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CLOUD

ORACLE CLOUDWORLD

Accelerate Innovation

Innovation to grow.
Insight to control.

A Revolution in Compute Infrastructure for the Cloud

Marshall Choy
Vice President, Oracle Systems

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Operated by Engineering

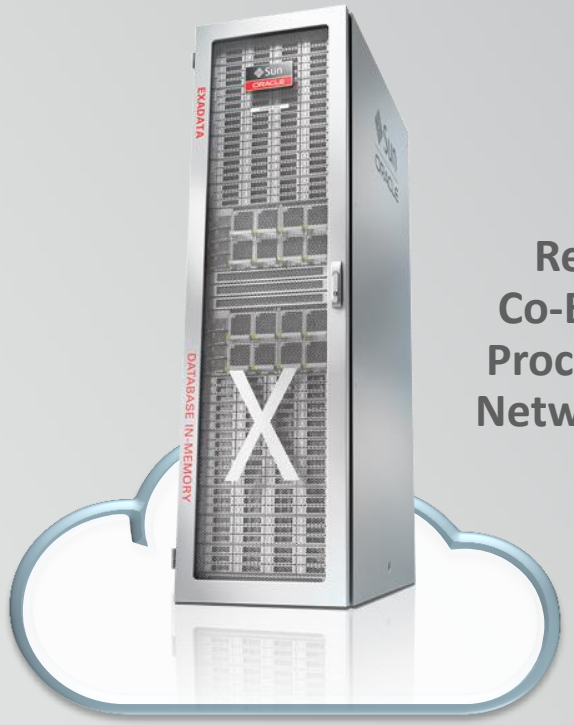
Horizontal Integration & Compromise No Longer The Only Way

Legacy Implementation

I.T. Integrates Disparate Components On-Premises

Modern Strategy

Engineered Complete Systems, Cloud, and Cloud@Customer



Revolutionary Co-Engineering of Processor, Storage, Networking, and OS

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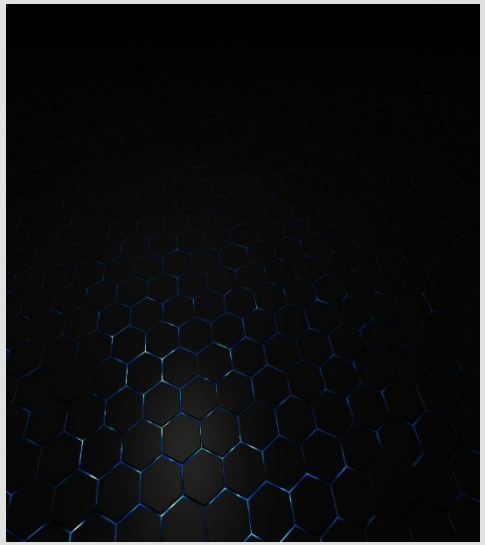

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SPARC M7
©2013, Oracle®
72GZL6C SERXXX
PG 1.0.0
140AEZ1114564
TWN
4500 -32 A00
7080074
1021

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Does Performance Matter to You?

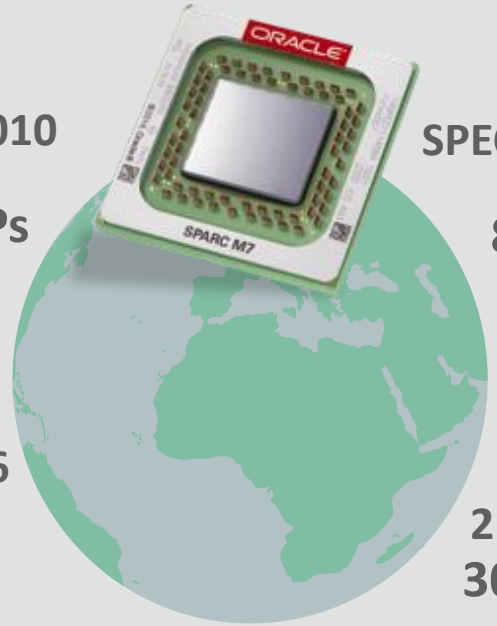
Hint: Better Performance = Better Price/Performance

SPARC **Transformational** Performance and Scale

SPARC M7 is the World's Fastest Conventional Microprocessor

#1
SPECjEnterprise2010
1-chip
25,093.06 EjOPs

#1
SPECfp_rate2006
1-chip
832 peak



#1
SPECint_rate2006
1-chip
1,200 peak

#1
SAP-SD
2 processor
30,800 SAPs

And more…

Software in Silicon Adds Revolutionary HW/SW Co-Engineering

Software in Silicon:
Software Functions on Chip

(See Disclosure Slide)

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Co-engineering Database, OS and Processor

Substantial improvements over Oracle Database 12.1

- **2X Faster transaction processing** by reduction in log file latency
- **14% More efficient multi-instance resource management** with instance synchronization
- **11% Faster analytics** from compiler optimizations
- **10% Better backup efficiency** with *IMC capacity high, hybrid columnar, RMAN*
- **In-memory optimizations** extended to additional functions
- **1.6x faster TDE security on SPARC than x86**
- **Silicon Secured Memory**: SGA buffer cache, redo cache and entire PGA

Faster Analytics – Faster OLTP – More Efficient – More Secure

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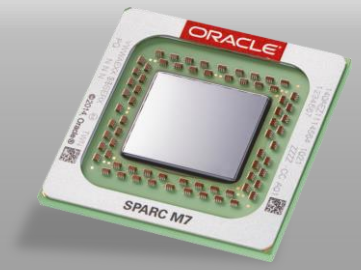
SPARC DAX + Database 12*c* In-Memory Performance

Speed Increases with Diversity of Data

SPARC M7

Solaris

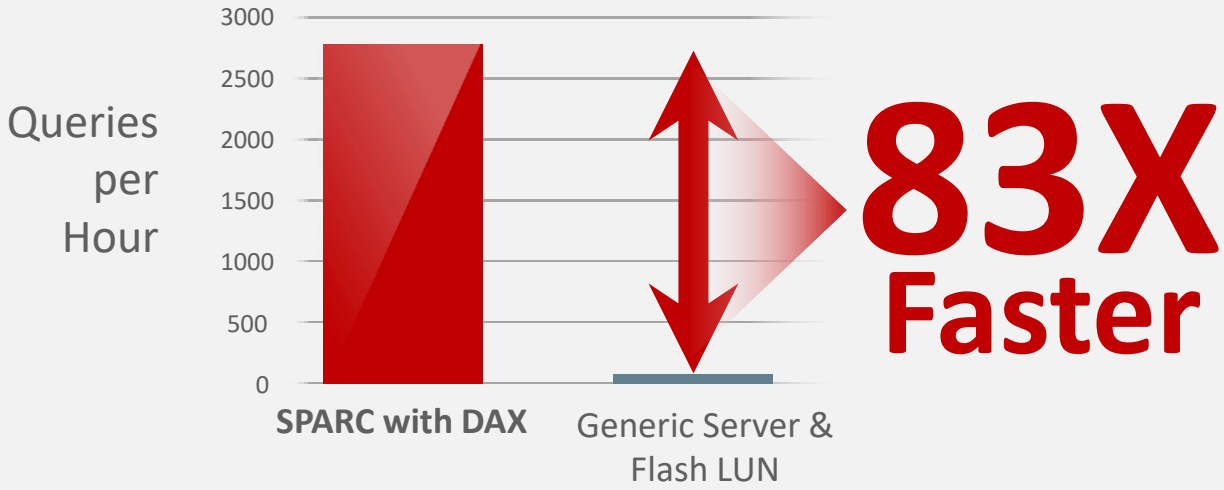
Database 12c



Product catalog of major on-line retailer with large number of parts

Query: *"How many unique products in stock?"*

Single Query Execution with DOP=32



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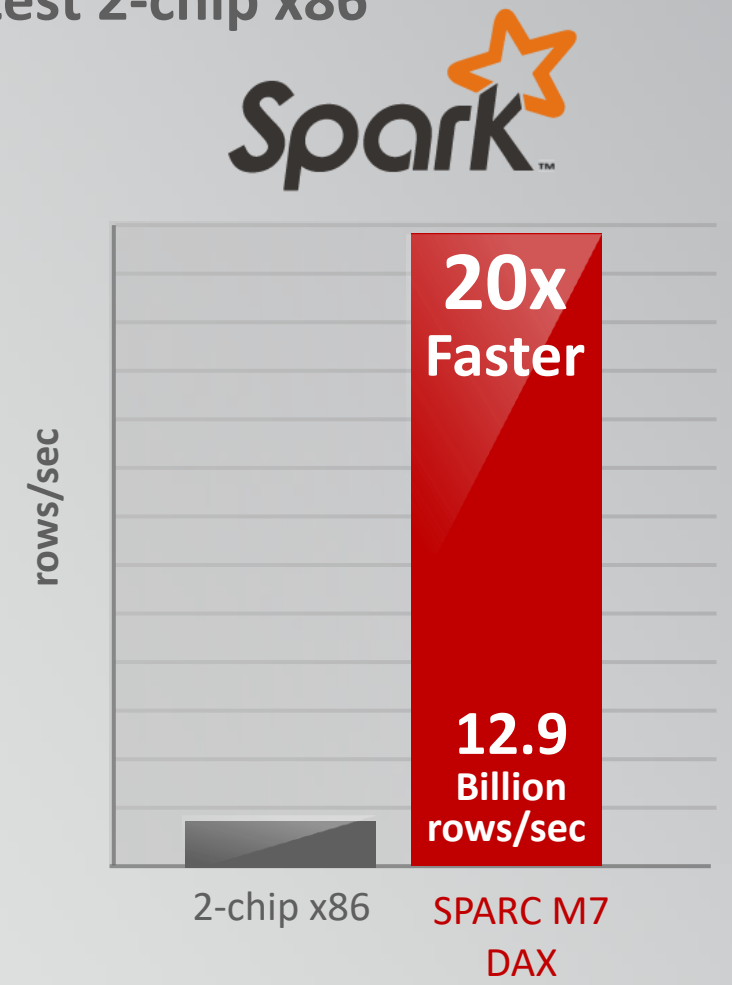
Preview: Accelerating Apache Spark In-Memory Columnar

Open DAX with Apache Spark SQL Over 20x Faster Than Latest 2-chip x86

- SPARC DAX offloads critical functions
  - SQL: filtering, dictionary encoding, 1 & 2 predicate, join processing, additional compression, etc.
  - 1-chip SPARC M7 DAX: **12.9 Billion rows/sec** 2-predicate scan
  - 20X faster than 2 of the latest 20-core x86



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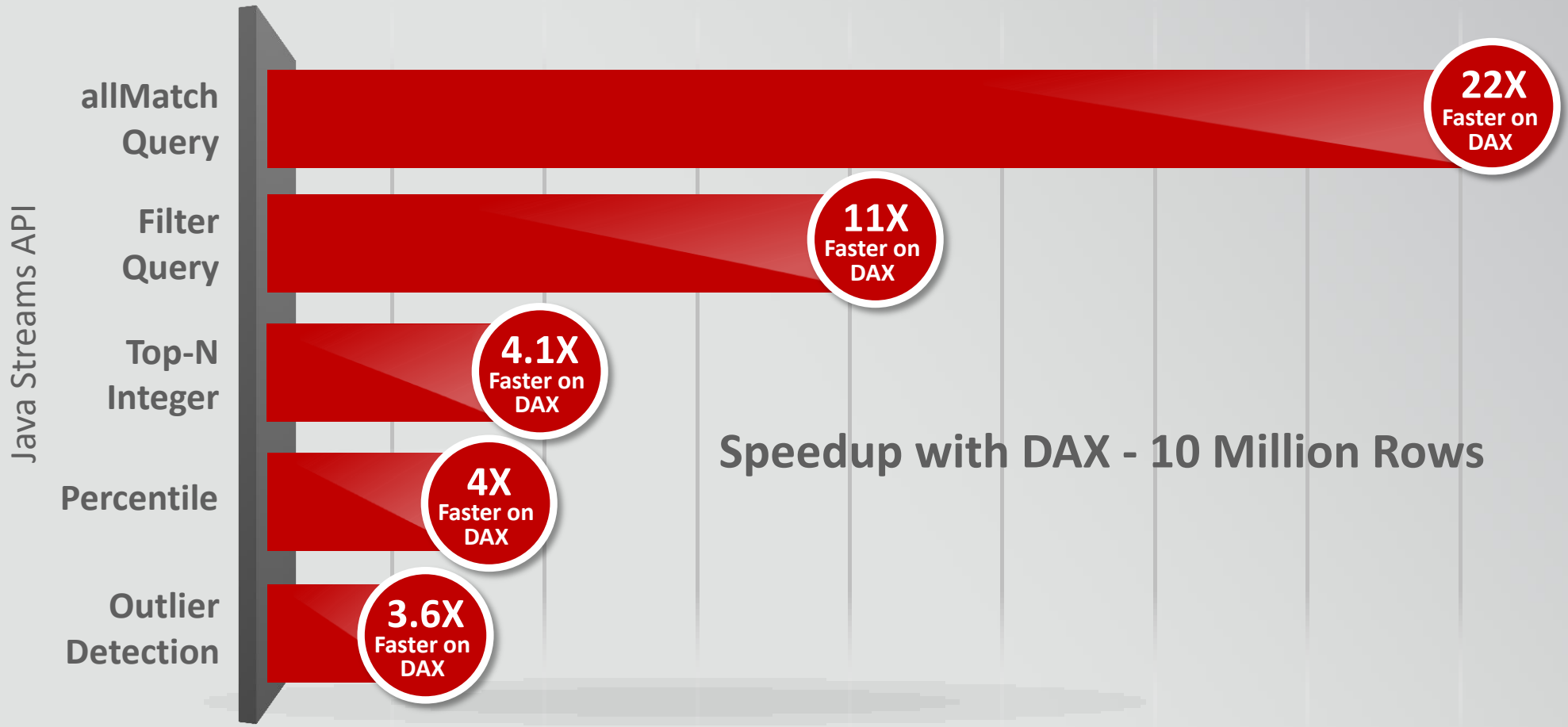
Preview: JDK 8 Streams Integration with DAX

Accelerating Java Analytics Application Performance



Use cases: SQL style Java, Eg: weather analysis, TopN integer, outlier detection, Cube building, KNN algorithm

Exadata & SuperCluster Deliver **Transformational** System Performance for All Database Workloads

- Fastest and Most Cost-Effective Hardware
  - **Best Compute:** Scale-out Database and Storage Servers
  - **Best Network:** Ultra-Fast Unified InfiniBand Fabric
  - **Best Storage:** Fastest PCIe Flash, Largest Helium Disks
- Unique Database Optimizations Across Entire System:
  - **Fastest Analytics:** Offload DB queries to storage
  - **Fastest OLTP:** Special InfiniBand and PCIe flash algorithms
  - **Most Cost Effective:** 10X Hybrid Col Compression, Best Consolidation

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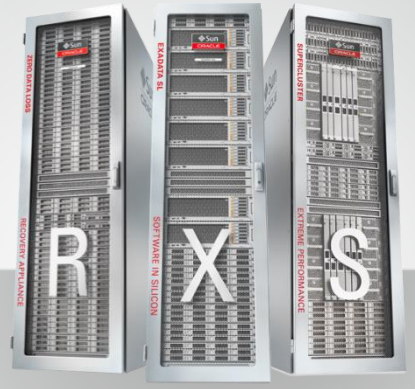
Engineered Systems: A Proven Global Standard



4 of the 5 Top Banks, Telcos, and Retailers Run on Engineered Systems

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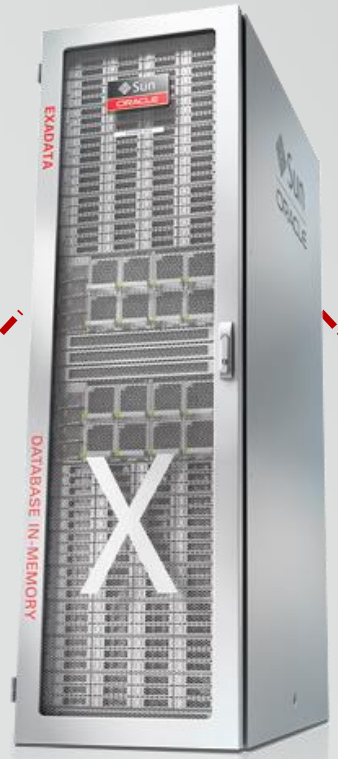
Exadata X6 Delivers Breakthrough DB IO Performance

301 GB/sec Analytic Throughput

12x Faster Analytics Scans Than All Flash EMC XtremIO

5.6 Million 8K OLTP Read IOPS



5.2 Million 8K OLTP Write IOPS

250 us IO Latency at 2.4 Million IOPS

2.5x Faster OLTP Write IOPS Than All Flash EMC XtremIO

Scales higher as racks are added

Performance of 1 Exadata Rack with 10 DB servers and 12 Extreme Flash storage servers

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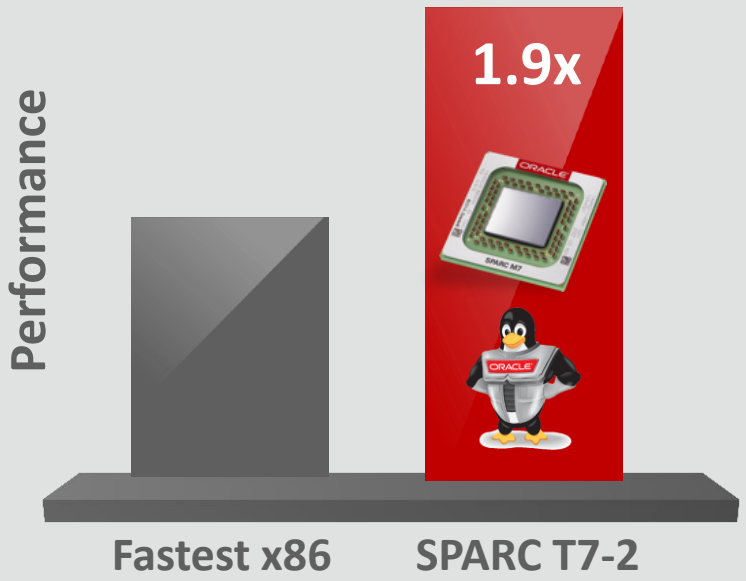
Preview: Exadata SL - SPARC Linux

Brings Transformational SPARC Software in Silicon to Exadata Database Machine

Exadata x86 Database Servers Upgraded to Ultra-fast SPARC T7-2 Servers



Best of All Worlds

Fastest Processors
32 Core SPARC M7

Fastest Network
InfiniBand

Fastest Storage
Exadata

Most Secure
Security in Silicon

Fastest Analytics
SQL in Silicon

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Does Cost Matter to You?

Hint: Better Performance Also Equals Lower Cost

Expanding M7 Software in Silicon to Low Cost Systems

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SPARC S7 Delivers **Transformational** Cost, No Compromises

Lower Cost Than Commodity x86

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Java

Better Performance/Core Than Latest x86

- 1.6x Faster Database
- 1.7x Faster Java
- 10x Faster Analytics

Well Configured Systems Under **$10,000**

Software in Silicon

- Security in Silicon
- SQL in Silicon
- Capacity in Silicon

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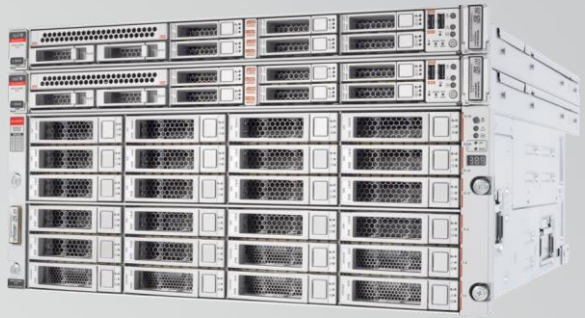
Low Entry Cost Engineered Systems Extend the Portfolio

NEW Database Appliance X6-2S

- Small or departmental workloads
- Starts at $18,000

NEW MiniCluster S7-2



ORACLE SPARC

- Maximum security with minimal effort
- No special training or OS skills required
- Much better performance than DIY x86

Automated Administration Designed for DBA's and Developers

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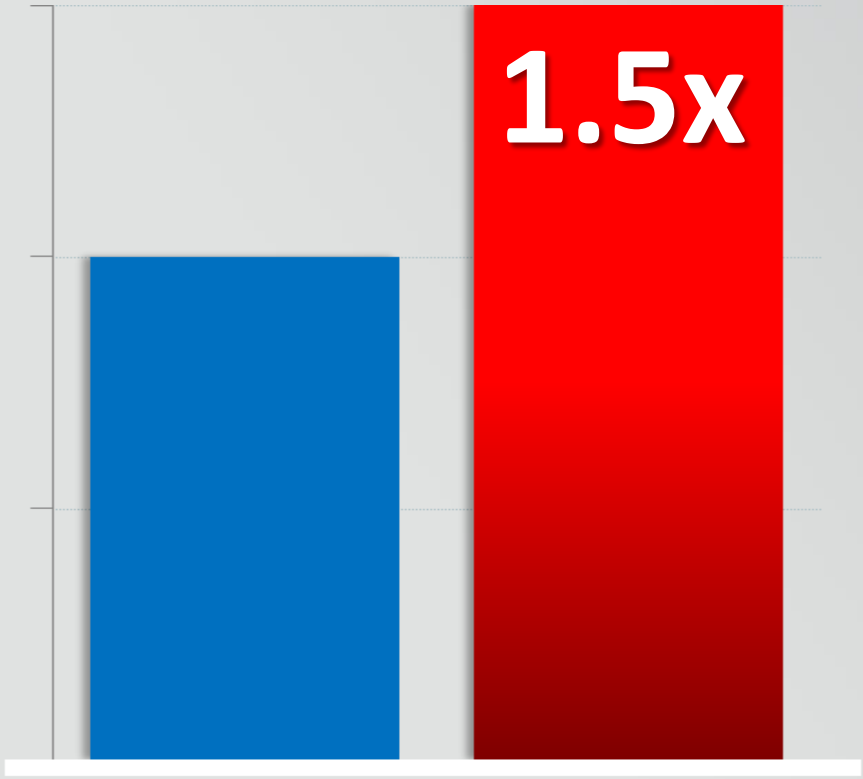
Do More Work With Less Software and Less Hardware

Baseline assumption for predicting real-world application performance per-core

Intel Xeon E5 v4



Baseline per-core Performance

SPARC S7

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MiniCluster Dramatically Lowers Cost and Complexity

ORACLE MINICLUSTER

MiniCluster S7-2

$ 129,000		$ 220,000
Yes	From box to production in 1 day	No
Yes	Push-button lifecycle management	No
Yes	Highest per-core performance	No
Yes	Factory tested HA configuration	No
Yes	End-to-end automated security	No
Yes	**Software in Silicon**	No

Hewlett Packard Enterprise

HPE DL 360 Gen 9 + HPE 3PAR 8200

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Cloud 2016 IaaS: Gen2 Lower Cost and Faster than AWS

Metric	Oracle Cloud Dense IO Shape	Amazon Cloud I2 8X Large	Oracle Advantage
Cores	36	16	2.25X
D-RAM	512 GB	244 GB	2X
SSD Storage	28.8 TB	6.4 TB	4.5X Capacity 11.5X IOPs
Price	$5.40 Per Hour	$6.82 Per Hour	1.2X

Pay 20% Less – 11.5 Times Faster than Amazon's Fastest

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Does Security Matter to You?

Hint: It Matters a Lot to Your Customers

Secure to the Core, From Chip to Cloud

Information Protection

Access Control

Compliance & Reporting

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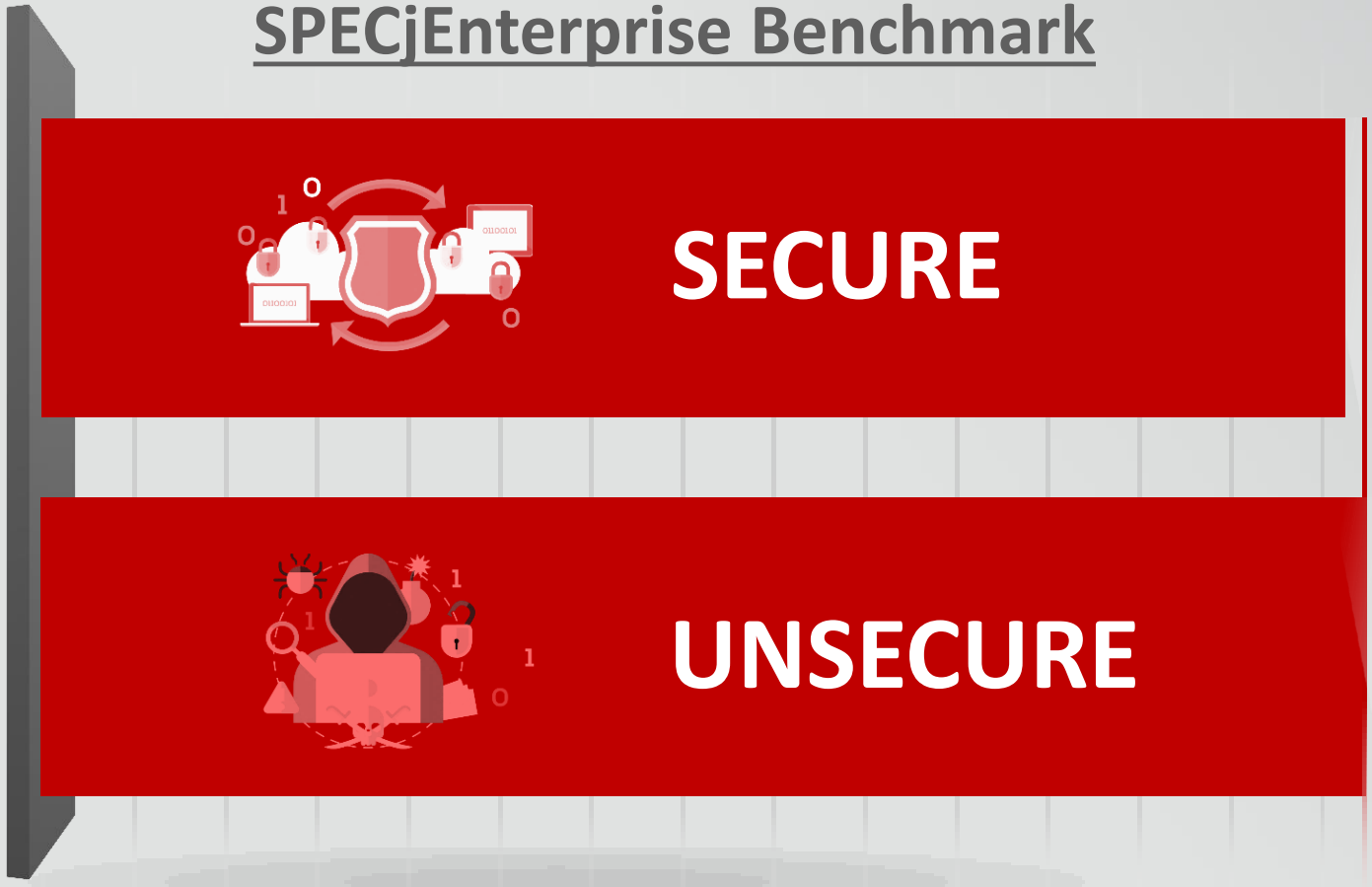
SPARC Enables **Transformational** Encryption by Default for Database, Application, & Web Tiers

SPECjEnterprise Benchmark



Only 2%
Overhead with Oracle SPARC

SPECjEnterprise2010 (see disclosure slide)

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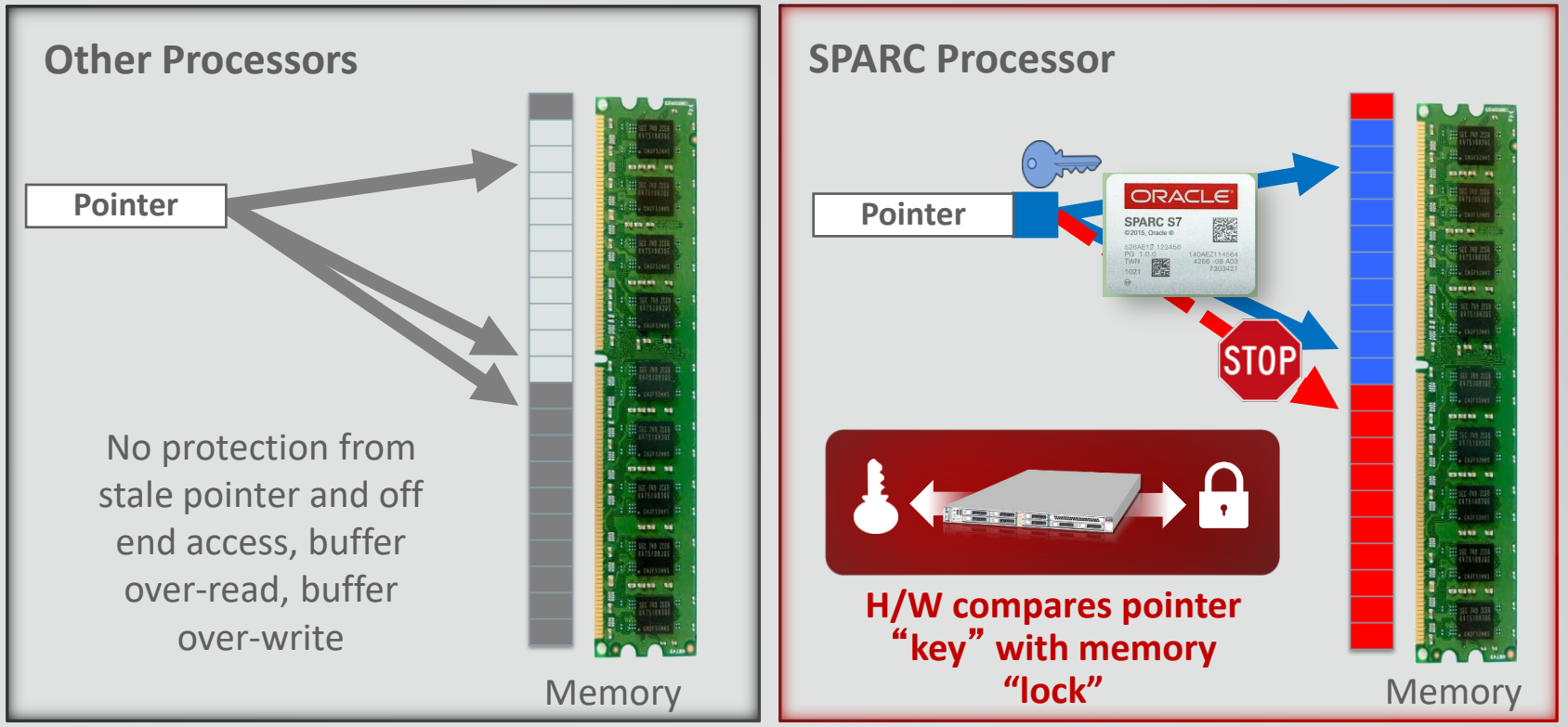
SPARC Delivers **Transformational** Security and Reliability

Age Old Problems of Buffer Overflow and Memory Corruption Now Solved



In-Memory Databases REDUCE SECURITY unless Memory Protection is Enforced by CPU

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Engineered Systems **Transformational** Full-Stack Security

- Oracle owns all component and **cross component** security
- Identical configurations for all customers
- Validated by thousands of audits at security sensitive organizations
  - Banks, Governments, Telecoms, Retailers, etc.

- FIPS 140-2 certification
- PCI-DSS compliant
- Encryption via hardware
- Linux and Solaris minimal distribution
- Secure erase
- System lockdown
- Live kernel patching

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MiniCluster: Secure by Default, No Training Required

A Vast Array of Unique and Standard Security Technologies Under One Master Control

250+ Integrated Security Controls

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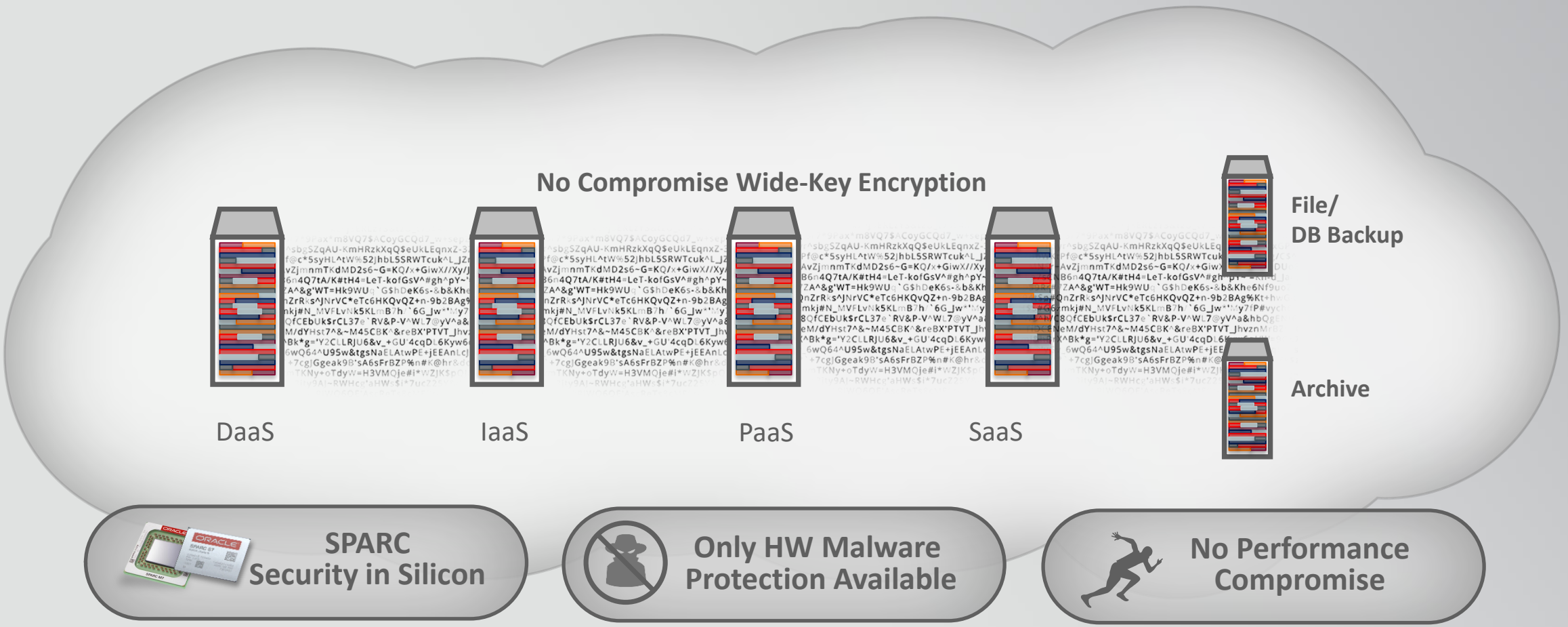
The High Performance Fully Encrypted Secure Cloud



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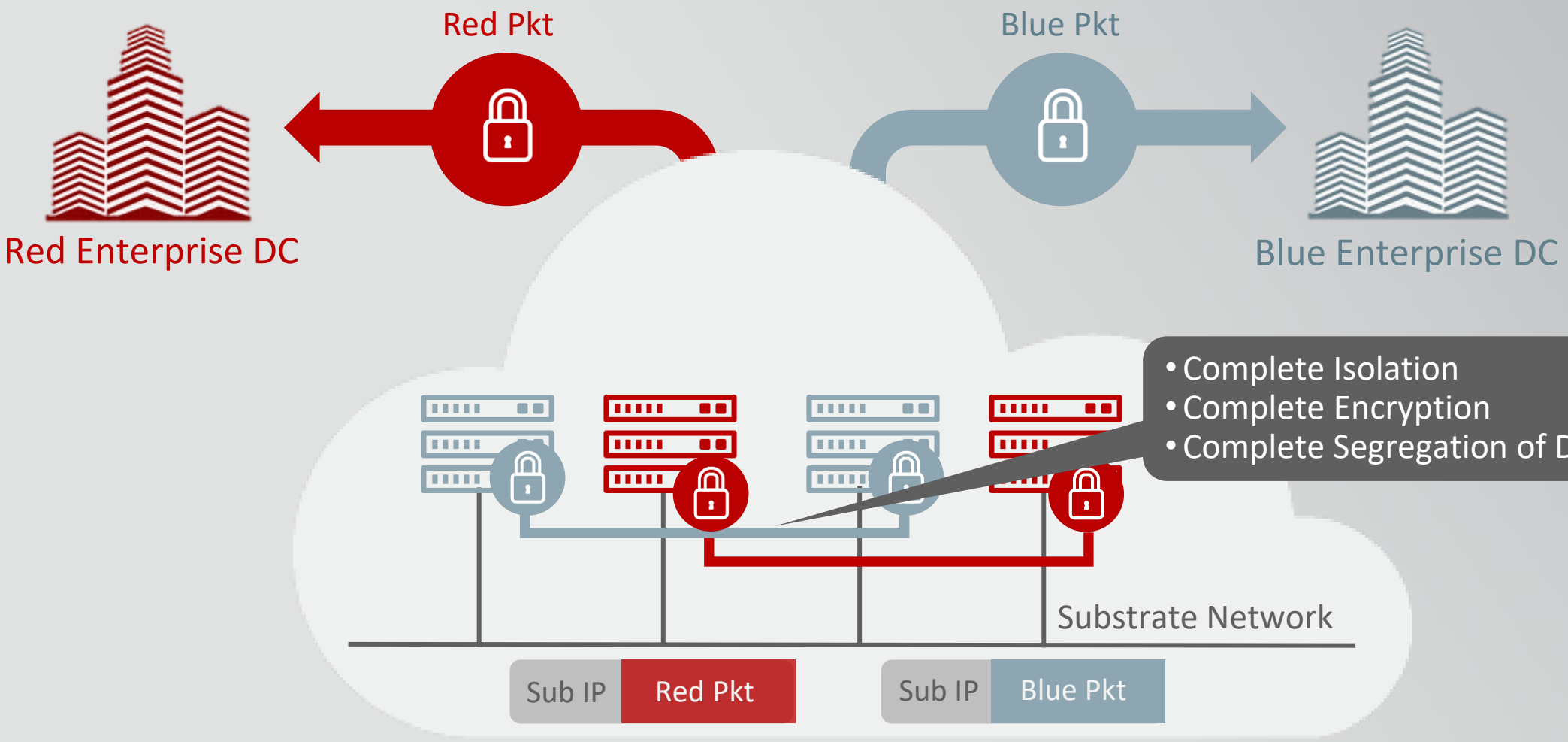
Oracle Cloud: Security Defense in Depth



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Does Availability Matter to You?

Hint: Think Brand Reputation, not Just Revenue

Transformational Full System Availability with Oracle

IDC

"Exadata and SuperCluster both achieve AL4 fault tolerance in a Maximum Availability Architecture configuration"

Only other AL4 Systems

- IBM - z Systems
- HPE - Integrity NonStop & Superdome
- Fujitsu – GS & BS2000
- NEC – FT Server/320 Series
- Stratus ftServer & V Series
- Unisys – Dorado

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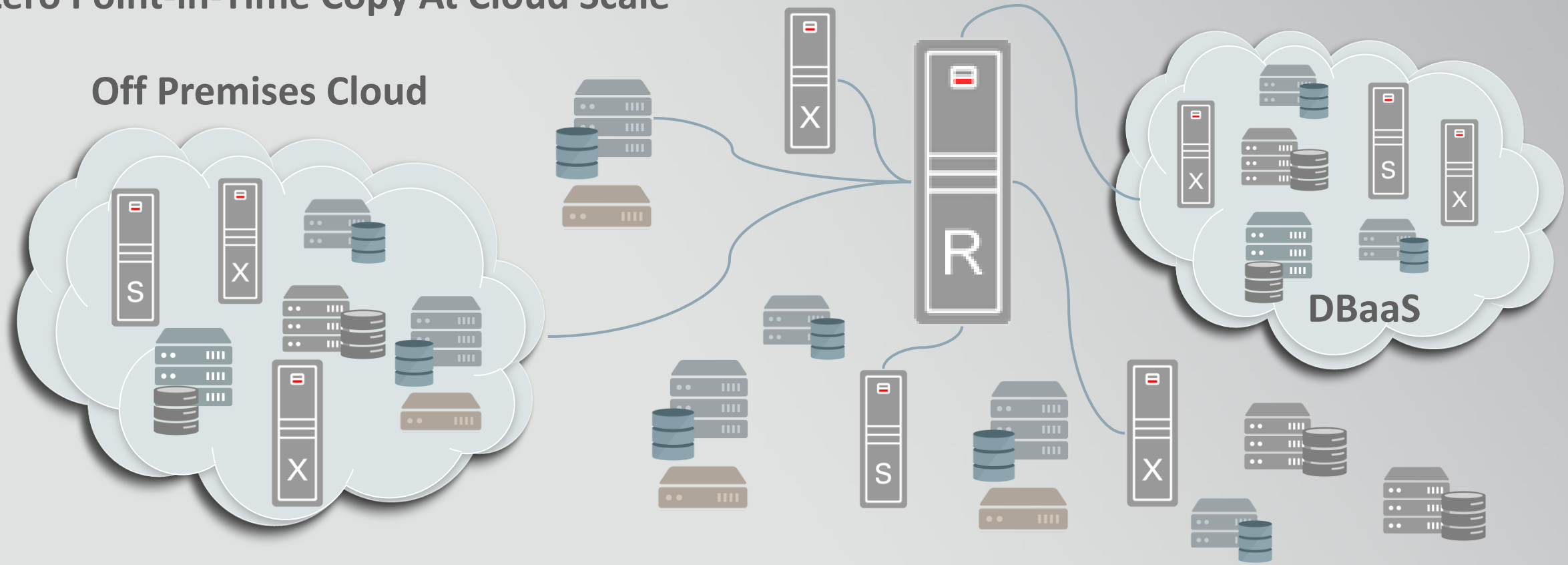
Transformational Scale-out Database Protection as a Service

Zero Point-in-Time Copy At Cloud Scale



Single System Scales to Protect All Databases in the Data Center

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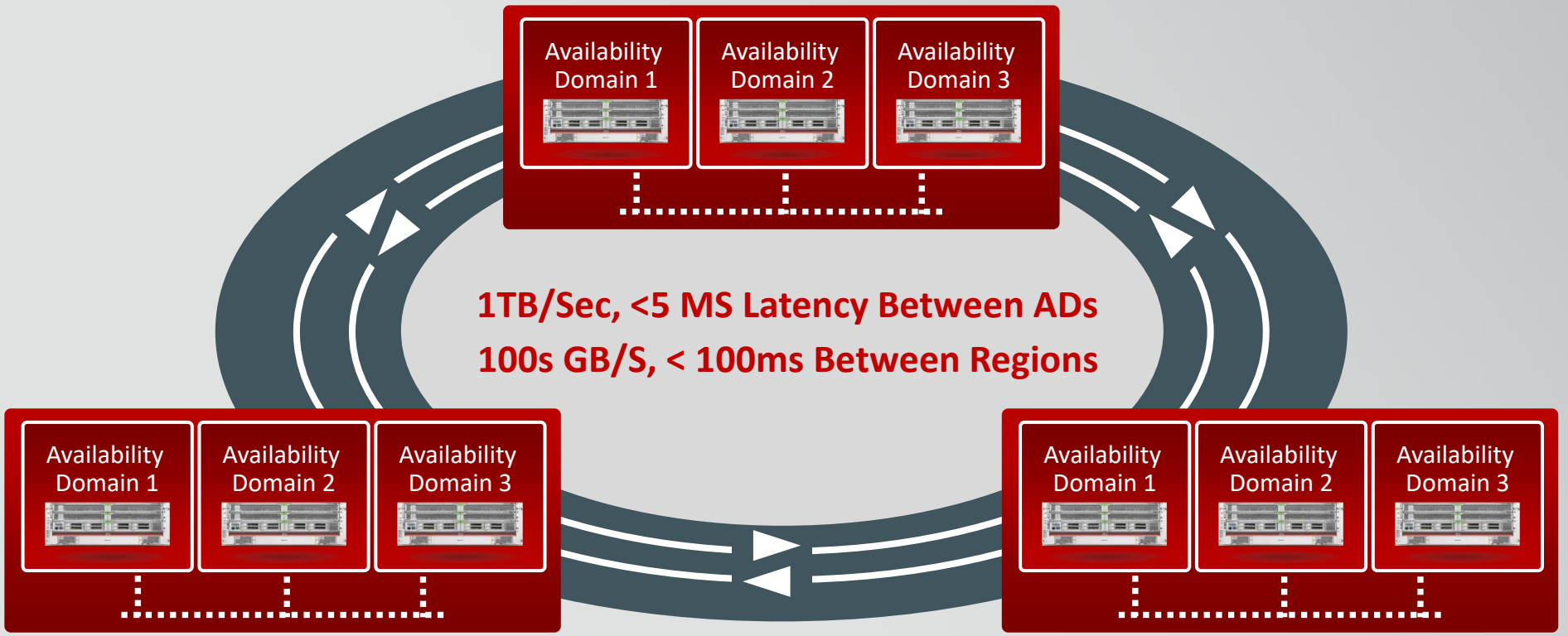
Oracle Cloud: Availability Domains For Always On Services

Low Latency High Bandwidth Access and Catastrophic Disaster Recovery



Low Latency and High Bandwidth Network Between Regions

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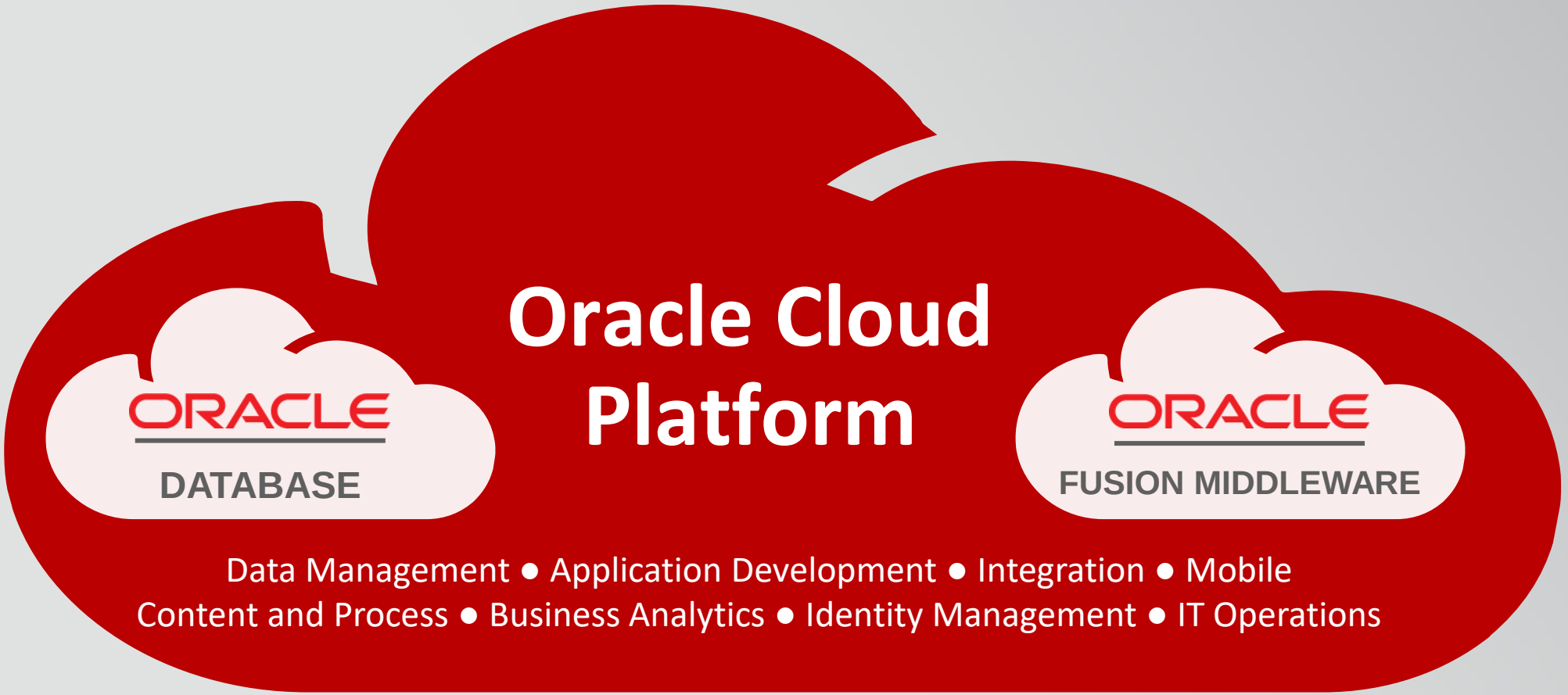
Does Cloud Matter to You?

Hint: It is the Future of I.T.

Oracle Cloud Platform

Based on #1 Database and #1 Java Middleware



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Complete SaaS Suites – Enterprise SW For Anyone

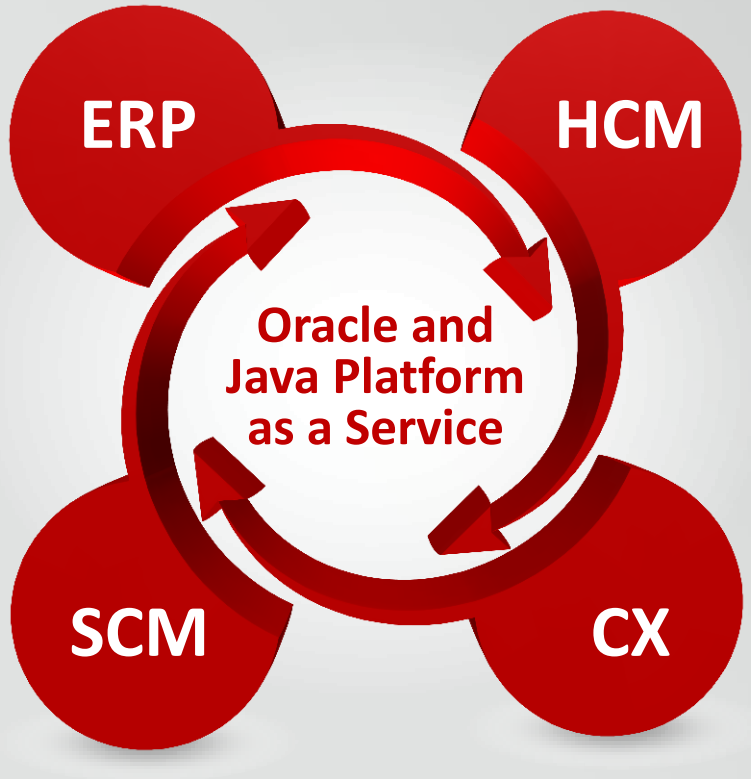
More SaaS Applications Than Any Other Cloud Services Provider…Adding More

Enterprise Resource Planning

- Planning & Budgeting
- Financial Management
- Financial Consolidation
- Financial Analytics & Reporting
- Procurement
- Sourcing
- Project & Portfolio Management
- Governance Risk & Compliance

Supply Chain Management

- Sourcing
- Procurement
- Product Lifecycle Management
- Product Master
- Planning
- Manufacturing
- Order Management
- Logistics



Human Capital Management

- Global HR
- Workforce Rewards & Payroll
- Workforce Management
- Workforce Optimization
- Recruiting & On-Boarding
- Talent Management
- Goals & Succession
- Learning & Development

Customer Experience SaaS

- Content Prep & Personalization
- Multi-Channel Marketing
- Social, Communities, & Data Mgmt
- Sales Force Automation
- Commerce
- Configure Price Quote
- Customer Service
- Field Service

1,000+ Customers Use Multiple Suites

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Transformational Technologies – Where YOU Want Them

On-Premises
Traditional Infrastructure

- Customer Data Center
- Purchased
- Customer Managed

Cloud@Customer
Cloud Machines

- Customer Data Center
- Subscription
- Oracle Managed

Public Cloud
IaaS, SaaS, PaaS

- Oracle Cloud
- Subscription
- Oracle Managed

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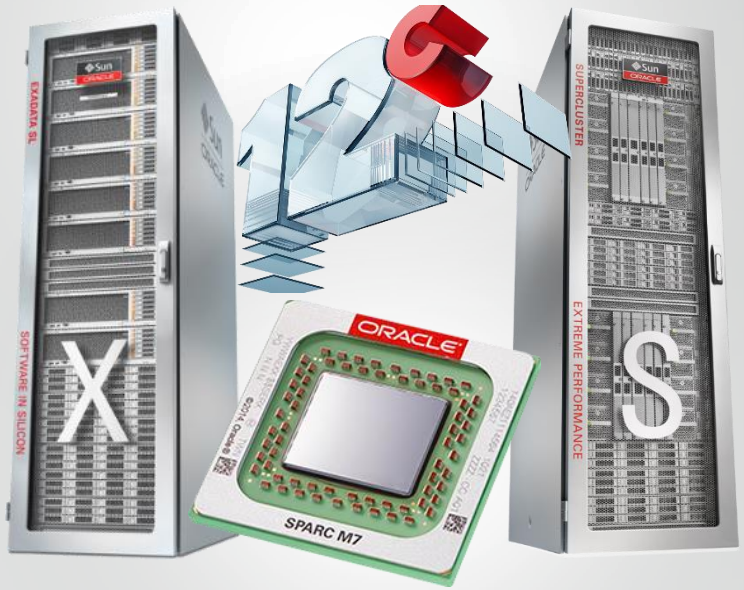
Conclusion

- Oracle is Revolutionizing …
  - Performance
  - Cost
  - Security
  - Availability
  - Cloud



- With Transformational
  - Software Technology
  - Processor Technology
  - System Technology

Leaps and Bounds Ahead of ALL Alternatives

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Integrated Cloud

Applications & Platform Services

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Required Benchmark Disclosure Statement

- Additional Info: http://blogs.oracle.com/bestperf

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- SPEC and the benchmark name SPECjEnterprise are registered trademarks of the Standard Performance Evaluation Corporation. Results from www.spec.org as of 6/29/2016. SPARC S7-2, 14,400.78 SPECjEnterprise2010 EjOPS (unsecure); SPARC S7-2, 14,121.47 SPECjEnterprise2010 EjOPS (secure); Oracle Server X6-2, 27,509.59 SPECjEnterprise2010 EjOPS (unsecure); IBM Power S824, 22,543.34 SPECjEnterprise2010 EjOPS (unsecure); IBM x3650 M5, 19,282.14 SPECjEnterprise2010 EjOPS (unsecure).
- SPEC and the benchmark name SPECjbb are registered trademarks of Standard Performance Evaluation Corporation (SPEC). Results from http://www.spec.org as of 6/29/2016. SPARC S7-2 (16-core) 65,790 SPECjbb2015-MultiJVM max-jOPS, 35,812 SPECjbb2015-MultiJVM critical-jOPS; IBM Power S812LC (10-core) 44,883 SPECjbb2015-MultiJVM max-jOPS, 13,032 SPECjbb2015-MultiJVM critical-jOPS; SPARC T7-1 (32-core) 120,603 SPECjbb2015-MultiJVM max-jOPS, 60,280 SPECjbb2015-MultiJVM critical-jOPS; Huawei RH2288H v3 (44-core) 121,381 SPECjbb2015-MultiJVM max-jOPS, 38,595 SPECjbb2015-MultiJVM critical-jOPSHP ProLiant DL360 Gen9 (44-core) 120,674 SPECjbb2015-MultiJVM max-jOPS, 29,013 SPECjbb2015-MultiJVM critical-jOPS; HP ProLiant DL360 Gen9 (44-core) 105,690 SPECjbb2015-MultiJVM max-jOPS, 52,952 SPECjbb2015-MultiJVM critical-jOPS;; Cisco UCS C220 M4 (44-core) 94,667 SPECjbb2015-MultiJVM max-jOPS, 71,951 SPECjbb2015-MultiJVM critical-jOPS; Huawei RH2288H V3(36-core) 98,673 SPECjbb2015-MultiJVM max-jOPS, 28,824 SPECjbb2015-MultiJVM critical-jOPs; Lenovo x240 M5 (36-core) 80,889 SPECjbb2015-MultiJVM max-jOPS,43,654 SPECjbb2015-MultiJVM critical-jOPS; SPARC T5-2 (32-core) 80,889 SPECjbb2015-MultiJVM max-jOPS, 37,422 SPECjbb2015-MultiJVM critical-jOPS; SPARC S7-2 (16-core) 66,612 SPECjbb2015-Distributed max-jOPS, 36,922 SPECjbb2015-Distributed critical-jOPS; HP ProLiant DL360 Gen9 (44-core) 120,674 SPECjbb2015-Distributed max-jOPS, 39,615 SPECjbb2015-Distributed critical-jOPS; HP ProLiant DL360 Gen9 (44-core) 106,337 SPECjbb2015-Distributed max-jOPS, 55,858 SPECjbb2015-Distributed critical-jOPS; HP ProLiant DL580 Gen9 (96-core) 219,406 SPECjbb2015-Distributed max-jOPS, 72,271 SPECjbb2015-Distributed critical-jOPS; Lenovo Flex System x3850 X6 (96-core) 194,068 SPECjbb2015-Distributed max-jOPS, 132,111 SPECjbb2015-Distributed critical-jOPS.
- SPEC and the benchmark name SPECjEnterprise are registered trademarks of the Standard Performance Evaluation Corporation. Results from www.spec.org as of 10/25/2015. SPARC T7-1, 25,818.85 SPECjEnterprise2010 EjOPS (unsecure); SPARC T7-1, 25,093.06 SPECjEnterprise2010 EjOPS (secure); Oracle Server X5-2, 21,504.30 SPECjEnterprise2010 EjOPS (unsecure); IBM Power S824, 22,543.34 SPECjEnterprise2010 EjOPS (unsecure); IBM x3650 M5, 19,282.14 SPECjEnterprise2010 EjOPS (unsecure).
- SPEC and the benchmark names SPECfp and SPECint are registered trademarks of the Standard Performance Evaluation Corporation. Results as of October 25, 2015 from www.spec.org and this report. 1 chip resultsSPARC T7-1: 1200 SPECint_rate2006, 1120 SPECint_rate_base2006, 832 SPECfp_rate2006, 801 SPECfp_rate_base2006; SPARC T5-1B: 489 SPECint_rate2006, 440 SPECint_rate_base2006, 369 SPECfp_rate2006, 350 SPECfp_rate_base2006; Fujitsu SPARC M10-4S: 546 SPECint_rate2006, 479 SPECint_rate_base2006, 462 SPECfp_rate2006, 418 SPECfp_rate_base2006. IBM Power 710 Express: 289 SPECint_rate2006, 255 SPECint_rate_base2006, 248 SPECfp_rate2006, 229 SPECfp_rate_base2006; Fujitsu CELSIUS C740: 715 SPECint_rate2006, 693 SPECint_rate_base2006; NEC Express5800/R120f-1M: 474 SPECfp_rate2006, 460 SPECfp_rate_base2006.
- Two-tier SAP Sales and Distribution (SD) standard application benchmarks, SAP Enhancement Package 5 for SAP ERP 6.0 as of 5/16/16:SPARC M7-8, 8 processors / 256 cores / 2048 threads,SPARC M7, 4.133 GHz, 130000 SD Users, 713480 SAPS, Solaris 11, Oracle 12cSAP, Certification Number: 2016020, SPARC T7-2 (2 processors, 64 cores, 512 threads) 30,800 SAP SD users, 2 x 4.13 GHz SPARC M7, 1 TB memory, Oracle Database 12c, Oracle Solaris 11, Cert# 2015050. HPE Integrity Superdome X (16 processors, 288 cores, 576 threads) 100,000 SAP SD users, 16 x 2.5 GHz Intel Xeon Processor E7-8890 v3 4096 GB memory, SQL Server 2014, Windows Server 2012 R2 Datacenter Edition, Cert# 2016002 . IBM Power System S824 (4 processors, 24 cores, 192 threads) 21,212 SAP SD users, 4 x 3.52 GHz POWER8, 512 GB memory, DB2 10.5, AIX 7, Cert#201401. Dell PowerEdge R730 (2 processors, 36 cores, 72 threads) 16,500 SAP SD users, 2 x 2.3 GHz Intel Xeon Processor E5-2699 v3 256 GB memory, SAP ASE 16, RHEL 7, Cert#2014033. HP ProLiant DL380 Gen9 (2 processors, 36 cores, 72 threads) 16,101 SAP SD users, 2 x 2.3 GHz Intel Xeon Processor E5-2699 v3 256 GB memory, SAP ASE 16, RHEL 6.5, Cert#2014032. SAP, R/3, reg TM of SAP AG in Germany and other countries. More info www.sap.com/benchmark