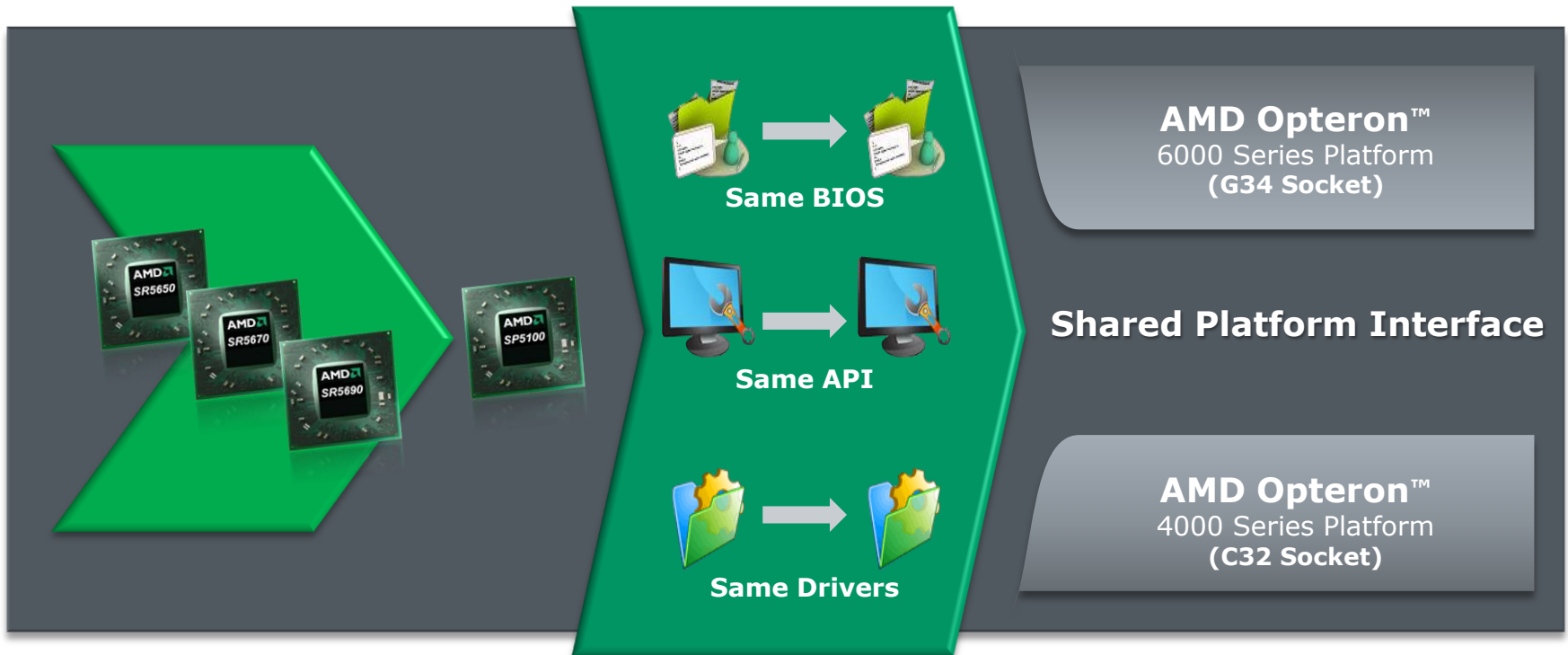


"Performance projections are based on Integer Throughput (SPECint®_rate2006)

SPEC and SPECint are registered trademarks of the Standard Performance Evaluation Corporation. The results for AMD Opteron™ 6000 processors and Intel Xeon 5600 processors are estimated. The results for Intel Xeon 5500 processors are based upon results published on <http://www.spec.org/cpu2006/results> as of January 7, 2010. The comparisons above are based on the best performing two-socket servers using the specified processor model number. For the latest SPECint_rate2006 results, visit <http://www.spec.org/cput2006/results>."



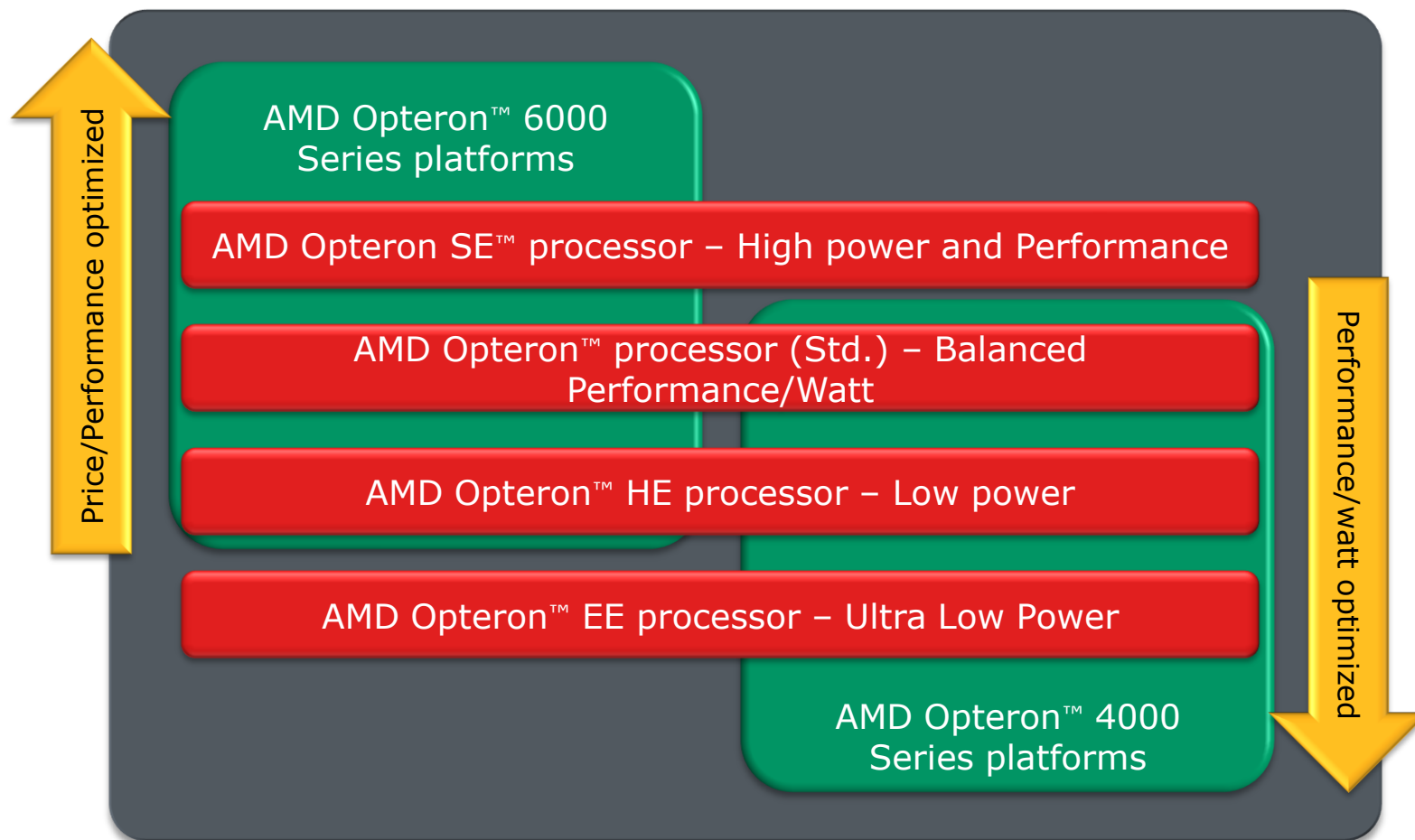
Unmatched Platform Consistency for Better Solutions



- **OEM Benefits:** enables easier design, validation and support
- **Customer Benefits:** easy management and flexibility

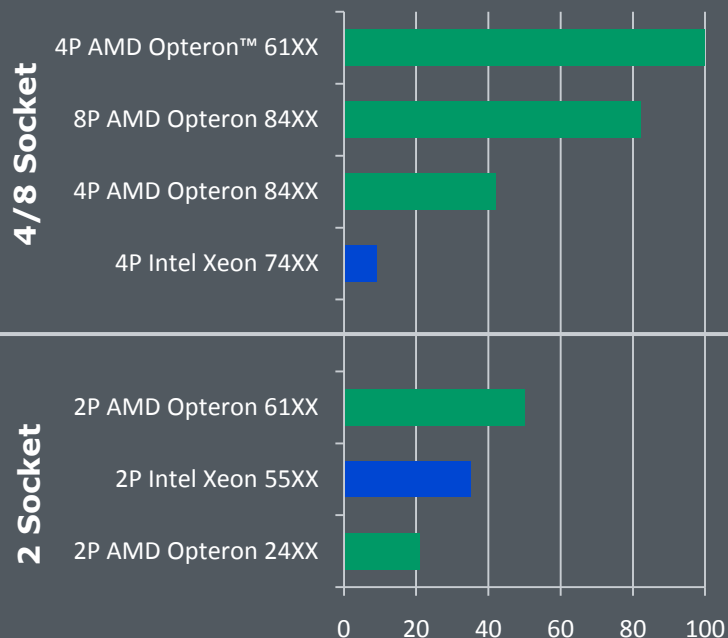


Platform Targeted Power Bands



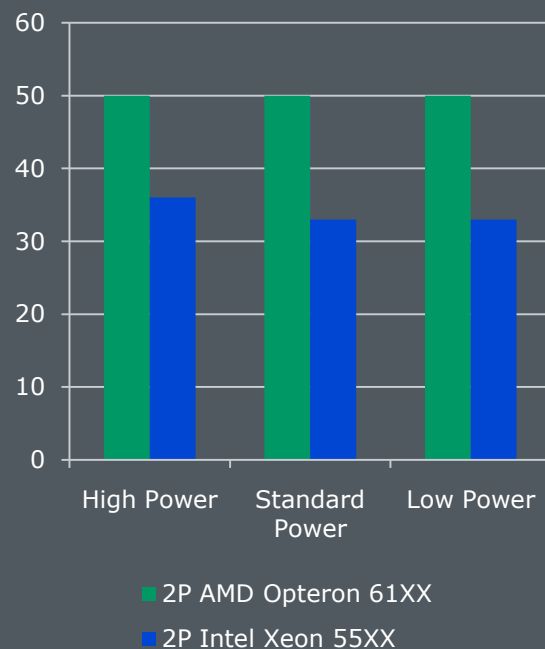
Enhanced Integrated Memory Architecture Benefits Virtualization, Database and HPC

Memory Bandwidth
(GB/s in STREAM benchmark)



GREATER PEAK PERFORMANCE

Memory Bandwidth
(GB/s in STREAM benchmark)



**CONSISTENCY ACROSS
POWER BANDS**

¹Based on measurements in AMD Performance Labs as of January 5, 2010. Please see backup slide 18 for configuration information.



AMD Opteron™ Platform Differentiators



Processor Value

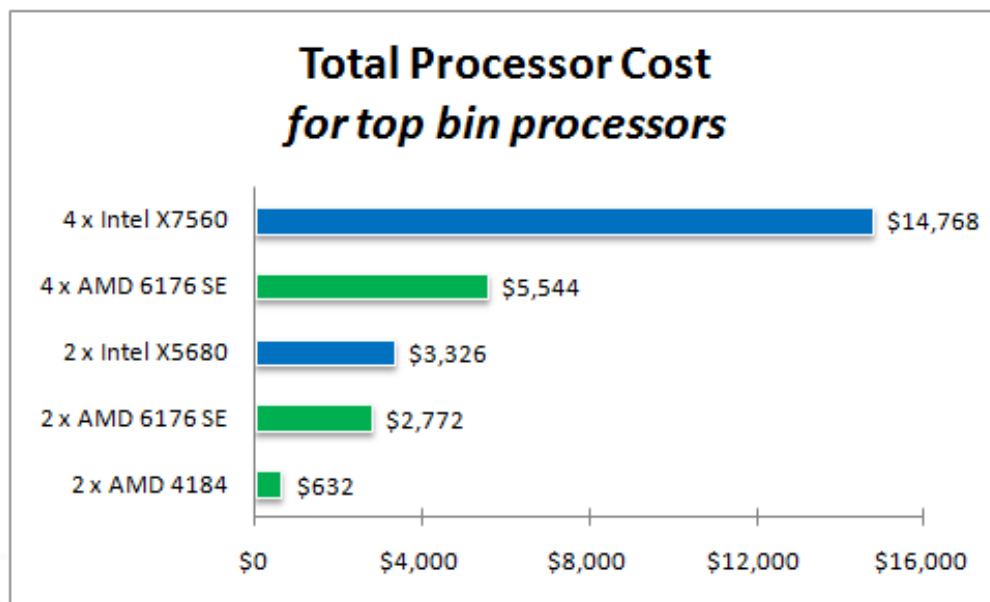
Customer Need

- Save money and maximize performance

AMD Differentiation

- AMD Opteron™ 6100 and 4100 Series processors offer more value
 - AMD 2P and 4P top bin 6176 SE is \$1,386 per processor
 - AMD 2P top bin 4184 is \$316 per processor
 - Intel 4P top bin X7560 is \$3,692 per processor
 - Intel 2P top bin X5680 is \$1,663 per processor

More Cores Than Competition				
Vendor	Top bin	Cores / processor	Config	Total cores
AMD	AMD 4184	6	2P	12
AMD	AMD 6176 SE	12	2P	24
Intel	Intel X5680	6	2P	12
AMD	AMD 6176 SE	12	4P	48
Intel	Intel X7560	8	4P	32



Price sensitive?

**AMD Opteron™ 4100
Series processors start
at \$99**

Intel Xeon 5600 Series
processor starts at \$440



Intel pricing as of 9/8/10 at http://files.shareholder.com/downloads/INTC/1002056983x0x397971/70BDAF47-C40B-44B9-93A5-272974D22129/Aug_8-15-22_and_29_combined_1ku_Price.pdf



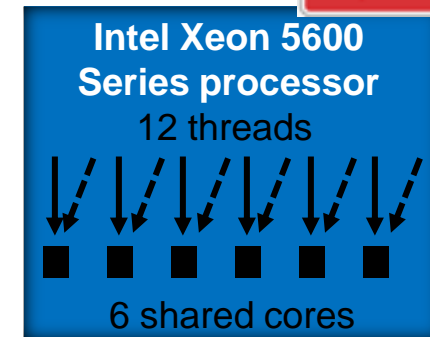
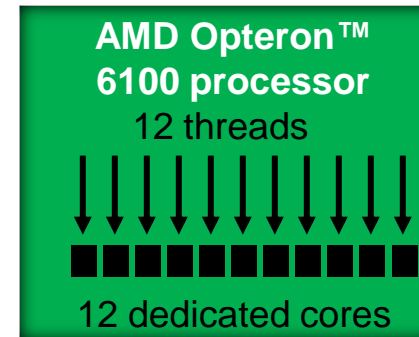
Throughput

Customer Need

- High throughput for demanding workloads
- Support many VMs per server while maintaining high performance

AMD Differentiation

- AMD Opteron™ 6100 Series processors have 100% more dedicated cores than Intel Xeon 5600 Series processors
 - Better scalability
 - Improvements in efficiency can lead to higher throughput
 - More core resources for virtualization
- Intel uses Intel Hyper-Threading Technology to attempt to make up for fewer cores



Caution
Heavy traffic

Intel Hyper-Threading Technology

Forces two threads into one core:

- Threads compete for resources
- Relies on under- utilization
- Can reduce performance when cores are highly utilized



Intel core spec info can be found at http://www.intel.com/p/en_US/products/server/processor/xeon7000/specifications and http://www.intel.com/p/en_US/products/server/processor/xeon5000/specifications
For info on Intel's hyperthreading, go to <http://www.intel.com/technology/platform-technology/hyper-threading/index.htm>

AMD
The future is fusion

Low Power

Customer Need

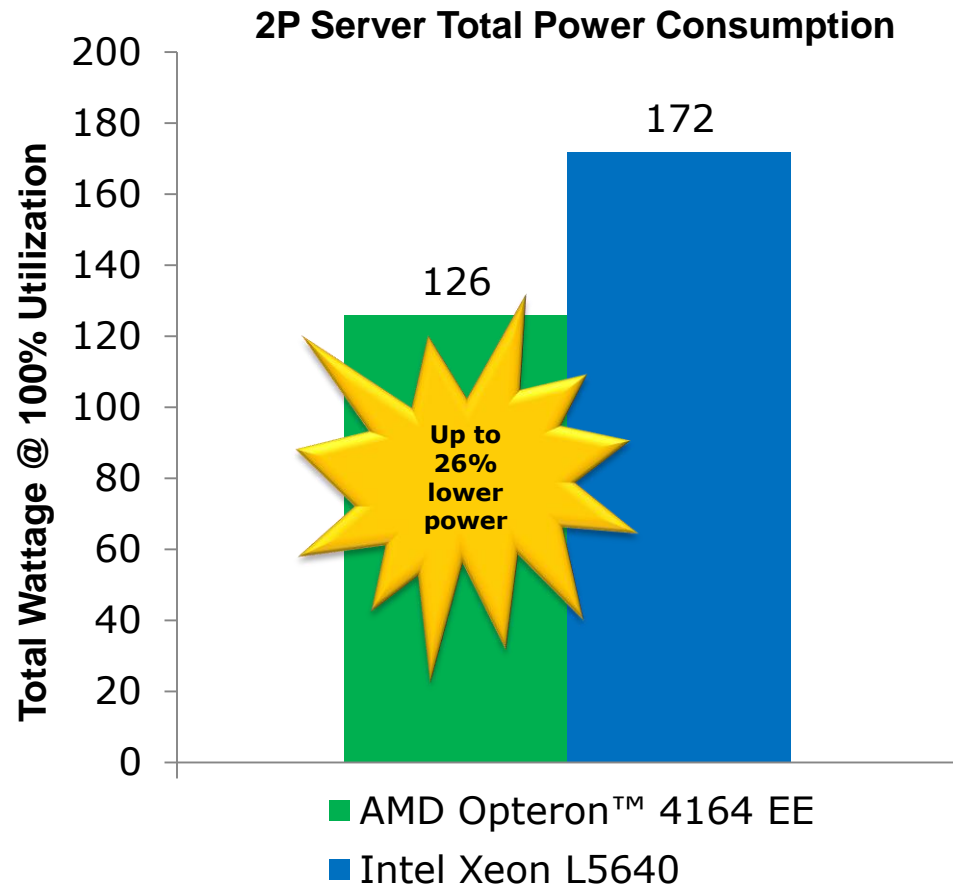
- Processor power efficiency during utilization to keep data center cooling costs to minimum

AMD Differentiation

- The AMD Opteron™ Processor Model 4100 is the lowest power 2P platform available

Low Power

- ✓ Ultra low power
- ✓ Energy efficient AMD chipset
- ✓ Support for Low power RDDR3
- ✓ AMD-P Technology
- ✓ Platform-level power management support



Source: Platform power measurements (as of 09/02/2010) using a java-based workload. Information is provided for illustrative purposes only. Any difference in system hardware or software design or configuration may affect actual performance. AMD Opteron™ 4164 EE results based on ZT Systems 1253Ra Datacenter Server, Intel Xeon L5640 results based on HP Proliant DL380 G7. Configuration details on slide 11.



Memory Cost

Customer Need

- Meet memory requirements in most cost effective manner

AMD Differentiation

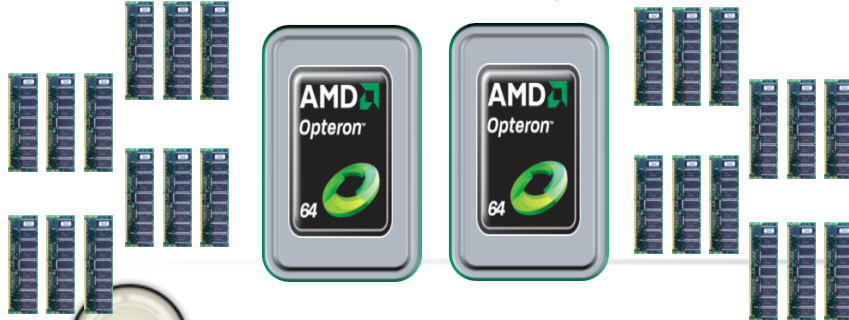
- With AMD Opteron™ 6100 Series processors there are 3 DIMMs per memory channel and four channels per socket, so customers can populate up to 12 DIMM slots per processor without having to purchase higher GB memory.
- With 3 DIMMs per memory channel and **only 3 channels per socket**, Intel Xeon Series processor customers are limited to 9 DIMM slots per processor before they must use higher GB memory.

Example

- Customer wanting 96GB total memory in 2P server config saves \$1,200 with AMD

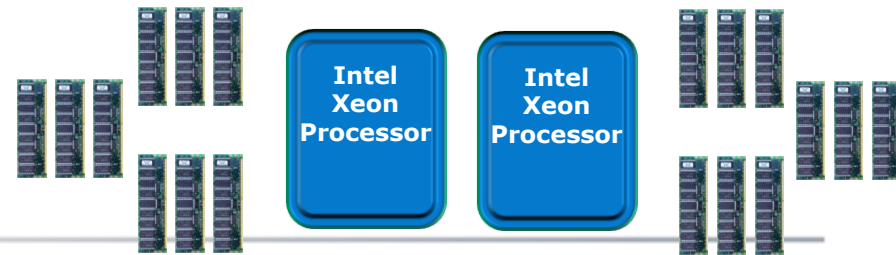
AMD (24 DIMM slots in 2P)

- Buys (24) 4GB DIMMS
- $24 \times \$150^{**} = \$3,600$



Intel (18 DIMM slots in 2P)

- Buys (12) 4GB DIMMS and (6) 8GB DIMMS
- $12 \times \$150^{**} + 6 \times \$500^{**} = \$4,800$



*Intel DIMM memory channel and DIMM spec as of 9/16/10 http://www.intel.com/p/en_US/products/server/processor/xeon5000

** Memory pricing as of 9/9/10 at www.crucial.com



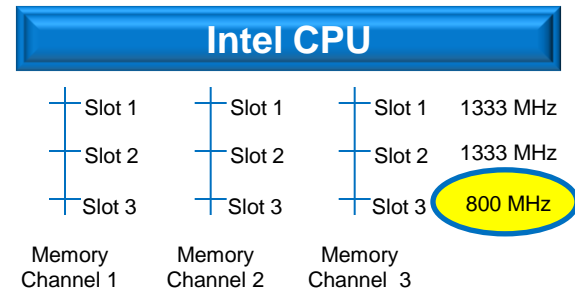
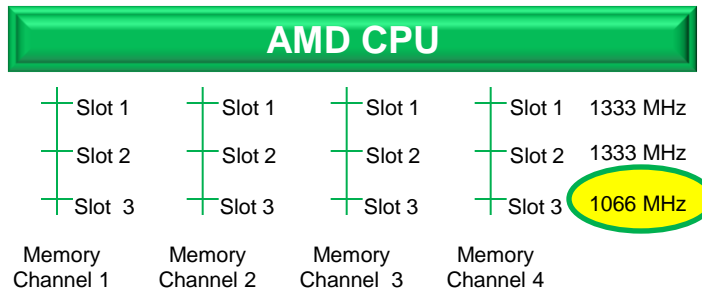
Memory Speeds

Customer Need

- Fast memory speeds with large memory configurations

AMD Differentiation

- 33.3% higher clock speed than Intel when slot 3 DIMMs are used
 - When any slot 3 DIMMs are used, all slot 1, 2, and 3 DIMMs get de-rated to slot 3 speeds.



Intel DIMMs de-rated to 800 MHz, see last row in table 3-2 see on p 58 as of 9/16/10
http://www.intel.com/Assets/en_US/PDF/datasheet/323370.pdf



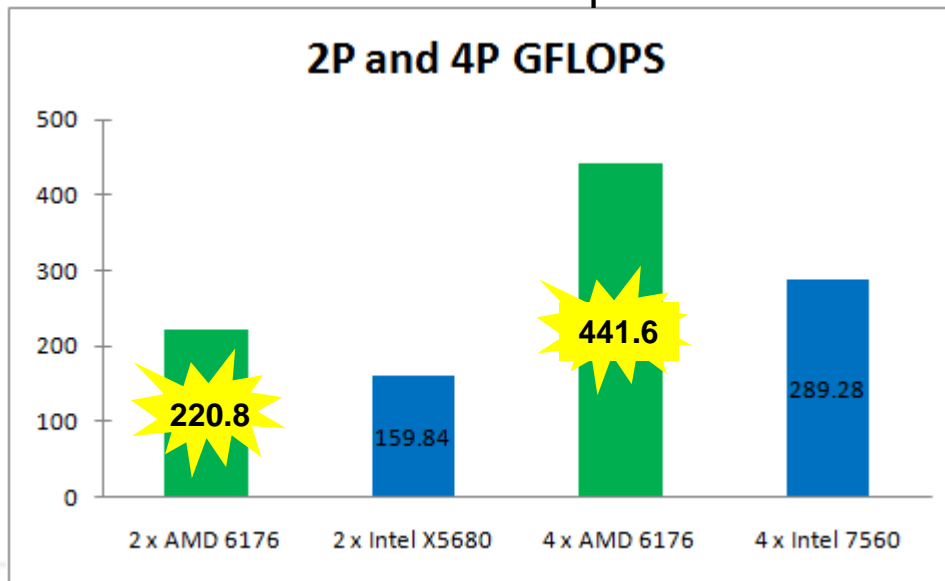
Floating Point Operations Per Second (FLOPS)

Customer Need

- High amount of floating point operations for technical workloads

AMD Differentiation

- Top bin head-to-head
 - In 2P config, the AMD Opteron™ 6176 SE processor is capable of 39.4% more GFLOPS than Intel Xeon X5680 processor
 - In 4P config, the AMD Opteron™ 6176 SE processor is capable of 52.7% more GFLOPS than Intel Xeon X7560 processor



GFLOPS = # processors x processor clock speed x # cores per processor x # 32-bit operations per second

Information on Intel's specs as of 9/16/10 http://www.intel.com/p/en_US/products/server/processor/xeon5000/specifications.

Information on AMD's specs as of 9/16/10 <http://www.amd.com/us/products/server/processors/6000-series-platform/pages/6000-series-model-number-methodology.aspx>



Migrating VMs

Customer Need

- Seamlessly migrate VMs between AMD-based servers of different processor generations from 2004 to present

AMD Differentiation

- AMD has consistent platforms across 1P, 2P, and 4P. All share the same processor features, which simplifies live migration.
- Many of the latest Intel-based servers have different architectures, which forces customers to turn off features that aren't compatible if they want to take advantage of live migration at anytime.
- VMWare
 - **EVC required** to VMotion between Intel Xeon (52xx, 54xx, 72xx, 73xx, and 74xx), Xeon (55xx, 65xx, 75xx), and Xeon (56xx) architectures
 - **EVC not required** to VMotion from AMD Opteron™ 23xx/83xx forward
 - **EVC not required** to VMotion between 2P and 4P in same generation for AMD
 - **EVC sets feature baseline to oldest CPU model in cluster (only features common to all CPUs are available)**



EVC info as of 9/16/10 http://kb.vmware.com/selfservice/microsites/search.do?language=en_US&cmd=displayKC&externalId=1003212




Consistent Platforms

Customer Need

- Ability to seamlessly migrate VMs and software among servers

Same Features Across Power Bands

Eliminate Forced Tradeoffs

	AMD 	Intel
Full memory speed on all models	✓	✗ ¹
Full I/O speed on all models	✓	✗ ²
Same chipset on all platforms	✓	✗ ²

Consistent Images and Software

Same Die, Chipset and Memory enable:



Same API



Same BIOS code



Same Drivers

Easy To Buy

No tradeoffs of performance & basic functionality

Easier To Qualify

Full consistency and same chipset across entire processor stack

Easier To Manage

Seamlessly migrate VMs and software between systems

Intel has different architectures and technologies across 1P, 2P, and 4P, so customers are forced to manage to different platforms.

1. Full memory speed on all Opteron™ 4100 and 6100 Series platforms. Intel memory speeds as of 9/16/10

http://i.cmpnet.com/crn/graphics/web/embedded/xeon_roadmap.JPG

2. Full I/O and same chipset on all Opteron™ 4100 and 6100 Series platforms. Intel chipset info as of 9/16/10 at

http://www.intel.com/products/server/chipsets/index.htm#s1=Server&s2=all&s3=all?iid=chipsets_body+server



Thanks & Question



Backup



Lowest Power 2P Platform Available

SPECpower ssj2008

172W (100% utilization) using 2 x Intel Xeon processors Model L5640 (60W TDP) in HP DL380 G7, 16GB (4 x 4GB DDR3-1333) memory, Windows Server 2008 64-bit

http://www.spec.org/power_ssj2008/results/res2010q3/power_ssj2008-20100727-00279.html

126W using 2 x AMD Opteron™ processors Model 4164 EE in ZT Systems 1253Ra Datacenter Server, 16GB (4 x 4GB DDR3-1333) memory, Windows Server 2008 64-bit

http://www.spec.org/power_ssj2008/results/res2010q2/power_ssj2008-20100601-00265.html



Disclaimer and Attributions

DISCLAIMER

The information presented in this document is for informational purposes only and may contain technical inaccuracies, omissions and typographical errors.

The information contained herein is subject to change and may be rendered inaccurate for many reasons, including but not limited to product and roadmap changes, component and motherboard version changes, new model and/or product releases, product differences between differing manufacturers, software changes, BIOS flashes, firmware upgrades, or the like. AMD assumes no obligation to update or otherwise correct or revise this information. However, AMD reserves the right to revise this information and to make changes from time to time to the content hereof without obligation of AMD to notify any person of such revisions or changes.

AMD MAKES NO REPRESENTATIONS OR WARRANTIES WITH RESPECT TO THE CONTENTS HEREOF AND ASSUMES NO RESPONSIBILITY FOR ANY INACCURACIES, ERRORS OR OMISSIONS THAT MAY APPEAR IN THIS INFORMATION.

AMD SPECIFICALLY DISCLAIMS ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. IN NO EVENT WILL AMD BE LIABLE TO ANY PERSON FOR ANY DIRECT, INDIRECT, SPECIAL OR OTHER CONSEQUENTIAL DAMAGES ARISING FROM THE USE OF ANY INFORMATION CONTAINED HEREIN, EVEN IF AMD IS EXPRESSLY ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

ATTRIBUTION

© 2010 Advanced Micro Devices, Inc. All rights reserved.

AMD, the AMD arrow logo, AMD Opteron, AMD64 logo and combinations thereof, are trademarks of Advanced Micro Devices, Inc. Windows and Windows Server are a registered trademarks of Microsoft Corporation in the United States and/or other jurisdictions. All other products names are for reference only and may be trademarks of their respective owners.

