FUSION1200

Scalable x86 SMP System

- Introduction
- Life Sciences Departmental System
- Manufacturing (CAE) Departmental System
- Competitive Analysis: IBM x3950
- Competitive Analysis: SUN x4600 / SUN x4600 M2

- FUSION-1200 is a new x86 SMP system
  - Shared memory
  - 8-48 Intel® Xeon® (Core® microarchitecture) processors:
    - Dual-Core or Quad-Core

- Target end-user challenges:
  - Applications can **benefit from SMP** and currently run on x86
  - Customer needing x86 and large **shared memory**
  - x86 cluster customers **tired of clustering** complexities

MODEL	FUSION1200
Processors	8-12 x Dual/Quad-Core Intel® Xeon® 5x00 (Woodcrest/Clovertown) processors
Memory	48-192 GB FBDIMM DDR2 (48 DIMMs) at 667 MHz
Architecture	ScaleMP® *Versatile SMP* (vSMP)
Network	Gigabit Ethernet: 7 ports
Storage	Up to 4.5 TB internal storage (6 x 750GB SATA drives)
I/O Expansion	- eSATA: 2 ports - One PCI expansion per Chassis
Operating System	- Red Hat: RHEL 4, Fedora Core 4 - SUSE: SLES 10, open SUSE 10
Form-Factor	- Desk-side - Rack-mount: 6U standard-depth
Expansion	Up to 4 chassis, max. configuration: - 48 x Dual/Quad-Core Intel® Xeon® 5x00 (Woodcrest/Clovertown) processors - 768GB FBDIMM DDR2 (192 DIMMs) at 667 MHz

VXTECH a division of ciara technologies

vSMPowered scalable systems by ScaleMP

intel Xeon inside

Designed specifically for **compute bound** applications,
requiring **large memory footprint** and **high memory bandwidth**

- The **BEST** x86-based mid-range (8-48 sockets) shared-memory system:
  - Faster and more affordable than SUN and IBM
  - No equivalent offerings from HP and Dell

- The **ONLY** x86-based SMP system designed from the ground-up for HPC:
  - **Highest socket count** – 12-socket (48 w/extension)
    - Competitive systems are limited to 8 sockets on AMD and 2 sockets for Intel Core® architecture
  - **Largest memory footprint** – 192GB RAM (768GB w/extension)
    - Competitive systems are limited to 128GB RAM on AMD and 64GB RAM on Intel Core® architecture
  - **Highest measured memory bandwidth** in the world – 3GB/sec per socket
    - SUN x4600 and IBM x460/x3950 (both 8 sockets system) provide less than half
  - Only system (>2 sockets) that supports **quad-core processors**
    - Not available on SUN x4600 systems or IBM x460/x3950
  - The only mid-range SMP system based on **Intel's new Core® microarchitecture**
    - Intel® Core processors (Woodcrest, Clovertown) rated 'best processors' by the industry

Use Case	Numerical intensive calculation apps (either MPI or OpenMP codes)	Applications that require large memory footprint	Mix of serial jobs and parallel jobs on the same system	Running multiple instances of same application (i.e. throughput mode)	Memory - bandwidth intensive apps
High Socket Count	X		X	X	X
Large memory footprint		X	X		
High memory bandwidth			X		X
Quad-core processors	X			X	
Intel Core® architecture	X	X	X	X	X
Typical Applications	Most of the codes in Life Science segment are of this nature	FEA / CSM codes require large memory to store the model Reservoir simulation applications EDA (single-thread) applications	CSM and CFD codes running in mixed workloads Multi-physics simulations	Applications that benefit from reduction in TCO via server consolidation	Many CFD and Crash Analysis workloads dependant on system bandwidth Schlumberger ECLIPSE

Manufacturing

Computational Structural Mechanics (CSM)

- ANSYS Mechanical
- ABAQUS/Explicit
- ABAQUS/Standard
- LSTC LS-DYNA

Computational Fluid Dynamics (CFD)

- FLUENT
- ANSYS CFX
- CD-adapco STAR-CD
- AVL FIRE

Others

- inTrace OpenRT

Life Sciences

- Schrödinger Jaguar
- Schrödinger Glide
- NAMD
- DOCK
- GAMESS
- GOLD
- mpiBLAST
- GROMACS
- MOLPRO
- OpenEye FRED
- OpenEye OMEGA
- SCM ADF
- HMMER

Energy

- Schlumberger ECLIPSE
- Paradigm Geophysical GeoDepth
- 3DGEO 3DPSDM

Horizontal & Benchmarks

- The MathWorks MATLAB
- SPEC CPU2000
- STREAM (OMP)

System Vendor	VXTECH	IBM	SUN	SUN	White-Box
System Model	**FUSION1200**	**x460 / x3950**	**x4600**	**x4600 M2**	
Processor					
Vendor	Intel	Intel	AMD	AMD	AMD
Model	Xeon 5x00	Xeon 71xx	Opteron 8xx	Opteron 8xxx	Opteron 8xxx
Micro-Architecture	Intel Core	Intel NetBurst	AMD K8	AMD K8	AMD K8
Dual-Core availability	Yes	Yes	Yes	Yes	Yes
Quad-Core availability	Yes	No	No	No	No
Chassis					
Max. Processors (CPU) / Chassis	12	4	8	8	8
Max. Memory / Chassis (GB)	192	64	64	128	128
Max. Internal Drives / Chassis	12	6	4	4	8
Integral GigE Ports / Chassis	7	2	4	4	3
System					
Max. Chassis	4	8	Not-Expandable	Not-Expandable	Not-Expandable
Max. Processors (CPU) / System	48	32	8	8	8
Max. Memory (GB) / System	768	512	64	128	128
Max. Internal Drives / System	48	48	4	4	8
Integral GigE Ports / System	28	16	4	4	3
Others					
Internal Drives Type	SATA	SAS	SAS	SAS	SATA / SAS
Integral IO Expansion / Chassis	Yes (eSATA)	No	No	No	No
Available PCI/E Slots / Chassis	1	6	8	8	5
Redundant Power Supply / Chassis	Multiple Power Supplies	No	Yes	Yes	Yes

- Scales up to **192 cores and 768GB RAM** in one rack

- Suitable for **desk-side** deployment utilizing only common wall power
  - The only system of its class that can be operated in an office environment
  - Office compatible configurations (power considerations):
    - Dual-Core processors:
      - Xeon 5148 - up to 12-processors
      - Xeon 5160 - up to 8-processors
    - Quad-Core processors:
      - Xeon 5345 - up to 8-processors

- Supports **eSATA** storage expansion
- Supports one FC HBA through one PCI/E slot per Chassis

FUSION1200

Life Science Departmental System

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- Manufacturing (CAE) Departmental System
- Competitive Analysis: IBM x3950
- Competitive Analysis: SUN x4600 / SUN x4600 M2

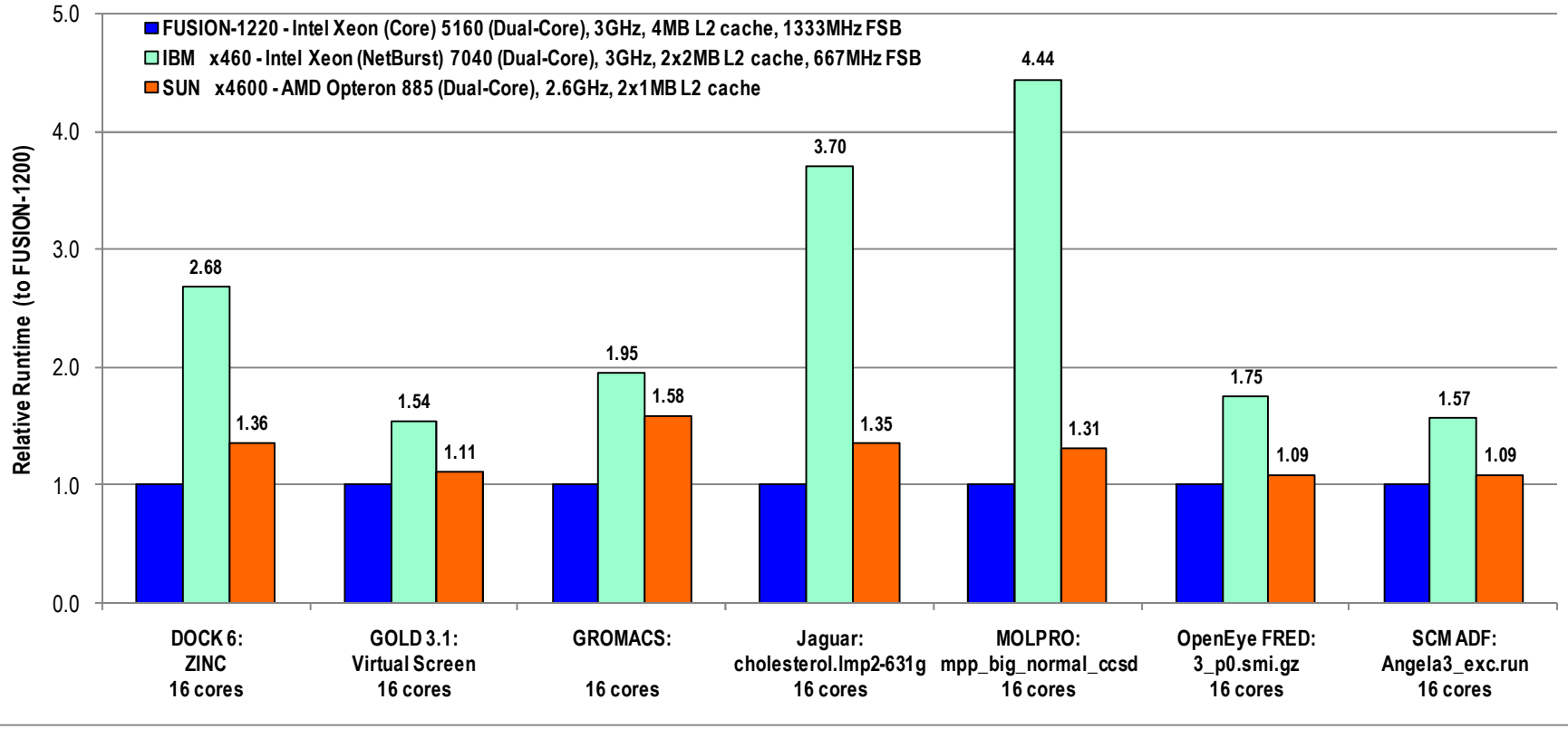
- Requirements:
  - Support a team of Life Sciences developers and scientists
  - Run mix of applications simultaneously
  - Simple and easy to manage compute platform
  - No performance compromise
  - Run large simulations in memory
  - Develop new applications faster. No cluster parallelization needed
  - Rapid deployment

- Introducing….

FUSION1200-Life Sciences Departmental System

Use Case	Numerical intensive calculation apps (either MPI or OpenMP codes)	Applications that require large memory footprint	Mix of serial jobs and parallel jobs on the same system	Running multiple instances of same application (i.e. throughput mode)	Memory - bandwidth intensive apps
High Socket Count	X		X	X	X
Large memory footprint		X	X		
High memory bandwidth			X		X
Quad-core processors	X			X	
Intel Core® architecture	X	X	X	X	X
Typical Applications	• Schrödinger Jaguar • NAMD • DOCK • GAMESS • GOLD • mpiBLAST • GROMACS • MOLPRO • OpenEye FRED • OpenEye OMEGA • SCM ADF • HMMER			• BLAST • Schrödinger Glide	

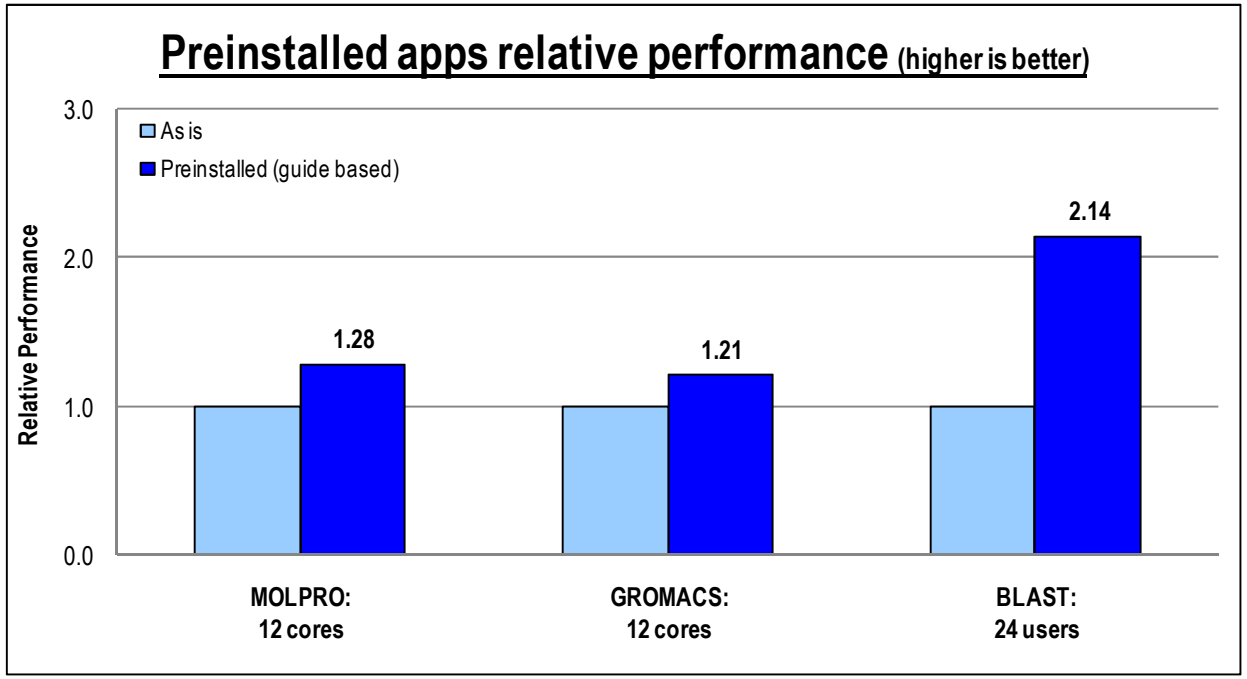
Mid-range x86 SMP Systems - Relative Runtime (lower is better)



Notes: - All results are for 16 cores run, on FUSION-1220 (Dual-Core system)
- FUSION1240 (Quad-Core system) results may vary
- **FUSION1240 is the only system with more than 2 Quad-Core processors**

- FUSION1200 is **preinstalled** with leading Life Sciences applications
- '**Top Performance for x86 Multi-core Systems**' – **guide included**
- Preinstalled applications and OS according to the guide for **top performance**

- Package details:
  - Operation System:
    - Red Hat RHEL 4
  - Applications:
    - NAMD
    - DOCK
    - GAMESS
    - mpiBLAST
    - GROMACS



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FUSION1200

Manufacturing (CAE) Departmental System

Introduction

Life Sciences Departmental System

Manufacturing (CAE) Departmental System

Competitive Analysis: IBM x3950

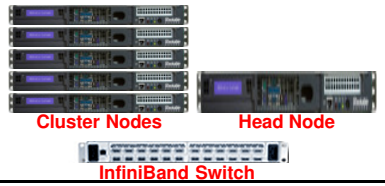
Competitive Analysis: SUN x4600 / SUN x4600 M2

- Requirements:
  - Support a team of engineers
  - Run both CSM and CFD simultaneously (FSI)
  - Perform high fidelity simulations
  - Simple and easy to manage compute platform
  - Run very large simulations in memory
  - Shorter design cycles
  - Rapid deployment

- Introducing….

FUSION1200 – Manufacturing (CAE) Departmental System

Use Case	Numerical intensive calculation apps (either MPI or OpenMP codes)	Applications that require large memory footprint	Mix of serial jobs and parallel jobs on the same system	Running multiple instances of same application (i.e. throughput mode)	Memory - bandwidth intensive apps
High Socket Count	X		X	X	X
Large memory footprint		X	X		
High memory bandwidth			X		X
Quad-core processors	X			X	
Intel Core® architecture	X	X	X	X	X
Typical Applications					

		Today's compute platform	Compute power increase options	
			Option I	Option II
Hardware	Deployment method	High-performance workstation	Cluster (data-center)	FUSION1200 – Departmental SMP System
				
	System specification	4-Socket, Dual-Core	1. 5 x 2-Socket, Dual/Quad-Core 2. 1 x 2-Socket, Dual/Quad-Core (large-mem.) 3. InfiniBand Switch	12-Socket, Dual/Quad-Core
	Max Cores / Simulation	8 (Dual-Core)	24 (Dual-Core) - 48 (Quad-Core)	24 (Dual-Core) - 48 (Quad-Core)
	Max Memory / Simulation	32GB (using 2GB DIMMS)	16GB (using 2GB DIMMS)	96GB (using 2GB DIMMS)
Capabilities	Large-memory Simulations	Yes	No	Yes
	Large Multi-processes Simulations	No	Yes	Yes
	# of Multi-user Simulations	1-2	1-4 (Job Scheduler Required)	1-6
Others	Administration costs	$	$$$$$	$
	Job Scheduler	Not Required	Required	Not Required

Manufacturing

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FUSION1200

Competitive Analysis: IBM x3950

Introduction

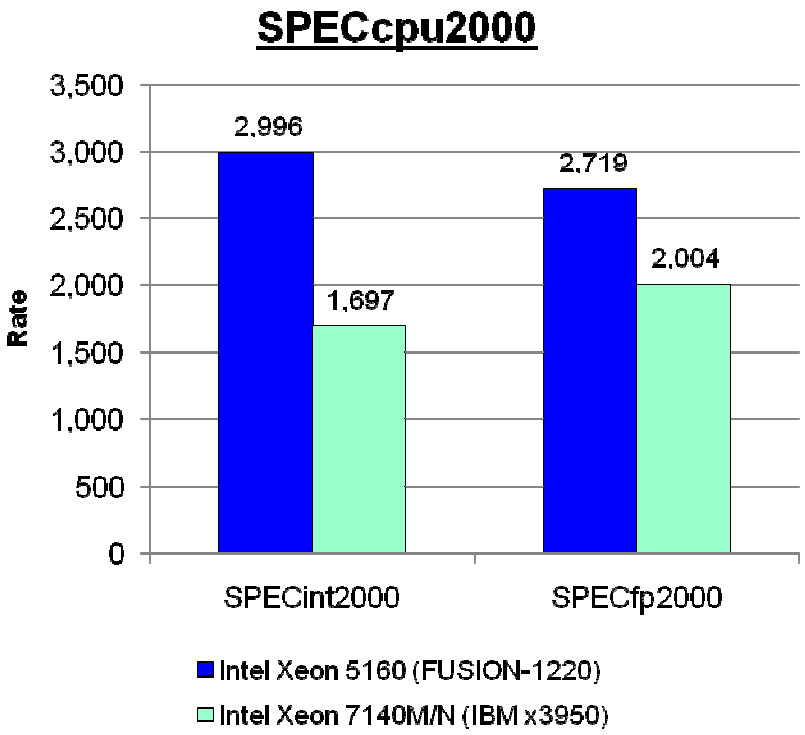
Life Sciences Departmental System

Manufacturing (CAE) Departmental System

Competitive Analysis: IBM x3950

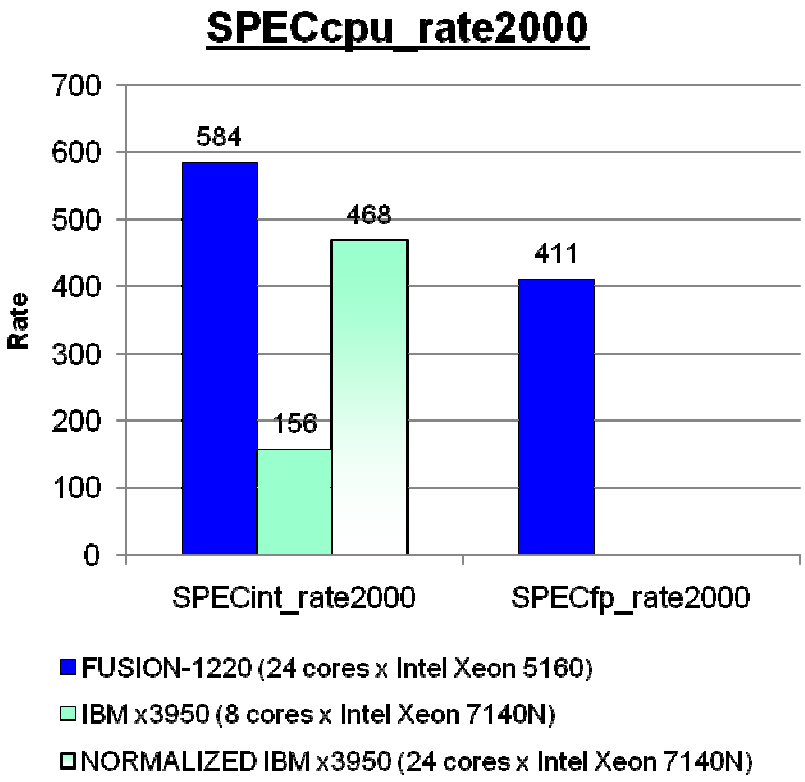
Competitive Analysis: SUN x4600 / SUN x4600 M2

- **IBM x3950** is using Xeon processors based on NetBurst micro-architecture
- **FUSION1200** is using Xeon processors based on Core micro-architecture, Intel's most advanced micro-architecture
- The IBM x3950 processors provides only **60%-75%** of the FUSION1220 SPECcpu2000 performance

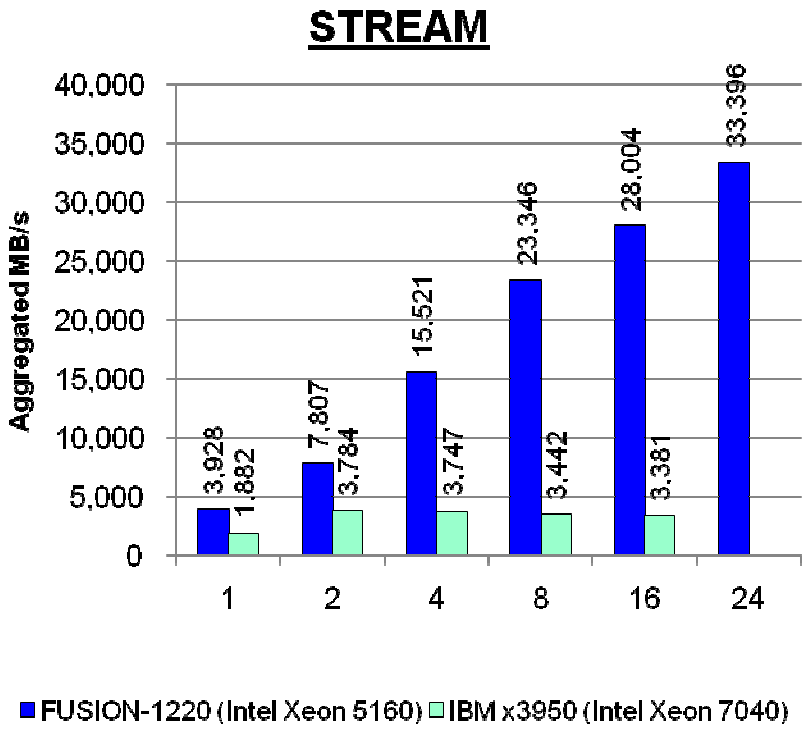


Notes:
1. IBM x3950 has 667Mhz FSB speed and can only use Intel Xeon 71xxN processors
2. There are no published SPECfp2000 results for 71xxN processors - 71xxM used instead
3. 71xxM have same clock rate but higher FSB speed (800MHz)

- **IBM x3950** has no published SPECcpu_rate2000 for 8 processors
  - No published SPECfp_rate2000
- The SPECint_rate2000 performance of the IBM x3950 is only **80%** of the FUSION1220
  - Results linearly normalized to 24-core



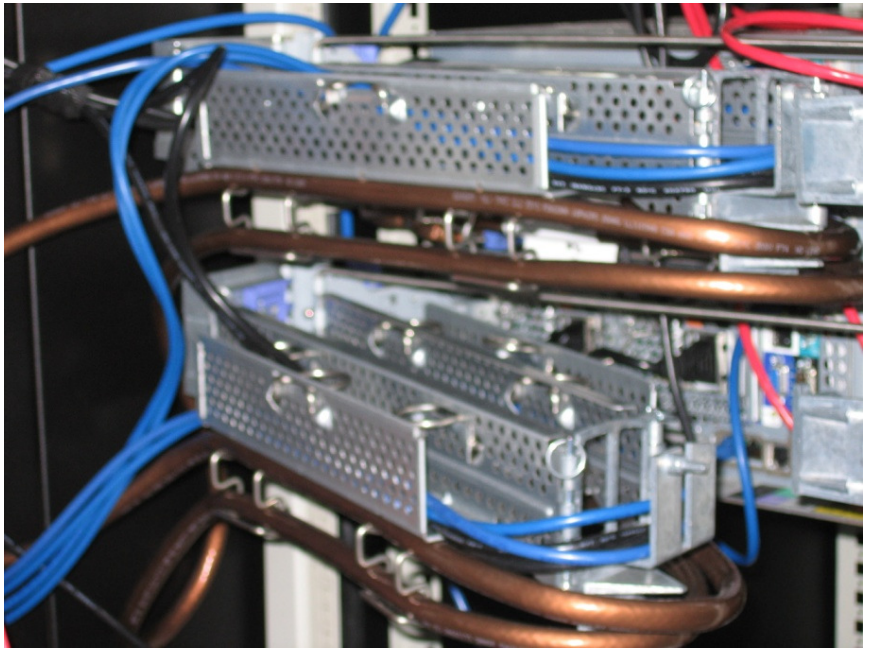
- **IBM x3950** max memory bandwidth (measured by STREAM benchmark) is 3.8GB/s
- **FUSION1220** max memory bandwidth is 33.4GB/s
- The IBM x3950 memory bandwidth is only **15%** of the FUSION1220 memory bandwidth on 16-cores



Notes:
1. Results by ScaleMP
2. x3950 results based on Intel Xeon 7040 processors
3. Intel Xeon 7040 and 71xxN processors has same FSB speed (667MHz)

- **IBM x3950** has 4 processors in a chassis and requires complex cabling for 8 processor configurations (total: 6U)

- **FUSION-1200** has 12 processors in a 7U chassis, also available in desk-side



IBM x460 / x3950 back view - 8 processor configuration - 2 chassis
Picture taken at ScaleMP lab

FUSION-1200 - 12 processor configuration
Picture shows desk-side, system available in rack-mount as well

System Vendor	VXTECH	IBM
System Model	**FUSION1200**	**x460 / x3950**
Processor		
Vendor	Intel	Intel
Model	Xeon 51xx / 53xx	Xeon 71xx
Micro-Architecture	Intel Core	Intel NetBurst
Dual-Core availability	Yes	Yes
Quad-Core availability	Yes	No
Chassis		
Max. Processors (sockets) / Chassis	12	4
Max. Memory / Chassis (GB)	192	64
Max. Internal Drives / Chassis	12	6
Integral GigE Ports / Chassis	7	2
System		
Max. Chassis	4	8
Max. Processors (sockets) / System	48	32
Max. Memory (GB) / System	768	512
Max. Internal Drives / System	48	48
Integral GigE Ports / System	28	16
Others		
Internal Drives Type	SATA	SAS
Integral IO Expansion / Chassis	Yes (eSATA)	No
Available PCIx/e Slots / Chassis	1	6
Redundant Power Supply	Multiple Power Supply	No

FUSION1200

Competitive Analysis: SUN x4600/4600M2

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- Manufacturing (CAE) Departmental System
- Competitive Analysis: IBM x3950
- Competitive Analysis: SUN x4600 / SUN x4600 M2

FUSION1200

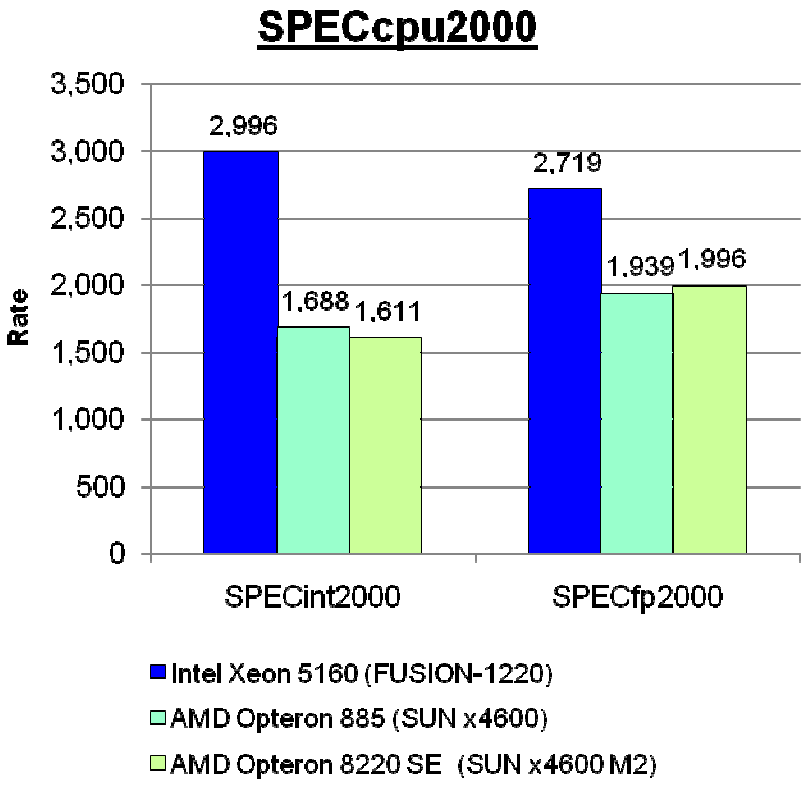
- FUSION1200 is a 12-socket Intel Xeon system
- FUSION1200 supports two types of Intel Xeon (Core micro-architecture) processors:
  - FUSION1220 – support Dual-Core processors: up to 3.0GHz with Intel Xeon 5160 and 1333MHz FSB
  - FUSION1240 – support Quad-Core processors: up to 2.33GHz with Intel Xeon 5145 and 1333MHz FSB
- Core is Intel's newest and most advanced micro-architecture

SUN x4600 / x4600 M2

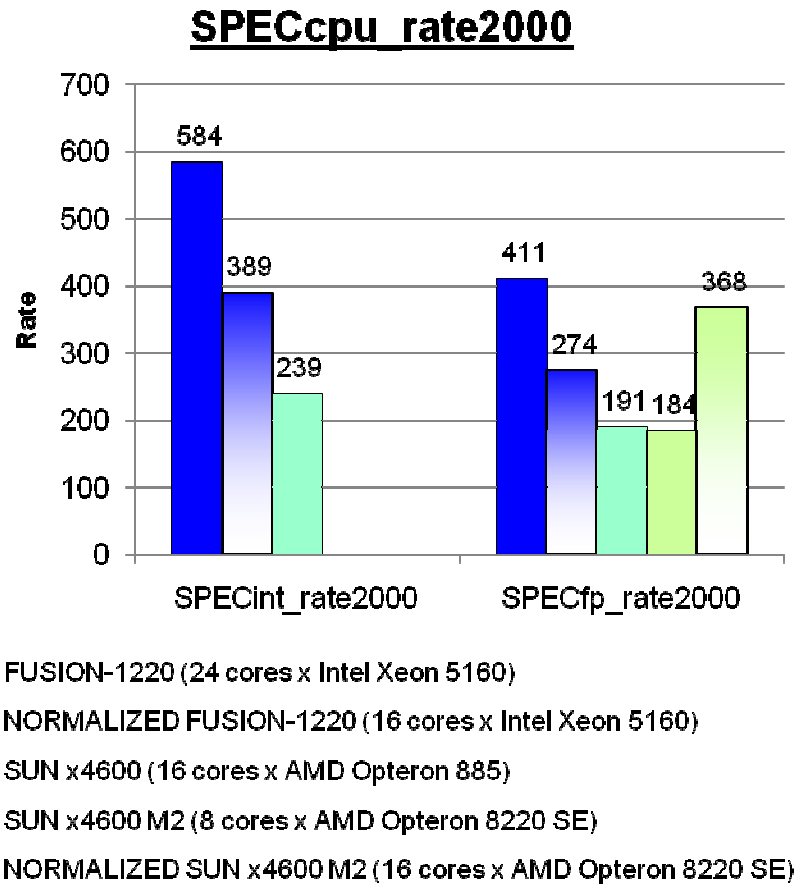
- SUN x4600 is SUN's first 8-socket AMD Opteron server
- SUN x4600 is supports two types of AMD Opteron Dual-Core processors:
  - x4600 – Socket E processors: up to 2.6GHz with AMD Opteron 885 and DDR1 memory
  - X4600 M2 – Socket F processors: up to 2.8GHz with AMD Opteron 8280 and DDR2 memory
- No Quad-Core support!

- No significant performance difference between the processors of **SUN x4600** and **SUN x4600 M2**

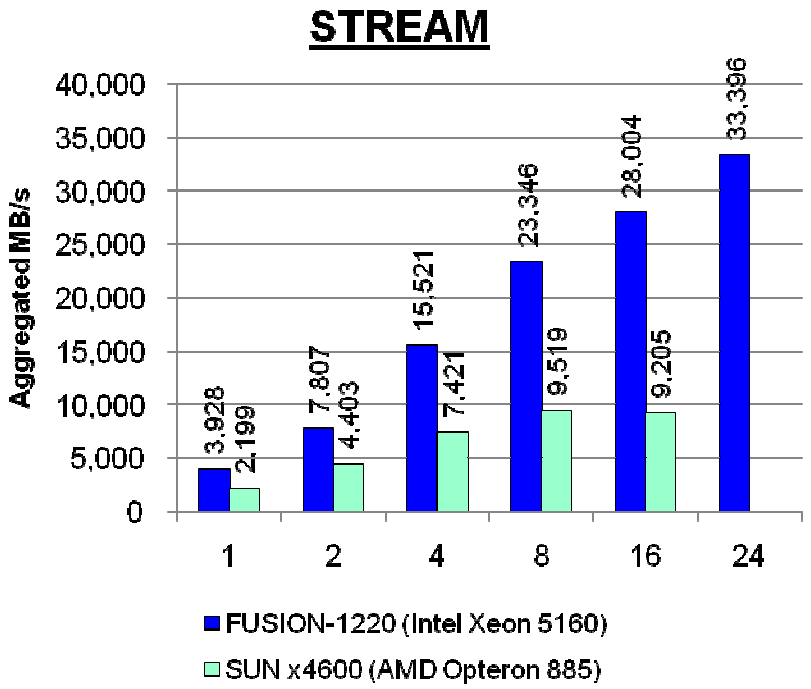
- The SUN x4600 / x4600 M2 processors provides only **55%-75%** of the **FUSION1220** SPECcpu2000 performance



- **SUN x4600 M2** has no published SPECcpu_rate2000 for 8 processors
  - No published SPECint_rate2000 at all!
- The SPECcpu_rate2000 performance of the SUN x4600 is only **60%-70%** of the **FUSION1220**
  - Results linearly normalized to 16-core
- The SPECfp_rate2000 performance of the SUN x4600 M2 is 135% of the FUSION-1220
  - Results linearly normalized to 16-core



- **SUN x4600** max memory bandwidth (measured by STREAM benchmark) is 9.5GB/s
- **FUSION1220** max memory bandwidth is 33.4GB/s
- The SUN x4600 memory bandwidth is only **35%** of the FUSION1220 memory bandwidth on 16-cores



Notes:
1. **Results by ScaleMP**

- **SUN x4600** / **SUN x4600 M2** has 8 processors in a rack-mounted only chassis and does not support chassis expansion

SUN x4600 / x4600 M2 front view

- **FUSION1200** has 12 processors in a chassis, also available in desk-side configuration. **FUSION1200** support **up to 4 chassis** in one system.

FUSION-1200 - 12 processors configuration
Picture shows desk-side, system available in rack-mount as well

System Vendor	VXTECH	SUN	SUN
System Model	**FUSION1200**	**x4600**	**x4600 M2**
Processor			
Vendor	Intel	AMD	AMD
Model	Xeon 51xx / 53xx	Opteron 8xx	Opteron 8xxx
Micro-Architecture	Intel Core	AMD K8	AMD K8
Dual-Core availability	Yes	Yes	Yes
Quad-Core availability	Yes	No	No
Chassis			
Max. Processors (sockets) / Chassis	12	8	8
Max. Memory / Chassis (GB)	192	64	128
Max. Internal Drives / Chassis	12	4	4
Integral GigE Ports / Chassis	7	4	4
System			
Max. Chassis	4	Not-Expandable	Not-Expandable
Max. Processors (sockets) / System	48	8	8
Max. Memory (GB) / System	768	64	128
Max. Internal Drives / System	48	4	4
Integral GigE Ports / System	28	4	4
Others			
Internal Drives Type	SATA	SAS	SAS
Integral IO Expansion / Chassis	Yes (eSATA)	No	No
Available PCIx/e Slots / Chassis	1	8	8
Redundant Power Supply	Multiple Power Supplies	Yes	Yes

Contacts: **David Giorgi, +1 (514) 885-9464**
Shai Fultheim, +1 (408) 480-1612