PLM System Architecture on Sun Microsystems

Global System Engineering
- Mfg. Industry Consultant

Hwanki Lee (hwanki.lee@sun.com)
- PLM on Sun
- PLM System Architecture
- Sun’s Solutions
PLM on Sun
Sun Microsystems on PLM Market

Hardware, Infrastructure software, architecture and network computing expertise

PLM software and services including systems implementation, integration, consulting and outsourcing services
<table>
<thead>
<tr>
<th>PLM Industry</th>
<th>Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry Specific Design and Collaboration Tools</td>
<td></td>
</tr>
<tr>
<td>Custom-specific EAI</td>
<td></td>
</tr>
<tr>
<td>Generic EAI Tools</td>
<td></td>
</tr>
<tr>
<td>PLM Software</td>
<td></td>
</tr>
<tr>
<td>Middleware</td>
<td>Web Server</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>Sun Java System Solution</td>
</tr>
<tr>
<td>Database</td>
<td>MySQL</td>
</tr>
<tr>
<td>NAS / SAN Storage / Backup</td>
<td>StorageTek</td>
</tr>
<tr>
<td>OS/ Server Platform</td>
<td>Solaris</td>
</tr>
</tbody>
</table>

Web, Networking, Java, XML, J2EE, JSP's Servlets 24x7 Support
<table>
<thead>
<tr>
<th>Developer Environment</th>
<th>NetBeans</th>
<th>Apache Software Foundation</th>
<th>php</th>
<th>JRuby</th>
<th>eclipse</th>
<th>Visual Studio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Database/Storage Platform</td>
<td>MySQL</td>
<td>ZFS</td>
<td>lustre</td>
<td>PostgreSQL</td>
<td>ORACLE</td>
<td>SYBASE</td>
</tr>
<tr>
<td>Application Infrastructure</td>
<td>Java</td>
<td>Project Glassfish</td>
<td>OpenSolaris</td>
<td>WebSphere</td>
<td>bea</td>
<td>Windows</td>
</tr>
<tr>
<td>Virtualization</td>
<td>xVM, Ops Center, Grid Engine</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Operating System</td>
<td>solaris</td>
<td>openSolaris</td>
<td>Ubuntu</td>
<td>Red Hat</td>
<td>SUSE</td>
<td>Windows</td>
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<tr>
<td>Systems</td>
<td>Sun Microsystems</td>
<td></td>
<td>IBM</td>
<td>DELL</td>
<td>HP</td>
<td>NetApp</td>
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<tr>
<td></td>
<td>Servers</td>
<td>Storage Backup</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Microprocessor</td>
<td>OpenSPARC</td>
<td></td>
<td>AMD Opteron</td>
<td>Intel</td>
<td>ULTRASPARC</td>
<td></td>
</tr>
</tbody>
</table>
Reference Architecture

MatrixOne Engineering Central Sizing

UGS TeamCenter User configuration

PTC Windchill User configuration
R&D Datacenter Architecture

- High Performance Visual Workstation
- HPC / CAD Farm Virtualization on X86
- Throughput Computing 1Socket/8Core/64 Thread
- PLM Server Virtualization on Solaris 10

Server Based Computing for Designer

- Sun Global Desktop
- Sun Ray

NFS / Lustre / ZFS

NAS Storages

Sun Fire X4500 Up to 48 terabytes of storage in 4RU

Storage Virtualization

SAN Storages

Tape Library
PLM System Architecture
PLM System Infrastructure Architecture

<table>
<thead>
<tr>
<th>WEB</th>
<th>PLM App. with WAS</th>
<th>Database Server</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Sun Java system Web Server</td>
<td>• PLM Application based on</td>
<td>• Free/Open Source DBs</td>
</tr>
<tr>
<td>• Apache</td>
<td>• Sun Java system App Server</td>
<td>• MySQL, PostgreSQL</td>
</tr>
<tr>
<td>• IIS (Microsoft)</td>
<td>• Weblogic, Websphere, etc...</td>
<td>• Commercial</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Oracle, MS SQL</td>
</tr>
<tr>
<td></td>
<td>• Dynamic Page Processing</td>
<td>• Meta Data</td>
</tr>
<tr>
<td></td>
<td>• JSP</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Servlets</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Standalone mod_perl/PHP/Python engines</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Internal Services</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• PLM Logic Processing</td>
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</tr>
<tr>
<td></td>
<td>• Dynamic content</td>
<td>• CPU</td>
</tr>
<tr>
<td></td>
<td>• CPU</td>
<td>• CPU</td>
</tr>
<tr>
<td></td>
<td>• Static Content</td>
<td>• Disk</td>
</tr>
<tr>
<td></td>
<td>• Dynamic content</td>
<td>• RAID</td>
</tr>
<tr>
<td></td>
<td>• CPU</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Java</td>
<td></td>
</tr>
</tbody>
</table>
Web Infrastructure

- Tier: (L3, L4)
- Hardware (L4 Switch)
- Software Load balancing
- Web
- WAS: Application Server, Web Container, EJB
- Database: Failover

Load Balancer
L4

Web / WAS based on PLM solutions

WAS

DB

• Web / WAS
• L4 Switch
• WAS Workload Balancing
• HA
• DB
Storage Architecture

<table>
<thead>
<tr>
<th>Architecture</th>
<th>NAS</th>
<th>SAN</th>
<th>iSCSI</th>
<th>DAS</th>
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<tbody>
<tr>
<td></td>
<td><img src="image" alt="Network Attached Storage" /></td>
<td><img src="image" alt="SAN Attached" /></td>
<td><img src="image" alt="SCSI Attached" /></td>
<td><img src="image" alt="Direct Attached" /></td>
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<tr>
<td></td>
<td>- NAS Data</td>
<td>- NAS Data</td>
<td>- TCP/IP</td>
<td>- NAS Data</td>
</tr>
<tr>
<td></td>
<td>- 100% Data</td>
<td>- 100% Data</td>
<td>- iSCSI</td>
<td>- 100% Data</td>
</tr>
<tr>
<td>Client</td>
<td>- Small Data / Web Server</td>
<td>- Large Data / DBMS Storage</td>
<td>- Large Data / Mail Server</td>
<td>- Small / Large Data</td>
</tr>
<tr>
<td></td>
<td>- Valut</td>
<td>- 8G Data</td>
<td>- 8G Data</td>
<td>- 8G Data</td>
</tr>
</tbody>
</table>
Backup Architecture

<table>
<thead>
<tr>
<th></th>
<th>SDLT320</th>
<th>SDLT600</th>
<th>LTO 2</th>
<th>LTO 3</th>
<th>LTO 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1 (Native)</td>
<td>160 GB</td>
<td>300 GB</td>
<td>200</td>
<td>400 GB</td>
<td>800 GB</td>
</tr>
<tr>
<td>#2 (Native)</td>
<td>16 MB/sec</td>
<td>36 MB/sec</td>
<td>30 MB/sec</td>
<td>80 MB/sec</td>
<td>120 MB/sec</td>
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<tr>
<td>#3</td>
<td>76 sec.</td>
<td>76 sec.</td>
<td>70~76 sec.</td>
<td>70~76 sec.</td>
<td>70~76 sec.</td>
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<tr>
<td>#4</td>
<td>SCSI</td>
<td>SCSI, FC</td>
<td>SCSI, FC</td>
<td>SCSI, FC</td>
<td>SCSI, FC</td>
</tr>
</tbody>
</table>

Local Area Network

Data

Backup Server

Storage Area Network

SAN

Backup

Data

Tape Library

Network Backup

SAN Backup
Sun’s Solution
Sun’s x86 Product Line

- Sun Grid Rack System
  - Sun Fire X6250
  - Enhanced w/ Quad-Core
- Sun Blade 6000
- Sun Blade 6048
- Sun Blade X8450
  - Sun Blade 8000
  - Sun Blade 8000 P
  - Modular System
- Sun Fire X4500
- Sun Fire X4600 M2
  - Enhanced w/ Quad-Core
- Sun Fire X4150
- Sun Fire X4450
- Sun Fire X4140
- Sun Fire X4240
- Sun Fire X4440
- Sun Fire X2200 M2
- Sun Fire X4100 M2
- Sun Fire X4200 M2
- Sun Ultra 24
- Sun Fire X2100 M2
- Sun Ultra 40 M2
- Sun Ultra 20 M2
Intel Architecture Product Family

4 sockets

Quad-Core
Intel Xeon 7300
Scalability, performance and reliability

Expandable

- Enterprise Databases
- ERP/CRM, Decision Support
- Server consolidation
- Scale-UP computing

Sun Fire X4450

2 sockets

Quad-Core
Intel Xeon 5300
Maximize performance density & performance/watt

Efficient Performance

- Infrastructure applications
- Infrastructure virtualization
- Dense 1u rack/blades
- Scale-OUT standardization

Sun Blade X6250
Sun Fire X4150

1 socket

Intel Core 2 Quad
Intel Core 2 Extreme
Intel Core 2 Duo
Ideal entry level workstation

Workstations

- Optimized for entry-level single socket workstations
- Platform longevity
- Supports lower power micro-architecture processors

Sun Ultra 24
Sun’s New X86 Systems

**Sun Fire X4150**
- 2x Intel Dual-Core & Quad-Core Xeon processor (Woodcrest/Clovertown)
- 16x FBDIMM DIMM slots (64GB max)
- 3x PCIe slots (all x8)
- 8x SFF SAS 2.5" disk drives (via PCIe) or 6x SFF SATA 2.5" disk drives
- 4x Gigabit Ethernet ports
- DVD-RW

**Sun Fire X4450**
- 4x Intel Dual-Core & Quad-Core Xeon processor (Tigerton)
- 32x FBDIMM DIMM slots (128GB max)
- 6x PCIe slots (2 x8, 4 x4)
- 8x SFF SAS 2.5" or 6x SFF SATA 2.5" disk drives
- 4x Gigabit Ethernet ports
- DVD-RW

**Ultra 24**
- Single socket Intel Xeon
- Dual-Core & Quad-Core (Conroe/Yorkfield)
- 4x DDR2 DIMM (8GB max)
- 2x PCIe x16 slots (Gen 2)
- 1x PCIe x4 (x8 mec), 1x PCIe x1 (Gen 1)
- 2x PCI (32-bit/33MHz)
- 6 USB, 2 IEEE 1394a
- 4x 3.5" SATA-II or SAS HDD SATA ODD – full 5.25 Drive

**Hot-swap Disks, Hardware RAID, Hot-swap redundant PSU, Hot-swap redundant Fans**
Sun’s Hybrid Data File Server

Integrated x86 compute power, massive storage capacity and high data throughput

compute
- 2 x Dual Core Opteron processors
- 16GB Memory

Storage
- 48 SATA II drives
- 48TB raw capacity

I/O
- Very high throughput
- 2x PCI- X slots
- 4 GigE

Availability
- Hot- swap/plug power, fans, disks

Management
- Same management as other Galaxy servers

Solaris\textsuperscript{TM} ZFS
- Ground- breaking file system performance
Sun CoolThreads System Evolution

UltraSPARC T1
- Sun Fire T1000 & T2000 (1 Socket, 8 Core, 32 thread)
- Sun Blade T6300 (1 Socket, 8 Core, 32 thread)

UltraSPARC T2
- Sun SPARC Enterprise T5120 & T5220 (1 Socket, 8 Core, 64 thread)
- Sun Blade T6320 (1 Socket, 8 Core, 64 thread)

UltraSPARC T2 +
- T5140/T5240 (2 Socket, 16 Core, 128 thread)
- T5440 (4 Socket, 32 Core, 256 thread)
- Sun Blade T6340 (2 Socket, 16 Core, 128 thread)
# Beat Industry Standard Performance

Leadership Across All Tiers of the Datacenter

<table>
<thead>
<tr>
<th>Model</th>
<th>Benchmark</th>
<th>Beats</th>
</tr>
</thead>
<tbody>
<tr>
<td>SE T5220</td>
<td>SPECweb2005</td>
<td>Xeon &amp; Opteron</td>
</tr>
<tr>
<td>SE T5120 &amp; T5220</td>
<td>SPECjbb2005</td>
<td>Power6, Power 5 &amp; Itanium 2</td>
</tr>
<tr>
<td>SE T5220</td>
<td>Lotus Domino Notes</td>
<td>Power 5 &amp; Xeon</td>
</tr>
<tr>
<td>SE T5220</td>
<td>SPECjAppServer2004 2–Node</td>
<td>Power 6, Itanium 2 &amp; Xeon</td>
</tr>
<tr>
<td>SE T5120</td>
<td>SAP SD 2-Tier</td>
<td>Power 6, Itanium 2 &amp; Xeon</td>
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<tr>
<td>SE T5120</td>
<td>Database Tier, SPECjApp</td>
<td>Power 5, Xeon &amp; Itanium 2</td>
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<tr>
<td>SE T5220</td>
<td>SSL Performance, SPECweb2005</td>
<td>Xeon &amp; Opteron</td>
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<tr>
<td>SE T5120 &amp; T5220</td>
<td>SPEC CPU2006</td>
<td>Power6, Xeon, Itanium, Opteron</td>
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<tr>
<td>SE T5220</td>
<td>SPEC OMPM2001</td>
<td>Power</td>
</tr>
<tr>
<td>SE T5120 &amp; T5220</td>
<td>SPECjbb2005 Single JVM</td>
<td>Power6, Xeon &amp; Itanium</td>
</tr>
<tr>
<td>SE T5120 / T5220</td>
<td>Siebel PSPP / Oracle Database</td>
<td>Power 6 &amp; Xeon</td>
</tr>
</tbody>
</table>

Unrivalled Performance / Watt & SWaP (Efficiency)
## SPARC Enterprise Server

<table>
<thead>
<tr>
<th></th>
<th>Mid-range</th>
<th></th>
<th></th>
<th>High-end</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>4U 2U</td>
<td>10U 2U</td>
<td></td>
<td>24U 24U</td>
<td>24U 24U</td>
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</table>

<table>
<thead>
<tr>
<th>Model</th>
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</tr>
</thead>
<tbody>
<tr>
<td>M4000</td>
<td>SAPRC64 VI 2.15GHz 5MB L2</td>
<td>128GB</td>
<td>4(8x1)</td>
<td>64(128x1)</td>
<td></td>
</tr>
<tr>
<td>M5000</td>
<td>SAPRC64 VI 2.15GHz 5MB L2</td>
<td>256GB</td>
<td>8(16x1)</td>
<td>64(64x1)</td>
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<tr>
<td>M8000</td>
<td>SAPRC64 VI 2.28, 2.4GHz 5-6MB L2</td>
<td>512GB</td>
<td>16(32x1)</td>
<td>32(64x1)</td>
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<tr>
<td>M9000-32</td>
<td>SAPRC64 VI 2.28, 2.4GHz, 5-6MB L2</td>
<td>1TB</td>
<td>32(2.5&quot; SAS)</td>
<td>64(64x1)</td>
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<tr>
<td>M9000-64</td>
<td>SAPRC64 VI 2.28, 2.4GHz 5-6MB L2</td>
<td>2TB</td>
<td>64(2.5&quot; SAS)</td>
<td>128(64x1)</td>
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</table>

- **PCI**
  - M4000: 4PCI-E, 1PCI-X
  - M5000: 8PCI-E, 2PCI-X
  - M8000: 32PCI-E
  - M9000-32: 64PCI-E
  - M9000-64: 128PCI-E
SPARC Enterprise Server – े े े े े

- Processor RAS
  > SPARC64 VI
  > Data error check points (HW) across server (ECC/parity)
- Memory assurance
  > Memory redundancy (Memory mirror)
  > Memory patrol (HW)
- Bus data Protection
  > Error check and Correction logic (HW) implemented across all major LSI, bus connections
# SPARC Enterprise Server – RAS

<table>
<thead>
<tr>
<th>SPARC Enterprise M-Series</th>
<th>IBM System p5 server</th>
<th>HP Integrate Server</th>
</tr>
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<tbody>
<tr>
<td>Redundancy</td>
<td>Redundancy</td>
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<tr>
<td>Hot swap</td>
<td>Hot swap</td>
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<table>
<thead>
<tr>
<th>Component</th>
<th>SPARC Enterprise M-Series</th>
<th>IBM System p5 server</th>
<th>HP Integrate Server</th>
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</thead>
<tbody>
<tr>
<td>Processors/ Memory</td>
<td>N/A</td>
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<td>N/A</td>
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<tr>
<td>Backplane/Crossbar</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
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<tr>
<td>System Board/Cell Board</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Service Processor</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
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<tr>
<td>Power Supply, Fans</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
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<tr>
<td>I/O Cards</td>
<td>N/A</td>
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<td>N/A</td>
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<tr>
<td>Disk</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Memory Redundancy</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>
Virtualization Technology

Hard Partitions/Blades
- App Server
- Database
- Identity Server
- Up to 18 Partitions
- Trend to flexibility
- Dynamic System Domains Blades
- Solaris Containers (Zones + SRM)
- Solaris Resource Manager (SRM)

Virtual Machines
- File Server
- Web Server
- Mail Server
- Up to 200 Partitions
- Trend to isolation
- Logical Domains Xen, VMware Microsoft virtual Server
- Solaris Containers for Linux Apps

OS Virtualization
- Calendar Server
- Database
- Web Server
- Up to 8,000 Partitions
- Trend to isolation
- Solaris Containers (Zones + SRM)
- Solaris Resource Manager (SRM)

Resource Management
- Unlimited

Sun Unique
Storage Portfolio

Investment Protection, Reduced Cost and Risk, Scalable

Enterprise Disk
Modular Disk
Archive
Virtual Tape
Tape Automation

Dynamic Data Protection Software

Enterprise Storage for Mainframe & Open Systems
Price/Performance, Scalability, Array Mgmt.
Faster, Cost Effective Back-up & Recovery Solutions
Solutions for Mainframe & Open Systems
SOA™  ™ Software Portfolio

Service Access
- Portal Server
- Web Server

Service Delivery
- Message Queue
- Sun Service Registry Repository
- Access Manager
- eBPM

Service Interface
Composite Application

Composite Application Platform
- eBPM
- eWay Intelligent Adapters
- eExchange Integrator
- eTL Integrator
- eGate Integrator

Service Integration Platform
- Message Queue
- Application Server
- Portal Server
- Web Server
- Directory Server

Application Service Platform

Infrastructure Services Platform
- solaris
- Sun Cluster
- N1 Service Provisioning System
- N1 Grid Engine

Legend:
- C/S
- Availability Suite
- N1 System
- Application Platform Suite
- Java Integration Suite
- Identity Management Suite
R&D Datacenter Architecture

- High Performance Visual Workstation
- HPC / CAD Farm Virtualization on X86
- Throughtput Computing 1Socket/8Core/64 Thread
- PLM Server Virtualization on Solaris 10

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SAN Storages

Storage Virtualization

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Tape Library
“We make the net work”