Oracle OpenWorld, 2010

SPARC Enterprise Systems, Today and Tomorrow

Naoki Izuta
General Manager,
SPARC Enterprise server Project,
Enterprise Server Business Unit,
Fujitsu Limited
扇子: pronounced “sensu”
A Japanese Fan
Our Talk Today

- The Fujitsu Group
- SPARC Enterprise Servers
- SPARC Enterprise Servers: Tomorrow
The Fujitsu Group
Fujitsu is **How Big?**

- **Sales and support operations in over 70 countries**
- **176,000 employees worldwide**

At a glance

- A $50.0B leader in IT systems and services for the global marketplace

**Core businesses:**

- **Technology Solutions (System Platforms & Services)**
- **Ubiquitous Product Solutions (PCs etc.)**
- **Device Solutions**

consolidated financials  FY2009
Business Composition

Device Solutions
- Electronic Components
- LSI Devices

Ubiquitous Product Solutions
- PC
- Mobile Phones

Technology Solutions
- Storage
- Server
- Submarine Network Solutions
- Software
- Security
- Data Center
- Consulting
- System Integration

Others

FY2009 $50.0 B

Note: US$1 = ¥93. FY 2009 is fiscal year ended March 31, 2010.
System Platforms

“If they don’t do all of the following, we don’t make them”

- High Performance and Scalable
- High Levels of Availability
- Customer Investment Protection
Mainframe GS21: We Protect Our Customers

1954 - Model 100 Relay based Computer
1968 - Model 230-60 Multi-Processor
1972 - Amdahl 470V/6 (M-190) Co-developed with Amdahl
1985 - Model M-780 Single board CPU
1995 - GS8000 series CMOS
2002 - GS 21 600 Max. 16 cluster / 256core

Next Generation
High Performance Computing: We Seek New Goals

1977
Model 230-75 APU

1982
Model VP-100/200

1992
VPP500

1999
VPP5000

2002
PRIMEPOWER HPC2500

2009
FX1 / JAXA
(Photo provided by JAXA)

2012
K computer 10pFLOPS

1982
Model VP-100/200

1999
VPP5000

2009
FX1 / JAXA
(Photo provided by JAXA)

2012
K computer 10pFLOPS
HAYABUSA: Asteroid Probe Project

6 billion Km journey of HAYABUSA over 7 years with Fujitsu’s technologies
- Orbit determination, Problem diagnostic, and Data transmission systems -

Arrived at asteroid “ITOKAWA”, 2005

Navigated with ion engines, 2003-2010

Return to Earth, 2010

Launched, 2003

The Sun

Photos of ITOKAWA and HAYABUSA by courtesy of JAXA
The Road to SPARC Enterprise

- **1983**: Initial partnership with Sun Microsystems
- **1987**: SF9010/MB86900, The First SPARC Processor
- **1988**: Enterprise Unix based-on System V Release4
- **1989**: DS/90 7000 series, hyperSPARC
- **1991**: SPARC64 V
- **1998**: PRIMEPOWER
- **2004**: Jointly developed SPARC/Solaris servers
- **2007**: SPARC Enterprise SPARC64 VI and VII
- **2007**: Next Generation
The Road to Human Centric Computing

- Human Centric
- Network Centric
- Computer Centric

- Cloud Computing
- Sensor Technology
- Ubiquitous Terminals
- Mobile Communication
Human Centric: IT Infrastructure
SPARC Enterprise Servers

- Unified Product with Oracle
- Virtualization
- Scalability / Performance
- High Availability
- Case Study
Jointly Developed, Manufactured & Delivered

Leveraging Sun and Fujitsu Strengths
Optimized Virtualization, Scalability and High Availability

Breakthrough Innovation and Best Enterprise OS

Technologies for Scalability, Reliability and Availability

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The SPARC Enterprise Server Family

T-series for Web/AP workloads
Scalability up to 4 sockets/256 threads

M-series for Mission Critical workloads
Scalability up to 64 sockets/512 threads
Major Worldwide Development Centers

Documents
Source code
Technical Drawings

Oracle: Burlington, USA
Oracle: Santa Clara, USA
Oracle: San Diego, USA
Fujitsu: Kawasaki, Japan
Fujitsu: Sunnyvale, USA

Development Center
Factory
Balanced High Performance Systems

- Maximum Resource Utilization
  - Scalable, Secure and Green
- HA Technologies in a single box

Consolidated Integrated

Clustered Web/AP apps

Clustered MC apps
SPARC Enterprise M-series

- Best platform for mission-critical workloads
- Agility to adapt to business change
- Customer Investment Protection

Virtualization
- Solaris Containers
- Hardware Partitioning
- Dynamic Reconfiguration (XSCF-DR)

Scalability
- SMP Inter-connect
- Oracle Solaris
- Memory Placement Optimization

Availability
- System RAS (Robustness)
- Solaris ZFS
- Solaris FMA
Enhanced DR Operation

PRIMEPOWER

Partition A
AP
CPU
CPU

Partition B
AP
CPU
CPU

Operation

SPARC Enterprise

Partition A
AP
CPU
CPU

Partition B
AP
CPU
CPU

XSCF

Operation

Operation

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CPU-Operating System Partnership

Next
SPARC64

Solaris 11

Solaris 10 9/10
ZFS RAID 3
Physical to Zone Migration

Solaris 10 5/09
Container Copy using ZFS clone

Solaris 10 5/08
CPU Capping for Container

capped-memory for Container

Solaris 10 11/06
ZFS
Enhancement for Container

Solaris 10
Solaris container
Dtrace, SMF, FMA

Upgradability, Compatibility
SPARC Enterprise
SPARC Enterprise Servers

- Unified Product with Oracle
- Virtualization
- Scalability / Performance
- Robustness
- Case Study
Virtualization Strengths

- Flexibility in resource optimization
- Manageability for ease of use
- Security for consolidation
Customer Focused Virtualization

Business Continuity
- Robustness
- Security
- Stability

Business Agility
- Effective Utilization
- Manageability

Consolidation of Varying Workloads

Higher
Fault Isolation
Lower

Lower
Flexibility
Higher

Hardware Partitioning
Oracle VM for SPARC
(Logical Domains: LDoms)
Solaris Containers

App A
OS
Firmware
Hardware

App A
OS
Firmware
Hardware

App A
OS
Firmware
Hardware

App B
OS
Firmware
Hardware

App B
OS
Firmware
Hardware

App B
OS
Firmware
Hardware
SPARC Enterprise Servers

- Unified Product with Oracle
- Virtualization
- **Scalability / Performance**
- High Availability
- Case Study
Scalability in Virtualized Environments

- High performance CPU and Cache hierarchy
- Proven scalability with robust interconnect
- Good balance of I/O and memory
High Performance CPU and Cache Architecture

- Over 20 times the performance since 2000

- 65nm
- 4-cores
- Multi-Thread / SMT
- 90nm
- 2-cores
- Multi-Thread / VMT
- L2$ on Die
- Over 2GHz frequency
- Non-Blocking Cache
- O-O-O Execution
- Super-Scalar

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Proven Scalability

- Scalability to 256 cores - *Benchmark*\(^1\) verified -
- Mesh interconnect
  - Low latency, high throughput
  - High-speed transmission technology
- Solaris MPO

![Diagram showing scalability with cores and memory specifications](image-url)

- **4TB Memory**
- **60 GB/s of IO bandwidth** \(^3\)
- **1TB Memory**
- **30GB/s of IO bandwidth**
- **512GB Memory**
- **15GB/s of IO bandwidth**
- **2TB Memory**

*1 SPECjbb2005(Single JVM), Oracle Peoplesoft Enterprise Payroll
*2 Result of SPECint_rate2006 (base)
*3 Values using the next enhancement version

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Easy & Effective Use of Large-Scale Resources

- Stable performance, even under high loads
  - Core / Thread / Process balancing
  - Automatic memory localization (Solaris MPO)

User/sys (%) vs. Number of threads

* SPARC Enterprise M9000 (128 cores/256 threads)
SPARC Enterprise with Flash Technology

- x7 higher throughput
- x20 Faster response time

Performance Test with Flash Module and Oracle Database Smart Flash Cache

Graphs showing:
- An increase in transaction per seconds [relative value] from HDD to HDD + F20 module, indicated as x7.
- A decrease in response time [relative value] from HDD to HDD + F20 module, indicated as x1/20.
SPARC Enterprise Servers

- Unified Product with Oracle
- Virtualization
- Scalability / Performance
- High Availability
- Case Study
Always ON

- Data Integrity
- 24x7 Operation
- Predictive self-healing
  - More critical in today’s multi-core CPU & SOC era
24x7 Predictive Self-Healing

- Data Integrity
- Dynamic Recovery and Component Offline
- Dynamic Replacement and Reallocation

SPARC64 VII Processor

- Hardware-based error detection and hardware-based self correction
- Hardware-based error detection
- Not affected in case of error

* This figure roughly depicts the ranges of error detection but does not exactly depict the actual chip floor plan.
Advanced System Architecture

- Superior Fault Management
  - Hardware fault detection and isolation
    - Dynamic instruction retry
    - Memory mirroring option
  - Statistical management

- Dynamic Resource Reallocation
  - In the Processor: cache ways, threads, cores
  - Memory: single page
  - Solaris ZFS

Solaris FMA and SMF

Secure data integrity throughout the system
SPARC Enterprise Servers

- Unified Product with Oracle
- Virtualization
- Scalability / Performance
- High Availability
- Case Study
Show case of SPARC Enterprise:
China Mobile Limited

- World leading Telecom carrier with the world’s largest network and customer base
  - Over 550 million customers
  - 70.6% of Market share in Mainland China
  - Their GSM global roaming services cover 237 countries

- Approx. 1000 SPARC Enterprise systems deployed in total
  - Including Centralized Finance System & General Budget System
    - SPARC Enterprise M9000, M8000, M5000, M4000, M3000
    - SPARC Enterprise T5240, T5220
Show case of SPARC Enterprise: Narita International Airport Corporation

- An aviation gateway to Japan
  - Destinations: 40 countries, 3 regions, 95 cities
    - Over 30 million passengers per year, 8th busiest airport in the world*
    - Total cargo 1.8 million tons, 4th busiest air-freight hub in the world*

- New Ramp Control System
  - New Air Traffic Control Information System delivers smooth airport operation through:
    - A design focused on ease of Air-Access
    - Always-ON, no system-down operation

- Systems
  - SPARC Enterprise M5000, M4000
  - Oracle Database 10g
  - FUJITSU CLUSTER Software

Show case of SPARC Enterprise: Mizuho Bank, Limited

- One of Japan’s “Megabanks”
- SPARC Enterprise Controlling Nation-wide ATMs
  - 5,300+ ATMs directly managed
  - 32x SPARC Enterprise M3000 in Cluster Configurations
SPARC Enterprise Servers: Tomorrow
Oracle/Fujitsu Collaboration: Next Stage

- Expand collaboration to maximize our strengths
- Deliver customers better: Products, Solutions, Delivery, and Support
- Enhance technologies for the Cloud Computing Era
Our Collaboration

Oracle: Burlington, USA
Oracle: Santa Clara, USA
Oracle: San Diego, USA
Fujitsu: Kawasaki, Japan
Fujitsu: Sunnyvale, USA
SPARC Enterprise Servers

Maximizing Results

<table>
<thead>
<tr>
<th>5 Year Trajectory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cores</td>
</tr>
<tr>
<td>Threads</td>
</tr>
<tr>
<td>Memory Capacity</td>
</tr>
<tr>
<td>Database TPM</td>
</tr>
<tr>
<td>Java Ops Per Second</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>T-Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-4 Socket</td>
</tr>
<tr>
<td>+20%</td>
</tr>
<tr>
<td>+ 2x Throughput</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>M-Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-8 Sockets</td>
</tr>
<tr>
<td>+3x Throughput</td>
</tr>
<tr>
<td>+1.5x Single Strand</td>
</tr>
</tbody>
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<table>
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<th>M-Series</th>
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<tbody>
<tr>
<td>8-64 Sockets</td>
</tr>
<tr>
<td>+6x Throughput</td>
</tr>
<tr>
<td>+1.5x Single Strand</td>
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</tbody>
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Solaris 10 Update

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<thead>
<tr>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
</tr>
</thead>
</table>
M-series Enhancements

- System Upgrade with Increased Performance
  - Significant Performance jump similar to SPARC64VI → VII + enhancement

- Customer Investment Protection
  - CPU Upgrade in a single box
  - Mix mode support in a single box
  - Binary Compatibility

- Coming Soon
  - Higher Frequency
  - Larger Caches
  - Increased IO Throughput

SPARC64 VI
- 2.4GHz
- 2 cores, 4 threads
- 2FPUs
- Shared L2$ Scalable to 64 Sockets
- Instruction Retry
- Mirrored Memory
- Dynamic Domains
- 90nm

SPARC64 VII
- 2.88GHz
- 4 cores, 8 threads
- Faster Memory
- 65nm

2006
2008/2009

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SPARC Enterprise Servers

Maximizing Results

5 Year Trajectory

<table>
<thead>
<tr>
<th></th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
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<tbody>
<tr>
<td>Cores</td>
<td>4x</td>
<td></td>
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<tr>
<td>Threads</td>
<td>32x</td>
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<tr>
<td>Memory Capacity</td>
<td>16x</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Database TPM</td>
<td>40x</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Java Ops Per Second</td>
<td>10x</td>
<td></td>
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ORACLE and FUJITSU Partnership
Thank you very much for attending today!

Come See More at the Fujitsu Booth @Moscone South #1311
Acknowledgements

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shaping tomorrow with you