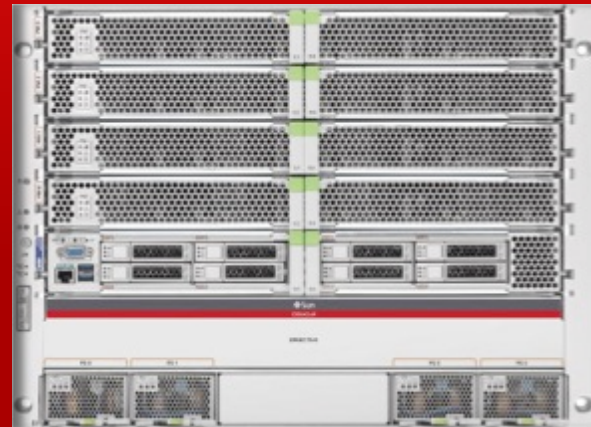ORACLE®

Why You Should Run Oracle on SPARC Solaris

New York Oracle Users Group
March 12, 2014

Paul Baumgartel
Principal Sales Consultant
Oracle
paul.baumgartel@oracle.com

Safe Harbor Statement

The following is intended to outline our general product direction. It is intended for information purposes only, and may not be incorporated into any contract. It is not a commitment to deliver any material, code, or functionality, and should not be relied upon in making purchasing decisions. The development, release, and timing of any features or functionality described for Oracle's products remains at the sole discretion of Oracle.

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Today's Challenges...

Improve Performance and Productivity

Support Business Growth

Shorten Deployment Cycles

Address High Cost of Complexity

Deal with Database & Application Silos

Modernize Legacy Infrastructure

Reduce Risk to Business

Prepare for Rapid Changes

Avoid any Disruptions

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ONE ENGINEERING TEAM

Program Agenda

- SPARC Technology Overview

- Solaris Technology Overview

- Advantages of Running Oracle Database on SPARC

- Unique Advantages of Running Oracle Database on Oracle Solaris

Oracle Database Runs Best On Oracle

Unique Oracle Solaris Advantages

Best Performance

- ✓ World record Oracle Database performance
- ✓ Unmatched scalability and security
- ✓ Unequaled database I/O performance manageability

Most Efficient

- ✓ Most efficient SGA online resizing
- ✓ Secure multiversion database multitenancy
- ✓ Most cost-effective for database licensing

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Investment in Core Technology

PROCESSORS

- SPARC microprocessors are the fastest in the world, and continue to lead the industry into the multi-core era

SOFTWARE

- Oracle Solaris is the leading enterprise cloud OS, many years ahead in scalability and reliability

BANDWIDTH

- SPARC servers reach incredible scale inside the server, or outside, through leading-edge InfiniBand technology

SYSTEMS

- Oracle's portfolio today has the performance and price / performance advantage, and offers breakthrough virtualization for business critical applications

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The Oracle Systems Strategy

Better Value from the Complete Stack of Hardware and Software

STRATEGY

- Develop together a full hardware and software stack: database, middleware and application software

- Optimized operating system and processors to run Oracle's database and Java software better and faster

- Engineered Systems: the ultimate demonstration of the value of the integration

LEADERSHIP

- **#1** Fastest Processor

- **#1** Operating System for Cloud

- **#1** Engineered Systems

- **#1** In-memory processing

- **#1** Fastest database server

- **#1** Fastest Java server

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SPARC T5

The World's Fastest Microprocessor

20+
WORLD
RECORD
BENCHMARKS

- **#1** TPC-C: fastest database server
- **#1** SPECjbb 2013: fastest Java server
- **#1** SPECjEnterprise 2010: fastest middleware server
- **#1** SPEC CPU 2006: fastest raw processor performance
- **#1** SAP-SD: fastest SAP 8-processor server
- **#1** Siebel: fastest CRM server

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Investing in Silicon Innovation
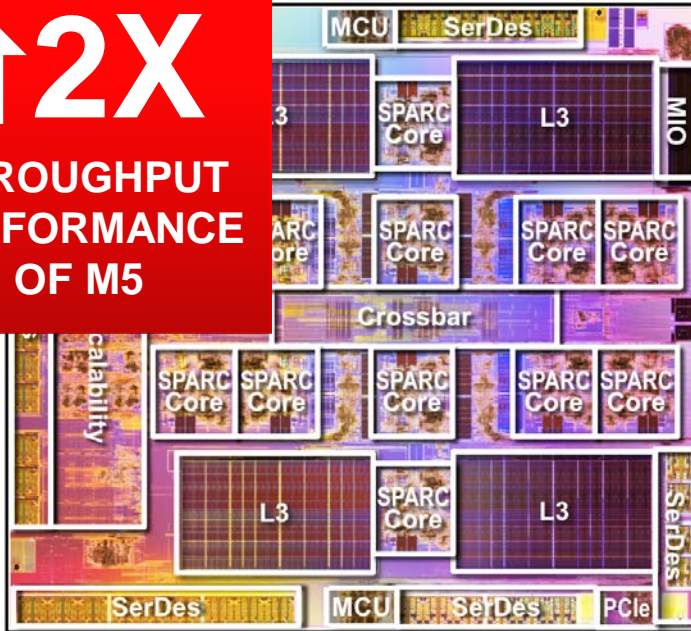## An Accelerated Pace of Engineering Execution

March 26, 2013

March 26, 2013

September 2013

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Powered By Oracle Processor Technology

SPARC M6: Higher Density and Lower Cost / Core
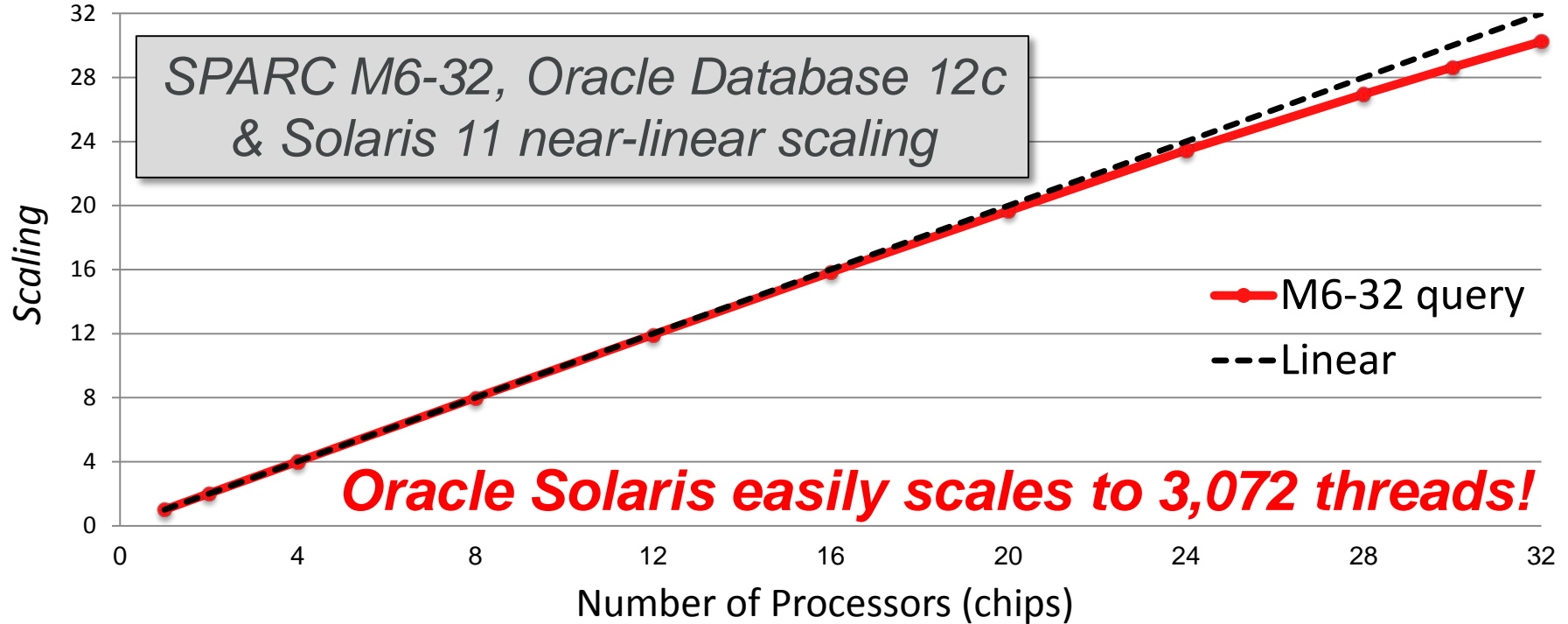

- 12 S3 cores @ 3.6GHz
- 48MB shared L3 Cache
- Scalable to 32 processors
- 2 Integrated 2x8 PCIe 3.0
- 4.1 Tbps total link bandwidth
- 4.27 billion transistors

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SPARC M6-32 Near-linear Query Scaling
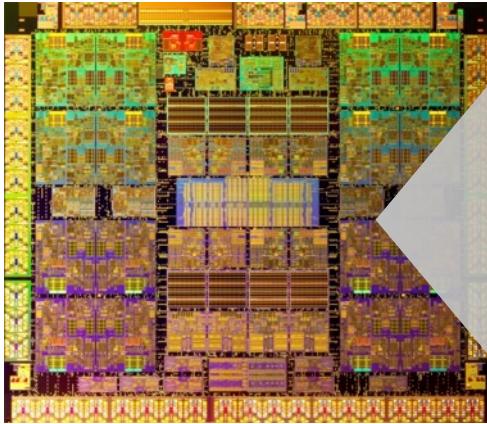
SPARC has been scaling to over 64 processors for over 20 years!

SPARC M6-32, Oracle Database 12c
& Solaris 11 near-linear scaling

Scaling

M6-32 query

Linear

Oracle Solaris easily scales to 3,072 threads!

Number of Processors (chips)

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The Ultimate Software Optimization: Hardware

Moving Oracle Database & Java Software Functions into Hardware

Database Query Acceleration

Java Acceleration

Application Data Protection

Data Decompression
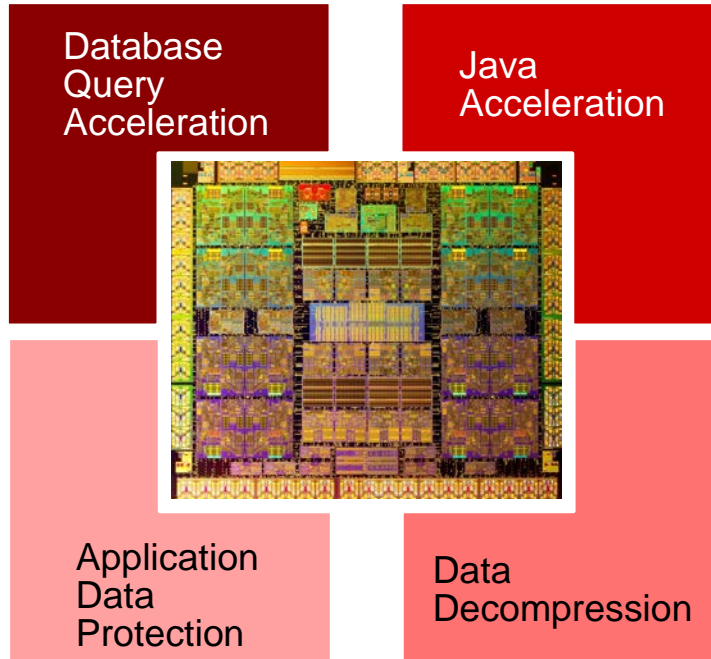
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The Ultimate Software Optimization: Hardware

Moving Oracle Database & Java Software Functions into Hardware
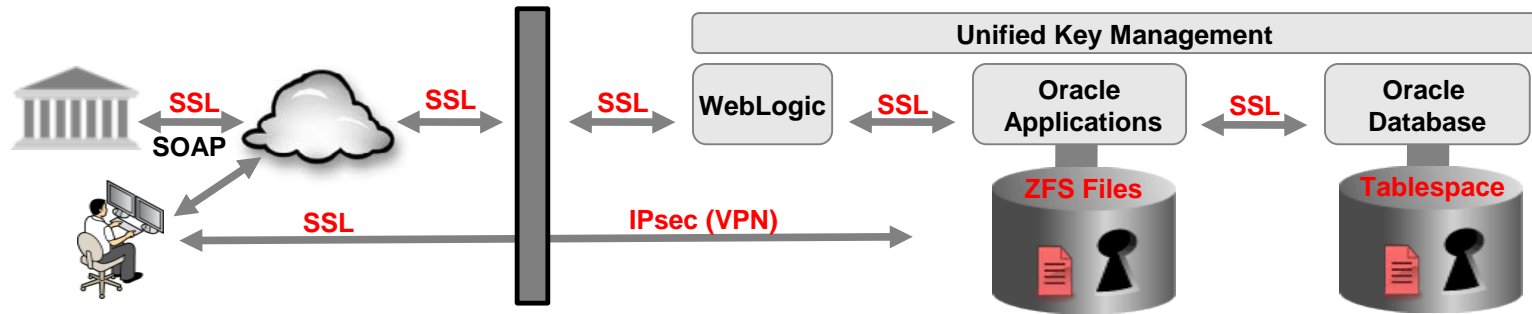

Software in Silicon

- Database query acceleration
- Java acceleration
- Application data protection
- Data decompression

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Unmatched Security: End-to-End Encryption

No Compromise, No Tradeoff, No Additional Costs

- Auto-offload of CPU-intensive security work to SPARC crypto accelerators

- Fast Oracle Database Advanced Security Transparent Data Encryption (TDE)

- Turbo charged JRE security

- Reduce risk with encryption by default

- ZFS Filesystem Crypto 3.9x faster vs. x86

- 10Gb/s SSL T5 uses <10% of system to saturate 10GbE vs. 30% for Xeon E5

Unified Key Management

SSL SOAP

SSL

SSL

WebLogic

SSL

Oracle Applications

SSL

Oracle Database

ZFS Files

Tablespace

SSL

IPsec (VPN)

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Leading SPARC T5 & Oracle 12c Security

Leading Full Table Scan Oracle TDE (Transparent Database Encryption)

- Database 12*c* Transparent Database Encryption
  - SPARC T5 1.5x faster secure than x86 E5-2697 v2 (AES-NI Ivy Bridge)
  - SPARC's design enables fastest secure database
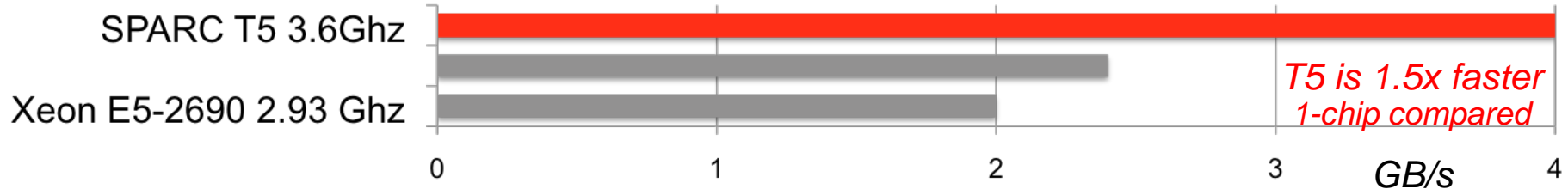
System + Oracle DB 12*c*	Cleartext	AES-CFB-128	Utilization
SPARC T5 3.6GHz	8.4 GB/s	**4.2 GB/s**	*100% user*
X86 E5-2697 v2 2.7GHz, *Ivy Bridge*	8.2 GB/s	**2.8 GB/s**	*100% user*
X86 E5-2690 2.93GHz, *Sandy Bridge*	8.2 GB/s	**2.0 GB/s**	*100% user*
SPARC T5 advantage	*1x*	***1.4x E5 v2***	

Oracle Database 12c & 11*g*R2

Tablespaces

On-Chip Accelerators for Database

Example: Looking for Instances of a Given Value in Memory

Today's Microprocessors

- Execution Code
  - Get target from memory
  - Compare to search value
  - Build results list
  - Do for each target in memory

- Consequence
  - Core busy for entire scan
  - Nothing else can happen
  - Slow and expensive

2014 Microprocessor

- Execution Code
  - Give range to scan and search value
  - Done

- Benefit
  - Core completely freed up
  - Other code can execute
  - Breakthrough performance and efficiency

Oracle SPARC Processor Roadmap

ORACLE
SOLARIS

Delivered

M6
2x Throughput
>1x Thread Strength

M5
+6x Throughput
+1.5x Thread Strength

T5
+2.5x Throughput
+1.2x Thread Strength

T4
+1x Throughput
+5x Thread Strength

In Lab
M-Series
+2x Throughput
+1.5x Thread Strength
In Lab
T-Series
+2x Throughput
+1.5x Thread Strength

Software in Silicon Features
- Database Query
- Decompression
- Encryption
- Application Data Protection

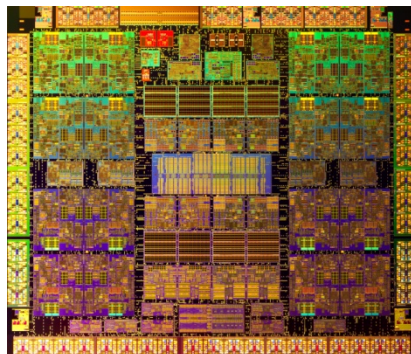| 2011	2012	2013	2014	2015
Solaris 11	Solaris 11.1	Solaris 11.x	Solaris 11.x	Solaris 11.x
Solaris 10 U10	Solaris 10 U11	Solaris 10	Solaris 10	Solaris 10

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SPARC @ Oracle
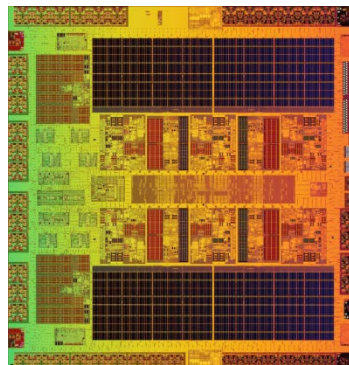
5 Processors in 4 Years

| 2010 | 2011 | 2012 | 2012 | 2013 |
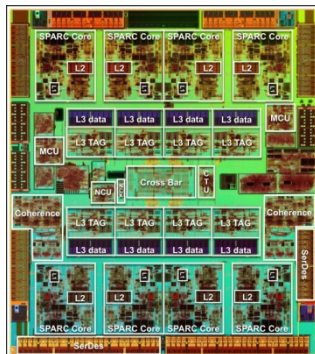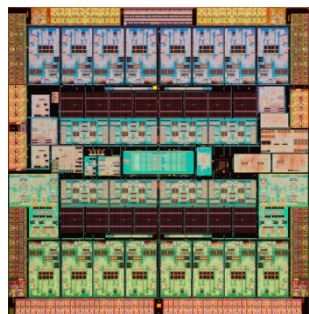
SPARC T3
- 16 S2 cores 128 Threads
- 40 nm technology
- 1.65 GHz

SPARC T4
- 8 S3 Cores 64 Threads
- 40nm Technology
- 3.0 GHz

SPARC T5
- 16 S3 Cores
- 28nm Technology
- 3.6 GHz
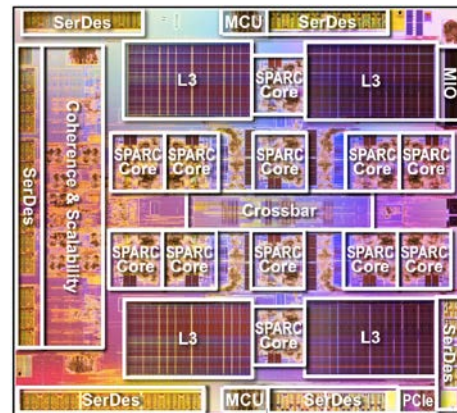
SPARC M5
- 6 S3 Cores, 48MB $
- 28nm Technology
- 3.6 GHz

SPARC M6
- 12 S3 Cores 48MB $
- 28nm Technology
- 3.6 GHz

Oracle SPARC Systems Direction
Increase Application Performance 2x Every Two Years

- Lead Mission Critical computing

- Embed Oracle-specific enhancements

- Design the best servers in the world. Period.

- Not just about servers: Integrate into Engineered Systems

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Investing in Silicon Leadership

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Investing in Silicon Leadership

ACQUIRE	FOCUS	COMPETE	ACCELERATE	OPTIMIZE

Oracle
100% performance
each generation

IBM Power & x86
30–50% performance
each generation

x86
x86
IBM
IBM
SPARC
SPARC
SPARC
SPARC
SPARC T-Series

M8/T8
M7/T7
SPARC

- **M7/T7**
  - Running in lab now
  - Deep Software in Silicon
  - Step function in performance
- **M8/T8**
  - New core

2010	2011	2012	2013	FUTURE
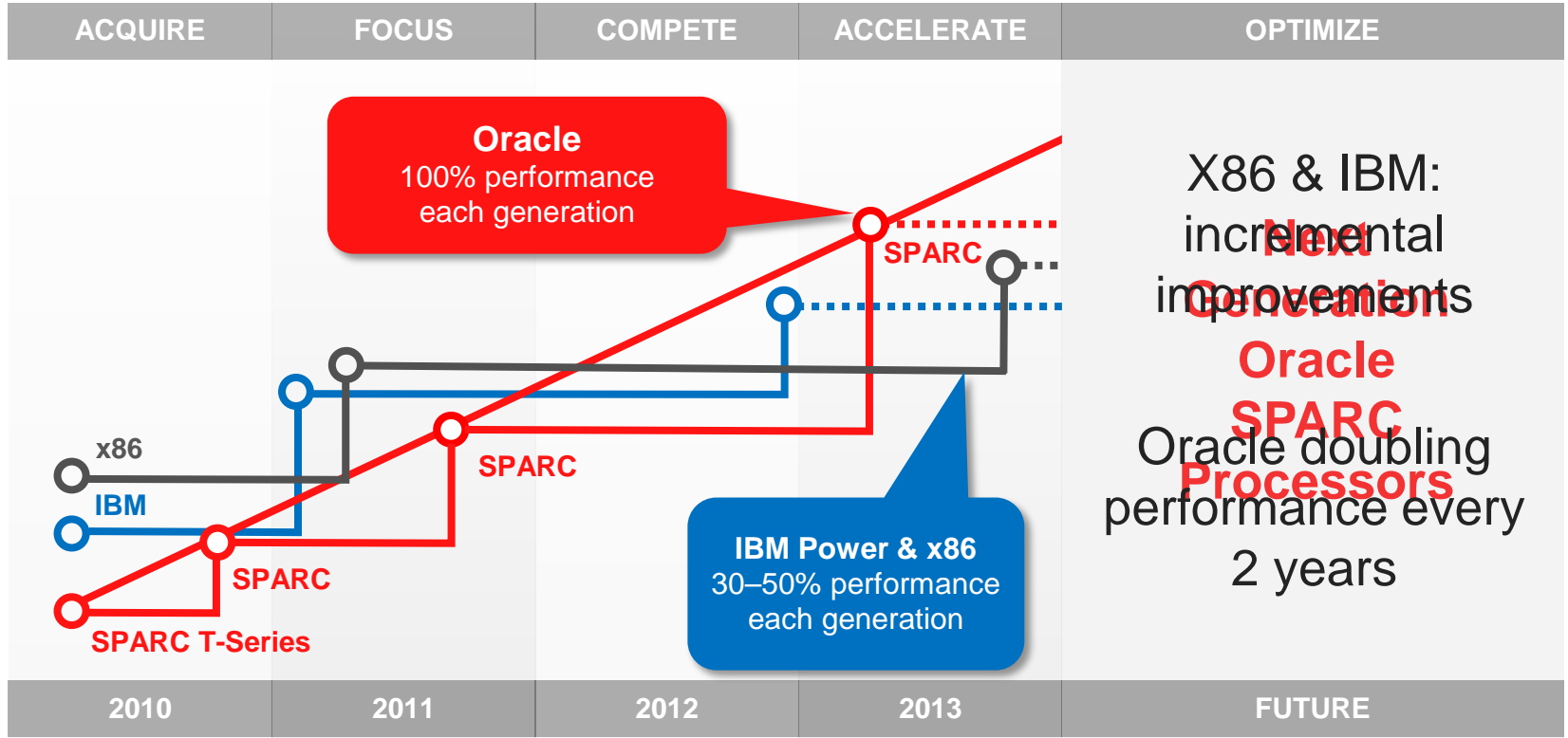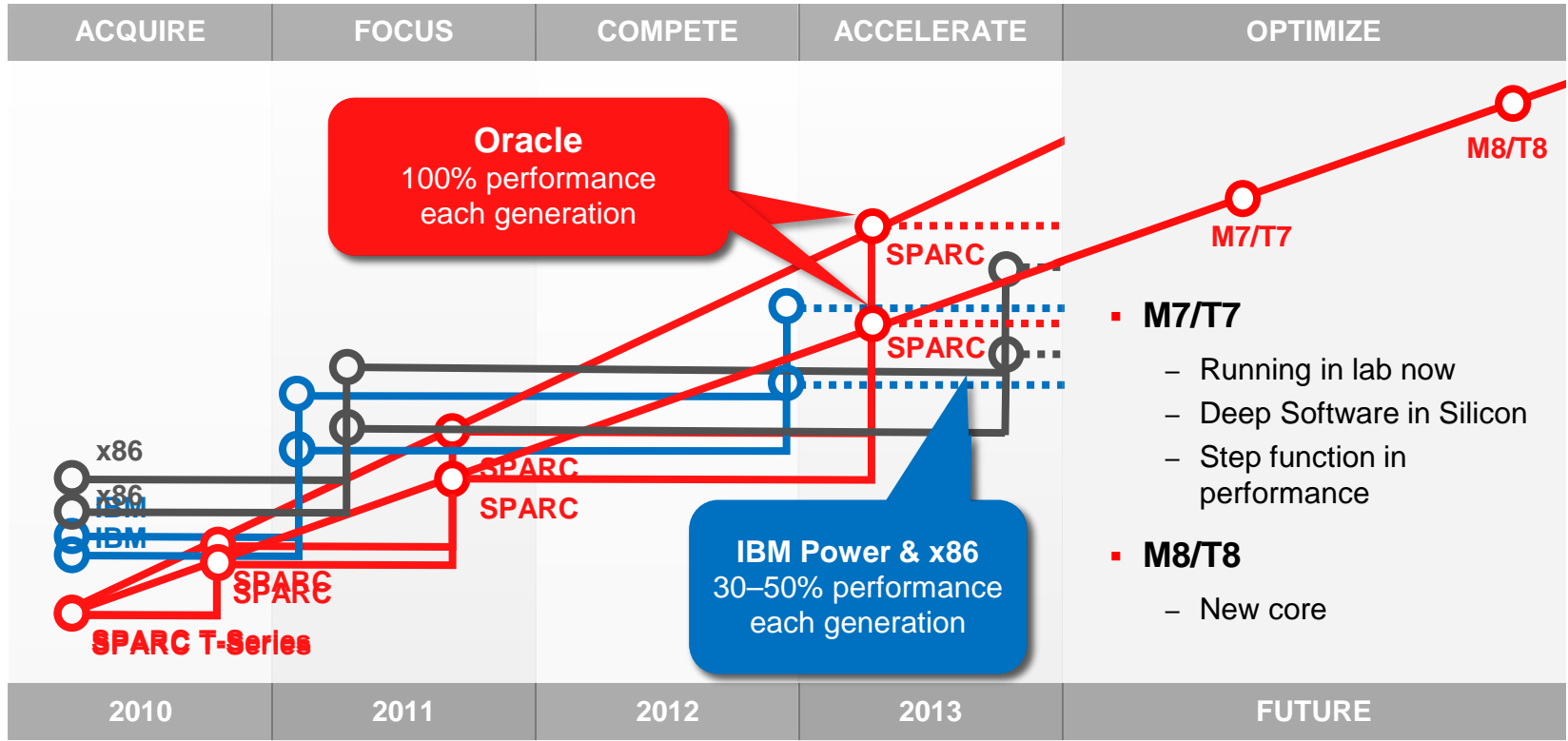
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Why Oracle Customers Choose Solaris

Top Reasons for Investing in Oracle Solaris Systems

1. **Reliable**: If it must run, it's on Solaris
2. **Fast**: World record leader for enterprise applications
3. **Scalable**: Engineered today for next generation systems. Invest for the future
4. **Secure**: Deeply integrated security. Trusted labeled configurations
5. **Virtualized**: Maximum resource utilization. Faster time to market
6. **Engineered for Oracle:** Best performance. Fastest deployments
7. **SPARC and x86**: Choice of industry's leading enterprise architectures
8. **Compatible**: Preserves your investments. Avoids costly migrations
9. **Trusted Vendor**: One phone call

Ultimate Oracle Database I/O Observability

Oracle Solaris DTrace Integration

New with Oracle Database 12c

- Provides end-to-end view for I/O operations taking too long
- Traces I/O requester, I/O device and the exact time spent in each layer: database, OS and the storage device
- Tracing info is loaded in V$ views for queries

Optimize your Database I/O performance

Quickly resolve I/O outlier events

v$kernel_io_outlier

TIMESTAMP
IO_SIZE
IO_OFFSET
DEVICE_NAME VARCHAR2(513)
PROCESS_NAME VARCHAR2(64)
TOTAL_LATENCY
SETUP_LATENCY

…

Ultimate Oracle Database I/O Observability

Oracle Solaris DTrace Integration

New with Oracle Database 12c

```
SQL> desc v$kernel_io_outlier
    Name                    Null?      Type
    ------------------- --------  -----------
    TIMESTAM                       NUMBER
    IO_SI                          NUMBER
    IO_OFFSET                      NUMBER
    DEVICE_NAME                    VARCHAR2(513)
    PROCESS_NAM                    VARCHAR2(64)
    TOTAL_LATENCY                  NUMBER
    SETUP_LATENCY                  NUMBER
    QUEUE_TO_HBA_LATENCY           NUMBER
    TRANSFER_LATENCY               NUMBER
    CLEANUP_LATENC                 NUMBER
    PID                            NUMBER
    CON_ID                         NUMBER
```

Optimize your Database I/O performance

Quickly resolve I/O outlier events

v$kernel_io_outlier

TIMESTAMP
IO_SIZE
IO_OFFSET
DEVICE_NAME VARCHAR2(513)
PROCESS_NAME VARCHAR2(64)
TOTAL_LATENCY
SETUP_LATENCY

…

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Ultimate Oracle Database I/O Observability
Oracle Solaris DTrace Integration

```
SQL> select DEVICE_NAME,IO_SIZE,PID,TOTAL_LATENCY,SETUP_LATENCY,QUEUE_TO_HBA_LATENCY,TRANSFER_LATENCY,CLEANUP_LATENCY from v$kernel_io_outlier;
  DEVICE_NAME IO_SIZE PID TOTAL_LATENCY SETUP_LATENCY QUEUE_TO_HBA_LATENCY TRANSFER_LATENCY CLEANUP_LATENCY
  ----------- ------- --- ------------- ------------- -------------------- ---------------- ---------------
  sd@3,0:a,raw    64   0        402554          2020                  107           400361              64
```

This example shows that this single 64k write to a SCSI target had an end to end latency of just over 400 milliseconds and the breakdown is:

SETUP_LATENCY
–Time in microseconds spent during initial I/O setup before sending to scsi target device driver (2020 microseconds)
QUEUE_TO_HBA_LATENCY
 – Time in microseconds spent in the scsi target device driver before being sent to the Host Bus Adaptor (107 microseconds)
TRANSFER_LATENCY
 – Time spent transferring (DMA) to the physical device (~400 milliseconds)
CLEANUP_LATENCY
 – Time in microseconds spent freeing resources used by the completed I/O (64 microseconds)

Unequaled Database I/O Management
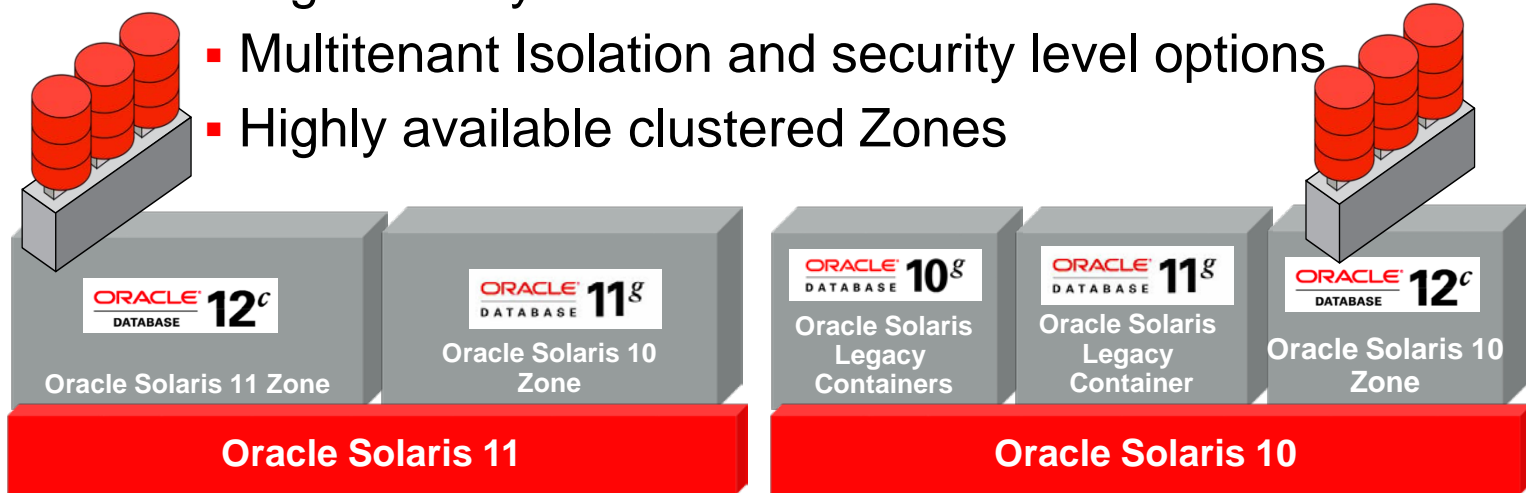## Integrated Network Virtualization

- Secure isolation of networks
- Bandwidth management per database instance
- Ideal for Database 12c Pluggable Databases I/O management
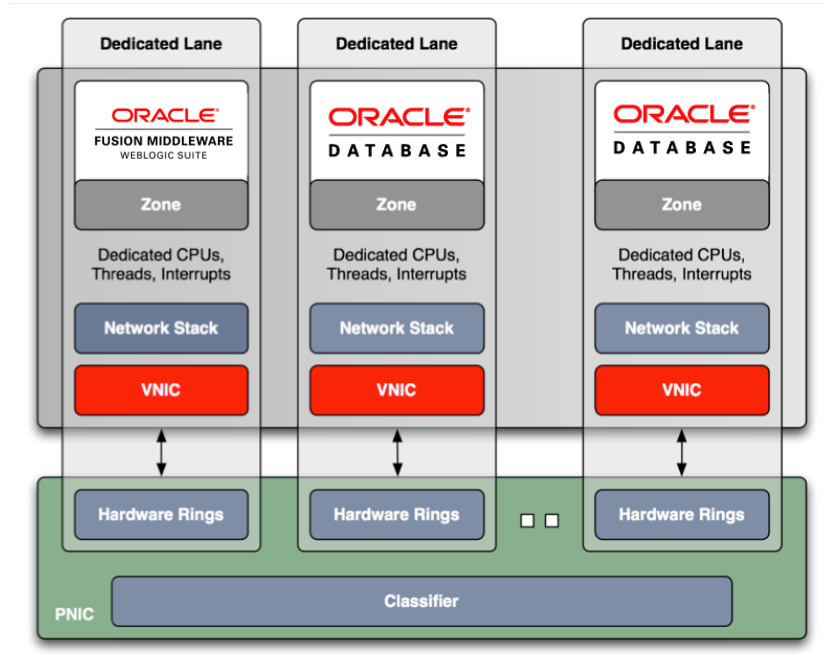
Secure Multiversion Database Multitenancy

For Database Consolidation and Database Clouds

- **Multiple versions of Database and OS on same server**
  - No impact on Performance
  - High-density Consolidation
  - Multitenant Isolation and security level options
  - Highly available clustered Zones

ORACLE DATABASE 12^c
Oracle Solaris 11 Zone

ORACLE DATABASE 11^g
Oracle Solaris 10 Zone

Oracle Solaris 11

ORACLE DATABASE 10^g
Oracle Solaris Legacy Containers

ORACLE DATABASE 11^g
Oracle Solaris Legacy Container

ORACLE DATABASE 12^c
Oracle Solaris 10 Zone
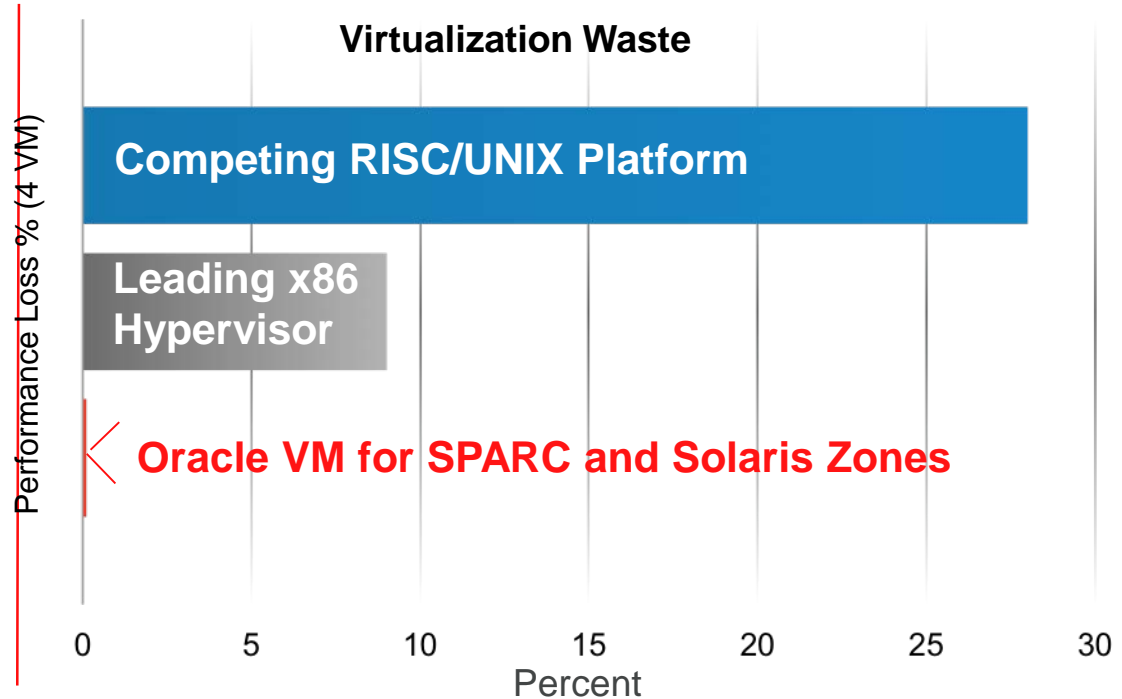
Oracle Solaris 10

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Unmatched Efficiency

Integrated virtualization, Hardened for Mission-critical Deployments

0%
VIRTUALIZATION WASTE

Oracle virtualization has the **best consolidation ratios, best efficiency**

Virtualization Waste

Performance Loss % (4 VM)

Competing RISC/UNIX Platform

Leading x86 Hypervisor

Oracle VM for SPARC and Solaris Zones

0   5   10   15   20   25   30

Percent

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Application Consolidation and Mobility

Recognized Hard Partition

Oracle Solaris Zones

- Resource management
- Independent software stacks
- Oracle Solaris 10 Environments
- Immutable (Read-Only) Zones
- Delegated Administration
- Physical/Virtual to Virtual Migration

What it provides:
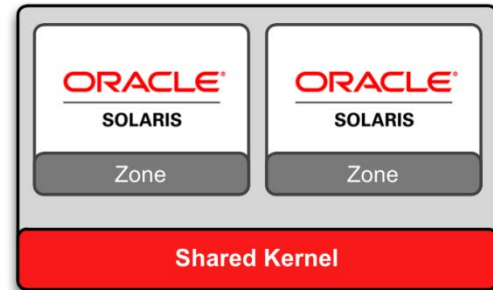
Isolated and secure virtual environments

Low overhead virtualization with **resource management**

Simplified management and resource control

Zero-Waste Virtualization

How you benefit:

Consolidate your applications without taking a performance penalty

ORACLE SOLARIS Zone | ORACLE SOLARIS Zone

Shared Kernel

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Oracle Database License Cost Reduction

Sub-capacity Licensing for Oracle Software

UP TO

95%

**LOWER
ORACLE SOFTWARE
LICENSE COSTS**

- All Oracle software products licensed per processor

- Allows customers to license as few as two (2) cores per server

- License cost savings of up to 95% on an Oracle T5-8 versus a comparable platform from any other vendor

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The Unique Oracle Advantage

Hardware and Software Engineered to Work Together

One Engineering Team

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Zero Downtime SGA Resizing

Increased Uptime

New with Oracle Database 12c

- New Oracle Solaris Optimized Shared Memory (OSM) interface – replaces DISM

- Works with Oracle DB Automatic Memory Management (AMM)

- Dynamic, NUMA- aware granule based shared memory

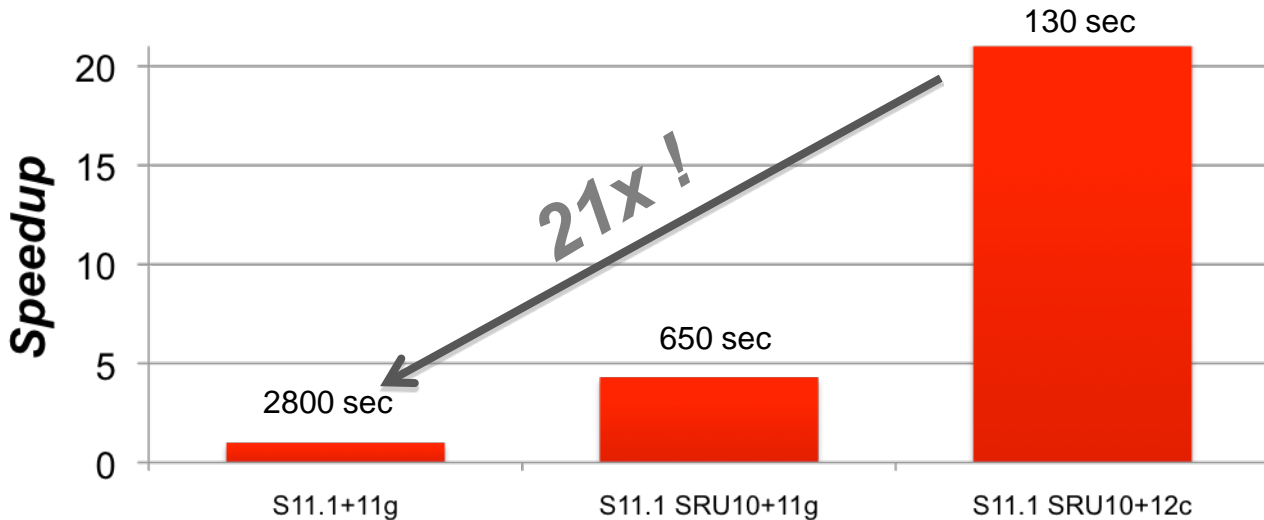Dynamically resize your Database SGA online without a reboot

Bring Oracle Database instances up 2x faster

Oracle DB SGA

Dramatically Faster Oracle Database Startup

With Oracle Solaris and Database optimizations

21X improvement with **30TB** of SGA

But Wait… There's More!

Reduce Management Risk and Complexity

Oracle Systems Running Solaris are Easier to Own and Operate

10X

LESS TIME FOR PATCHING, UPDATES

- 1 patch deployment for the entire system, including drivers, firmware and system software

- Automated, cloud-scale patch and update deployment

- Failsafe patching with fault detection auto-roll-back

- Full-system testing of patches and updates before release

Self-healing, Tuning and Diagnostics

Fewer Management Hours per System, Less Human Error

- Automated service and fault management
- Application-aware clustering

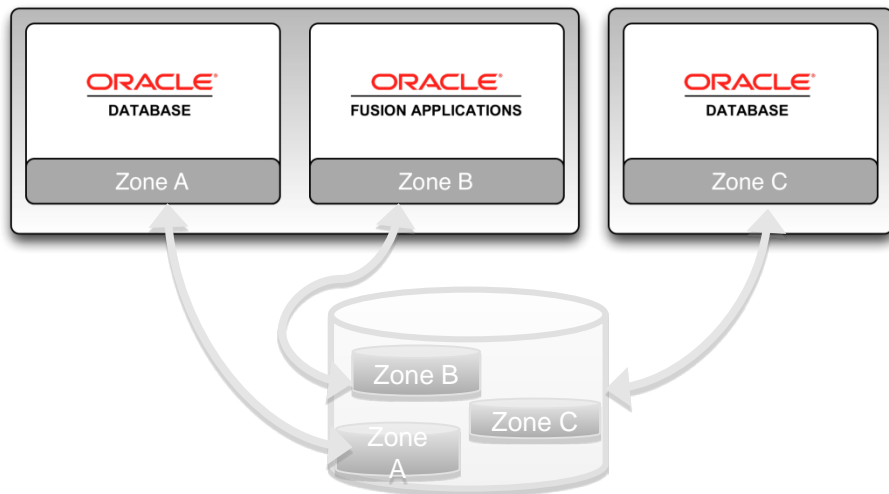- Automated compliance reporting
- Unequalled system observability

- Predictive Self-healing
- Automated resource management

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Easy Database and WebLogic Mobility

Zones on Shared Storage

- Attach/detach of storage devices
- Zones framework automatically manages
- For SAN and iSCSI

Move zones around between systems quickly and easily

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Included with Every Oracle System

Complete Software Infrastructure at No Additional Charge

$0

SOLARIS SOFTWARE LICENSE COST

- Proven, Trusted Enterprise OS
- Server, Network and Storage virtualization
- Security and compliance tools
- Provisioning automation
- Unique integration with Oracle hardware and software
- Included with Premier Support at no additional charge

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Oracle DB 12c Optimized Shared Memory

- New Optimized Shared Memory interface (OSM)

- Works with Oracle DB Automatic Memory Management (AMM)

- Dynamic, NUMA- aware granule based shared memory

Bring Oracle Database instances up 2x faster

Dynamically resize your Database SGA online without a reboot

Oracle DB SGA
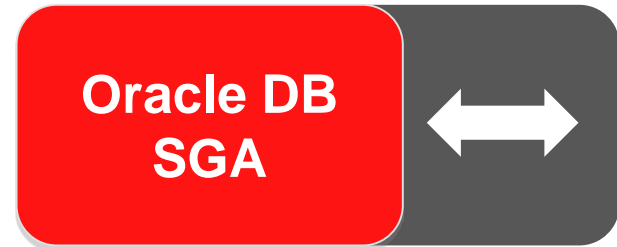
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Best OS for Oracle RAC
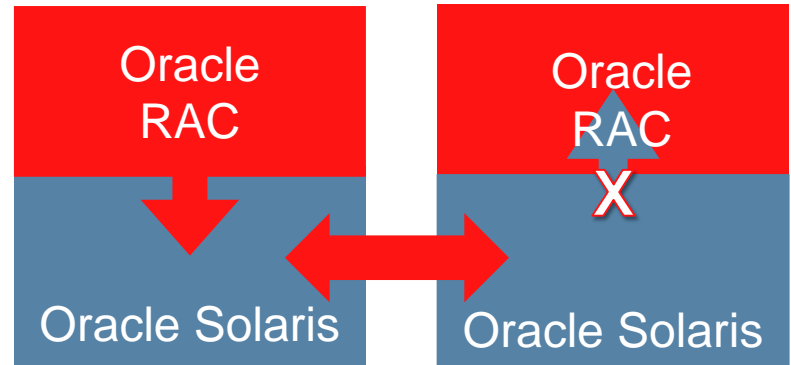
New with Oracle Solaris 11.1

- New Oracle Solaris/RAC Kernel Mode Acceleration
- Allows Oracle Solaris to respond directly to lock requests
- Saves lock state in memory shared by database and kernel

Consistent, predictable RAC performance

Oracle RAC	Oracle RAC X
Oracle Solaris	Oracle Solaris

30-40% lower latency lock grants

Up to 20% higher throughput

ORACLE

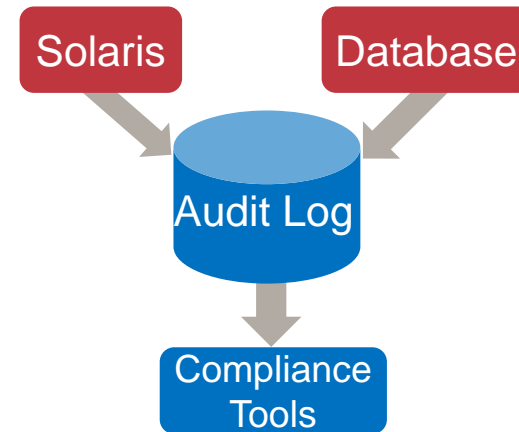# Centralized Audit Reporting and Alerts

Only Solaris

New with Solaris

- New collector in Oracle Audit Vault and Database Firewall

- Puts Solaris Audit logs in the same repository as the Database audit logs

Simplify compliance reporting for Solaris and Database

More easily detect and analyze security threats

Solaris

Database

Audit Log

Compliance Tools

Solaris Optimizations for Oracle RDBMS

The Tip of the Iceberg

Key: In Solaris 11   New in Solaris 11.1

CPU	Full MT-hot kernel, scales to 100s of cores and 10,000s of HW threads Support for Critical Threads features in T4 chip 5x performance improvement of high-resolution timer Multi-processing and multi-threading support for 12c
Memory	Large Page support Optimized Shared Memory (OSM) NUMA I/O Framework Fast DB Restart Latency-aware kernel memory allocator (x86, SPARC) Re-architecture of Virtual Memory sub-system Userland Fast-Memory Registration and Shared Protection Domain
File System	Userland file system for DB, Oracle File Server support
I/O	uDAPL, RDSv1, RDSv3, SDP: Support for low-latency Infiniband protocols Direct I/O with concurrent writes Exclusive-IP zone support for RDSv3 to support DBaaS Dynamic reconfiguration for IB HCAs

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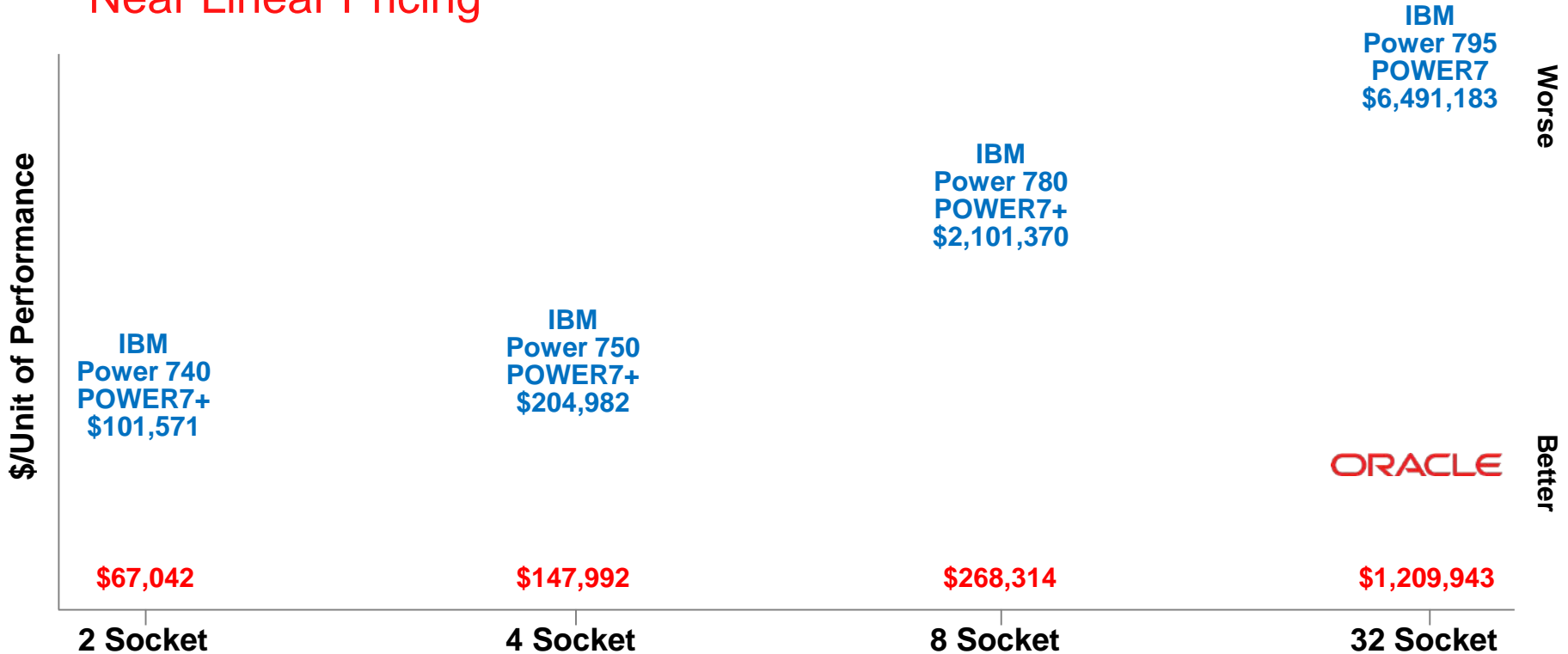# More Solaris Optimizations for Oracle RDBMS

The Tip of the Iceberg

Key: In Solaris 11   New in Solaris 11.1

Observability	Enhanced observability for segmentation faults Read-out of libdtrace by Oracle 12c
Reliability and Availability	Dynamic reconfiguration notifications for DB for resources rebalancing FMA callback for bad hardware
Performance	Improved PGA performance Kernel lock acceleration for Oracle RAC Message Passing Co-processor Remote Memory Access (RMA)
Multi-tenancy	Zones: Secure isolation, lowest latency virtualization
Security	Transparent crypto off-load

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Historical Economics of SMP

Near Linear Pricing

IBM
Power 795
POWER7
$6,491,183

IBM
Power 780
POWER7+
$2,101,370

IBM
Power 750
POWER7+
$204,982

IBM
Power 740
POWER7+
$101,571

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$/Unit of Performance

Worse

Better

$67,042 $147,992 $268,314 $1,209,943

2 Socket   **4 Socket**   **8 Socket**   **32 Socket**

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Conclusion: SPARC & Oracle Solaris

- Oracle #1 in real-world performance
  - Deep integration with Database, WebLogic – Oracle runs Oracle best
  - SPARC T5 performs best on complex workloads because of design
    - blogs.oracle.com/bestperf - benchmarks/best practices details
    - www.oracle.com/benchmarks

- SPARC/Solaris has best consolidation ratios
  - Zero-waste virtualization overhead reduces complexity and lowers TCO
  - Dynamically change resources on-the-fly with Dynamic Reconfiguration
  - Oracle's better consolidation ratios mean lower energy bills and less SW licenses

- Oracle Solaris: unmatched reliability, security & scalability
  - Oracle Solaris has Near-linear speedup even on complex workloads
  - Unique features: ZFS, Zones, DTrace, Predictive self-healing, RAS

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Oracle Solaris

▪ Best for Oracle

- Co-engineered with Oracle
- Full-stack observability
- Zero-downtime DB resizing
- Oracle RAC lock offload

▪ Lifecycle Management

- Automated install
- Instant rollbacks leveraging ZFS

▪ Built-in Virtualization

- Zero performance overhead
- Compute, network, storage
- Immutable zones

▪ Fault Management

- Automatic service restart
- Predictive self-healing

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SOLARIS

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Oracle Software Runs Best on Oracle Hardware

ORACLE

Hardware and Software

ORACLE®

Engineered to Work Together

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- TPC Benchmark C, tpmC, and TPC-C are trademarks of the Transaction Processing Performance Council (TPC). SPARC T5-8 (8/128/1024) with Oracle Database 11g Release 2 Enterprise Edition with Partitioning, 8,552,523 tpmC, $0.55 USD/tpmC, available 9/25/2013, New Order 90th% Response Time 0.410sec. IBM Power 780 Cluster (24/192/768) with DB2 ESE 9.7, 10,366,254 tpmC, $1.38 USD/tpmC, available 10/13/2010, New Order 90th% Response Time 2.10 sec. IBM x3850 X5 (4/40/80) with DB2 ESE 9.7, 3,014,684 tpmC, $0.59 USD/tpmC, available 7/11/2011. IBM x3850 X5 (4/32/64) with DB2 ESE 9.7, 2,308,099 tpmC, $0.60 USD/tpmC, available 5/20/2011. IBM Flex x240 (2/16/32) with DB2 ESE 9.7, 1,503,544 tpmC, $0.53 USD/tpmC, available 8/16/2012. IBM Power 780 (2/8/32) with IBM DB2 9.5, 1,200,011 tpmC, $0.69 USD/tpmC, available 10/13/2010. Source: http://www.tpc.org/tpcc, results as of 3/26/2013.
- SPEC and the benchmark name SPECjEnterprise are registered trademarks of the Standard Performance Evaluation Corporation. Results from www.spec.org as of 3/26/2013. SPARC T5-8, 57,422.17 SPECjEnterprise2010 EjOPS; SPARC T4-4, 40,104.86 SPECjEnterprise2010 EjOPS; Sun Server X2-8, 27,150.05 SPECjEnterprise2010 EjOPS; Cisco UCS B440 M2, 26,118.67 SPECjEnterprise2010 EjOPS; IBM Power 780, 16,646.34 SPECjEnterprise2010 EjOPS. IBM PowerLinux 7R2, 13,161.07 SPECjEnterprise2010 EjOPS. Sun Server X4-2, 11,259.88 SPECjEnterprise2010 EjOPS. SPARC T5-8 (SPARC T5-8 Server base package, 8xSPARC T5 16-core processors, 128x16GB-1066 DIMMS, 2x600GB 10K RPM 2.5. SAS-2 HDD, 4x Power Cables) List Price $268,742. IBM Power 780 (IBM Power 780:9179 Model MHB, 8x3.86GHz 16-core, 64x one processor activation, 4xCEC Enclosure with IBM Bezel, I/O Backplane and System Midplane,16x 0/32GB DDR3 Memory (4x8GB) DIMMS-1066MHz Power7 CoD Memory, 12x Activation of 1 GB DDR3 Power7 Memory, 5x Activation of 100GB DDR3 Power7 Memory, 1x Disk/Media Backplane. 2x 146.8GB SAS 15K RPM 2.5. HDD (AIX/Linux only), 4x AC Power Supply 1725W) List Price $992,023. Source: Oracle.com and IBM.com, collected 03/18/2013. SPEC and the benchmark name SPECjEnterprise are registered trademarks of the Standard Performance Evaluation Corporation. Results from www.spec.org as of 5/1/2013. SPARC T5-8, 27,843.57 SPECjEnterprise2010 EjOPS; IBM Power 780, 10,902.30 SPECjEnterprise2010 EjOPS. Oracle server(4 app: 4db) only hardware list price is $298,494, and total hardware plus software list price is $1,565,092. Oracle server(5 app: 3db) only hardware list price is $304,914, and total hardware plus software list price is $1,487,792. http://www.oracle.com as of 9/20/2013. IBM server only HW list price is $803,613 and HW+SW cost of $1,943,162.00 and IBM PowerLinux 7R2 server total hardware plus software cost of $819,451.00 based on public pricing from http://www.ibm.com as of 9/20/2013.
- SPEC and the benchmark name SPECjbb are registered trademarks of Standard Performance Evaluation Corporation (SPEC). Results from www.spec.org as of 9/22/2013 unless cited below. SPARC T5-2 81,084 SPECjbb2013-MultiJVM max-jOPS, 39,129 SPECjbb2013-MultiJVM critical-jOPS; Sun Server X2-4 65,211 SPECjbb2013-MultiJVM max-jOPS, 22,057 SPECjbb2013-MultiJVM critical-jOPS; Cisco UCS B200 M3 62,393 SPECjbb2013-MultiJVM max-jOPS, 23,505 SPECjbb2013-MultiJVM critical-jOPS, result from www.cisco.com/en/US/prod/collateral/ps10265/le_41704_pb_specjbb2013b200.pdf; Sun Server X4-2 52,664 SPECjbb2013-MultiJVM max-jOPS, 20,553 SPECjbb2013-MultiJVM critical-jOPS, result from www.oracle.com/benchmarks; Sun Server X3-2 41,954 SPECjbb2013-MultiJVM max-jOPS, 13,305 SPECjbb2013-MultiJVM critical-jOPS; HP ProLiant DL560p Gen8 66,007 SPECjbb2013-MultiJVM max-jOPS, 16,577 SPECjbb2013-MultiJVM critical-jOPS; HP ProLiant ML350p Gen8 40,047 SPECjbb2013-MultiJVM max-jOPS, 12,308 SPECjbb2013-MultiJVM critical-jOPS.

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Required Benchmark Disclosure Statement
Must be in SPARC T5 & M6 Presos with Benchmark Results (2 of 2)

- Two-tier SAP Sales and Distribution (SD) Standard Application benchmarks SAP Enhancement package 5 for SAP ERP 6.0 as of 3/26/13:SPARC M5-32 (32 processors, 192 cores, 1536 threads) 85,050 SAP SD users, 32 x 3.6 GHz SPARC M5, 4 TB memory, Oracle Database 11*g*, Oracle Solaris 11, Cert# 2013009.   SPARC T5-8 (8 processors, 128 cores, 1024 threads) 40,000 SAP SD users, 8 x 3.6 GHz SPARC T5, 2 TB memory, Oracle Database 11g, Oracle Solaris 11, Cert# 2013008. IBM Power 760 (8 processors, 48 cores, 192 threads) 25,488 SAP SD users, 8 x 3.41 GHz IBM POWER7+, 1024 GB memory, DB2 10, AIX 7.1, Cert#2013004. Two-tier SAP Sales and Distribution (SD) Standard Application benchmarks SAP Enhancement package 4 for SAP ERP 6.0 as of 4/30/12:IBM Power 795 (32 processors, 256 cores, 1024 threads) 126,063 SAP SD users, 32 x 4 GHz IBM POWER7, 4 TB memory, DB2 9.7, AIX7.1, Cert#2010046. SPARC Enterprise Server M9000 (64 processors, 256 cores, 512 threads) 32,000 SAP SD users, 64 x 2.88 GHz SPARC64 VII, 1152 GB memory, Oracle Database 10g, Oracle Solaris 10, Cert# 2009046. SAP, R/3, reg TM of SAP AG in Germany and other countries. More info www.sap.com/benchmark
- SPEC & benchmark names SPECfp, SPECint are registered trademarks of the Standard Performance Evaluation Corporation. Results as of March 26, 2013 from www.spec.org and this report. SPARC T5-8: 3750 SPECint_rate2006, 3490 SPECint_rate_base2006, 3020 SPECfp_rate2006, 2770 SPECfp_rate_base2006; SPARC T5-1B: 489 SPECint_rate2006, 441 SPECint_rate_base2006, 369 SPECfp_rate2006, 350 SPECfp_rate_base2006. IBM Power 780 8-chip 3.92GHz: 2640 SPECint_rate2006. IBM Power 710 Express 1-chip 3.556GHz: 289 SPECint_rate2006.
- TPC Benchmark, TPC-H, QphH, QthH, QppH are trademarks of the Transaction Processing Performance Council (TPC). Results as of 6/7/13, prices are in USD. SPARC T5-4 www.tpc.org/3288; SPARC T4-4 www.tpc.org/3278; SPARC Enterprise M9000 www.tpc.org/3262; SPARC Enterprise M9000 www.tpc.org/3258; IBM Power 780 www.tpc.org/3277; HP ProLiant DL980 www.tpc.org/3285.
- SPC Results as of September 10, 2013, for more information go to http://www.storageperformance.org/results SPC-2. Results for Oracle ZFS Storage ZS3-4 are 17,244.22 SPC-2 MBPS™, $22.53 SPC-2 Price-Performance. Full results at http://www.storageperformance.org/results/benchmark_results_spc2#b00067. Results for IBM DS8870 are 15,423.66 SPC-2 MBPS, $131.21 SPC-2 Price-Performance. Full results at http://www.storageperformance.org/results/benchmark_results_spc2#b00062. Results for HP P9500 XP Disk Array are 13,147.87 SPC-2 MBPS, $88.34 SPC-2 Price-Performance. Full results at http://www.storageperformance.org/results/benchmark_results_spc2#b00056.
- SPEC SFS SPEC & benchmark names SPECfp, SPECint are registered trademarks of the Standard Performance Evaluation Corporation. Results as of September 10, 2013, for more information see www.spec.org. For details on performance and price comparisons see http://www.oracle.com/us/solutions/performance-scalability/sun-storage-gateway-160373.html

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