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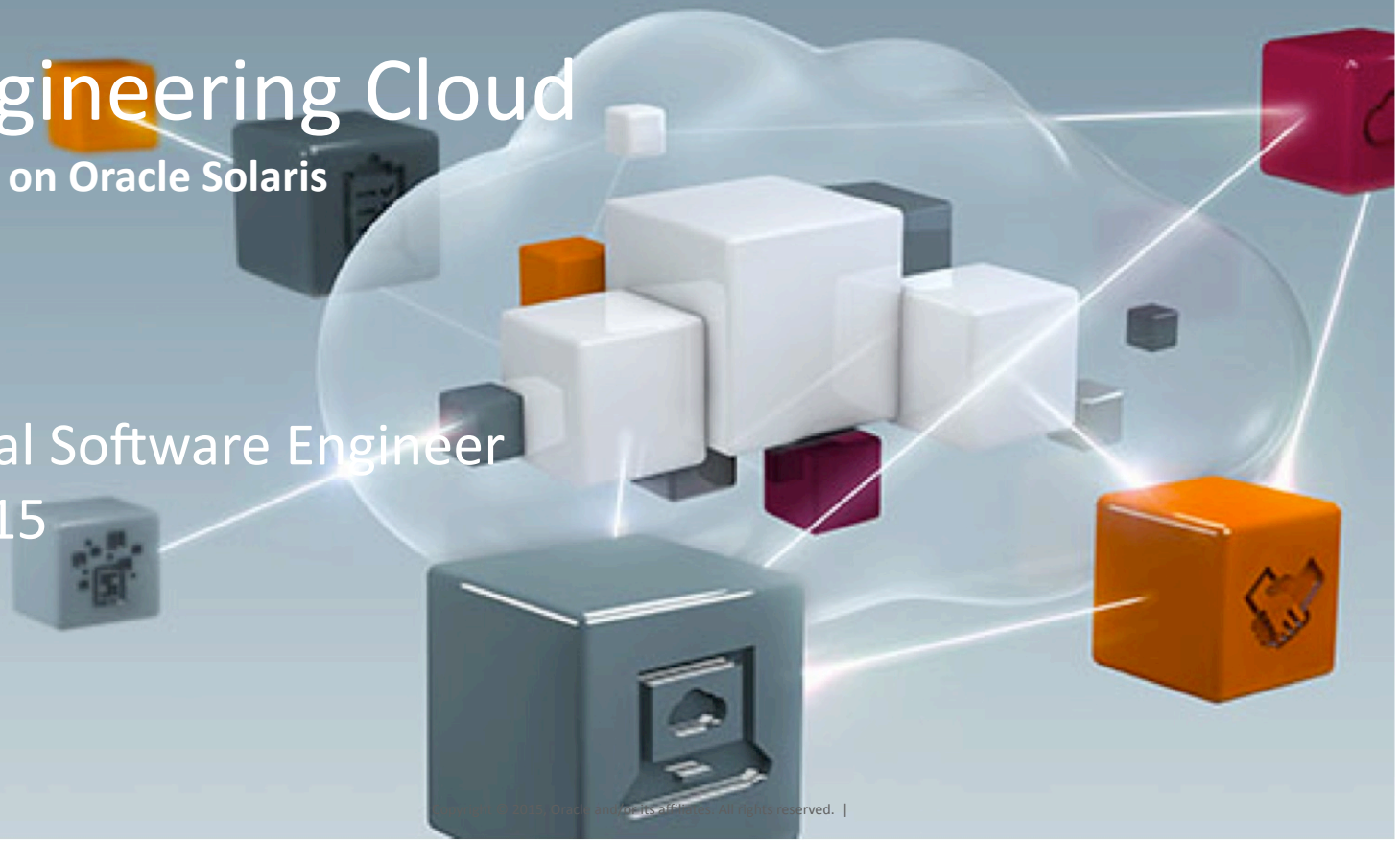
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SOLARIS

Solaris Engineering Cloud

Built on OpenStack on Oracle Solaris

Dave Miner
Senior Principal Software Engineer
November 2015



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Oracle Solaris Strategy

- Security, speed, simplicity
- One engineering team
- Secure to the core
- World class SPARC performance
- Secure OpenStack IaaS

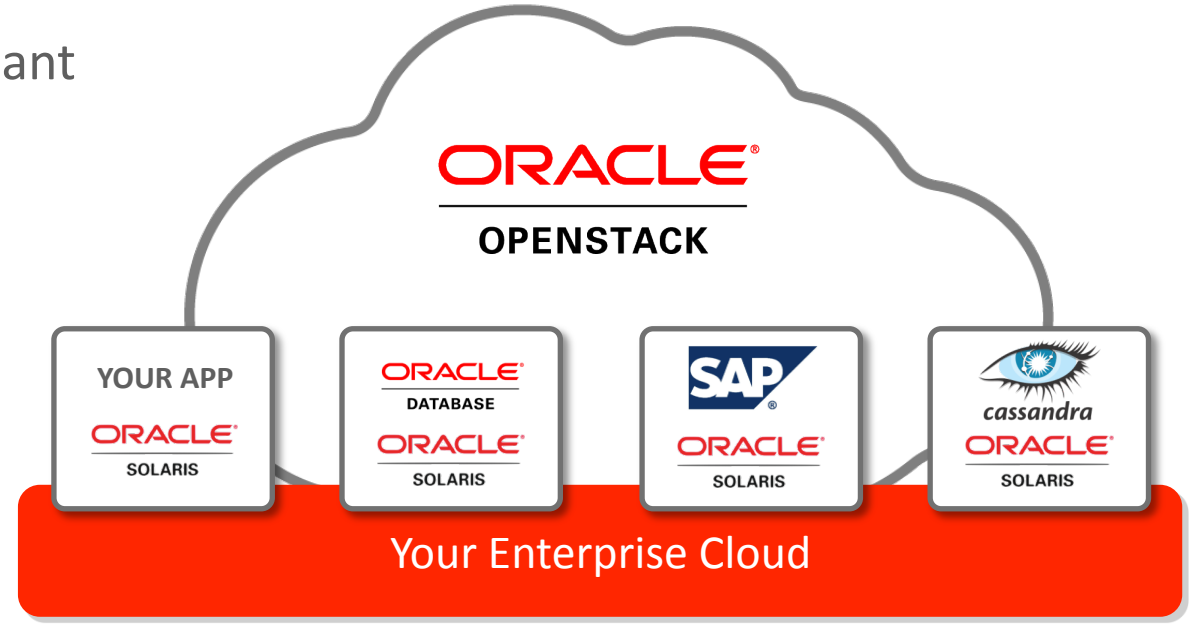


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Oracle Solaris 11.3 – Security. Speed. Simplicity.

- ✓ Secure and Compliant
- ✓ Simple
- ✓ Efficient
- ✓ Open
- ✓ Affordable

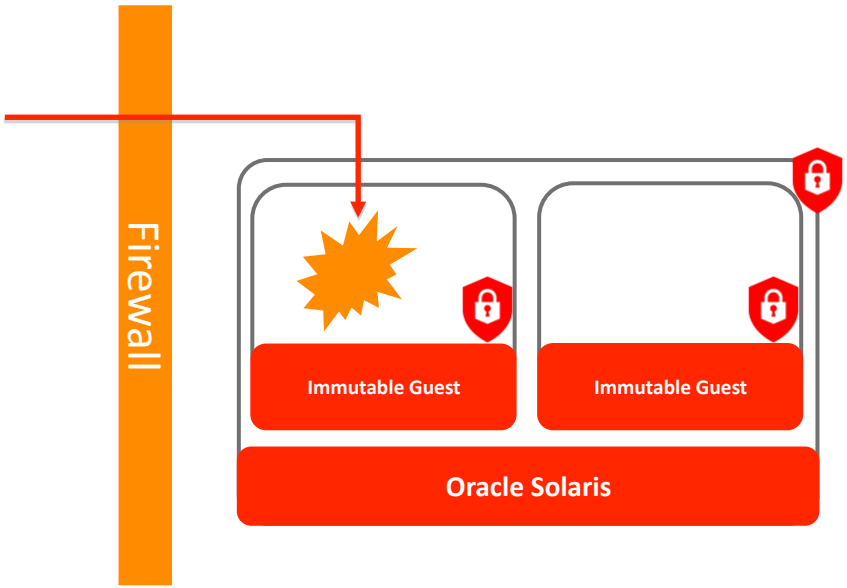


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Protects Hypervisor and Guest Environments

- Locked down hypervisor and guests
- Stop malware before it gets in
- Prevent administrator mistakes
- Update and patch but unwritable by users, applications, or hackers
- Simple on/off with ready made security levels

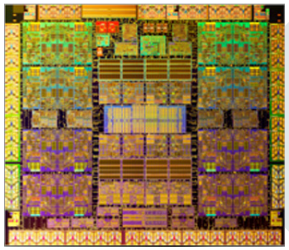


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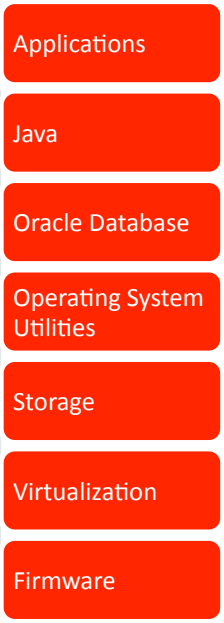
Makes Encryption Everywhere Affordable

End-to-End, Always on Cryptography

- **No performance loss**
- **Automatically** accelerates Java, Oracle Database, OpenSSL, and custom applications
- Protection of **data at rest and in motion**
- Meet compliance with high performance **disk encryption**
- **Integrates with Oracle Key Manager**







No Compromise

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Much Faster End-To-End Encryption

M7 Advantage Increases on Highest Security Ciphers



***AES** 128-CBC: Popular for Cloud, DB*

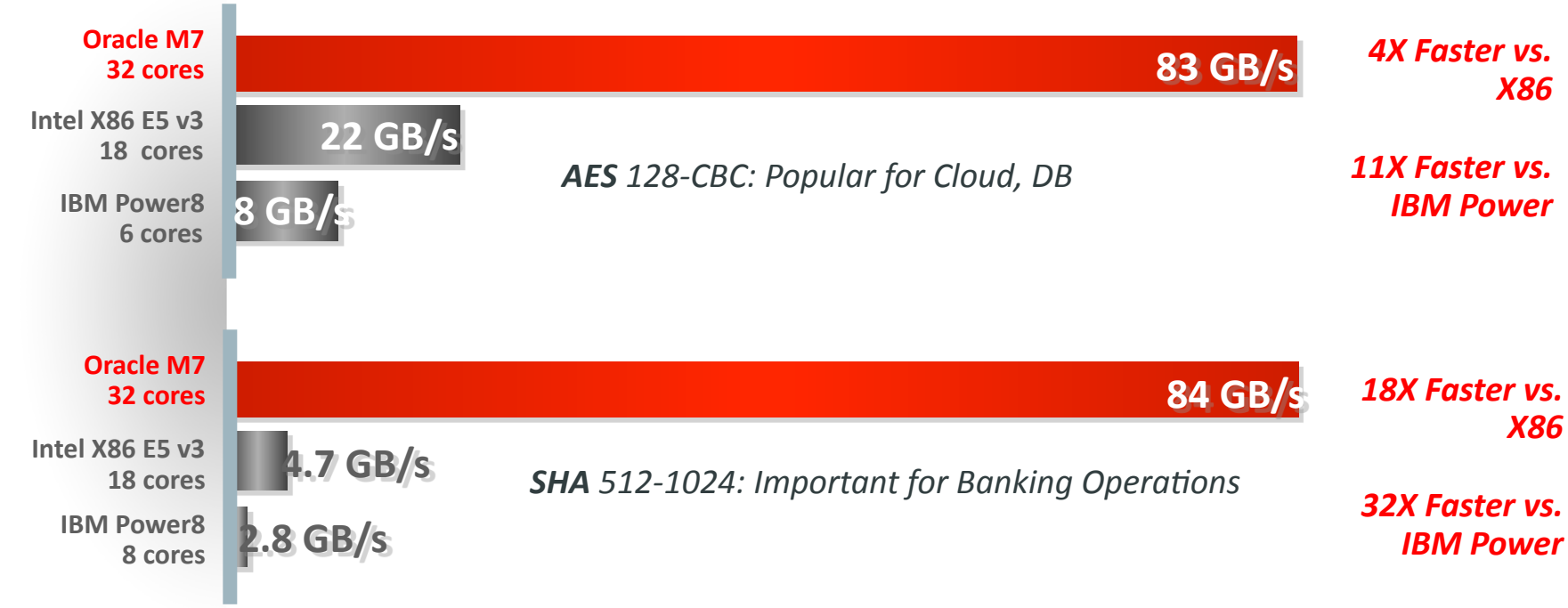
4X Faster vs. X86

11X Faster vs. IBM Power

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Much Faster End-To-End Encryption

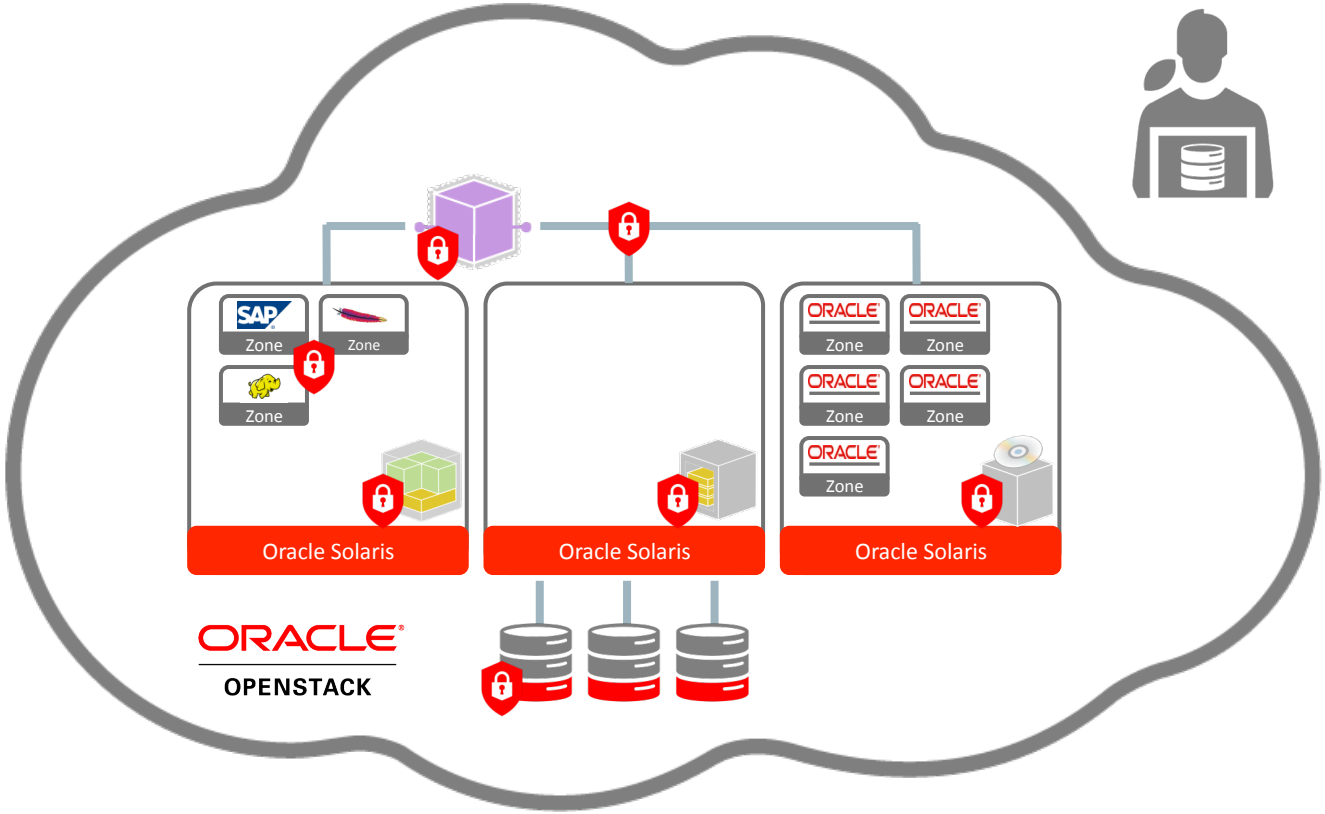
M7 Advantage Increases on Highest Security Ciphers



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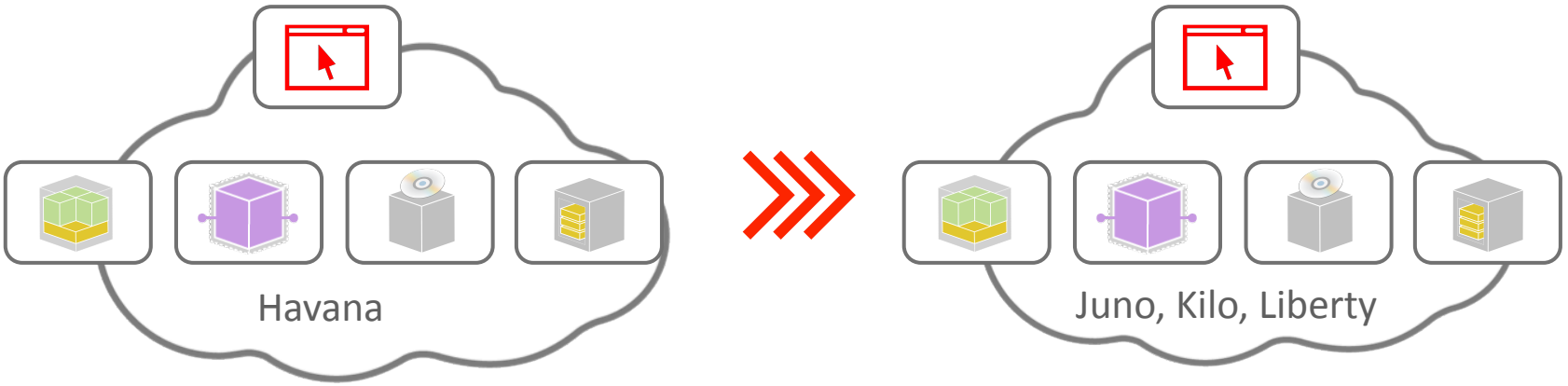
Secure OpenStack-Based IaaS, PaaS and DBaaS

- Secure Services
  - Minimum privileges
- Data at Rest
  - ZFS Encryption
- Data in Motion
  - Secure Migration
- Application
  - Read only VM
- Network
  - Data link Protection



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Simple and Seamless Cloud Updates



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OPENSTACK

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What Solaris Brings to OpenStack – Today

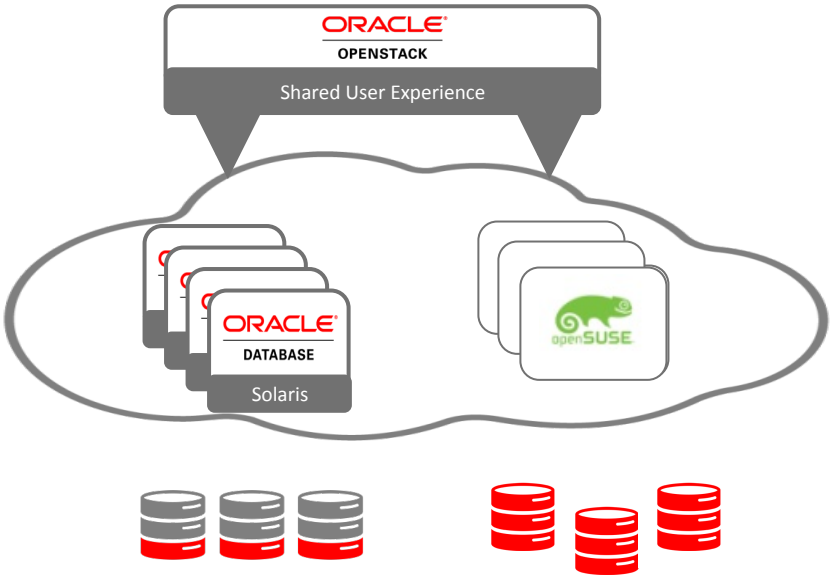
- One integrated, OpenStack package of all required components, downloadable from a secure repository
- Solaris Boot Environments allow seamless updates and roll back
- Immutable VMs for multitenant data security and zero overhead
- Modern, efficient ZFS storage on backend
- Fault resilience at all levels
- Both SPARC and x86 in one cloud



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What Solaris Brings to OpenStack – In Progress

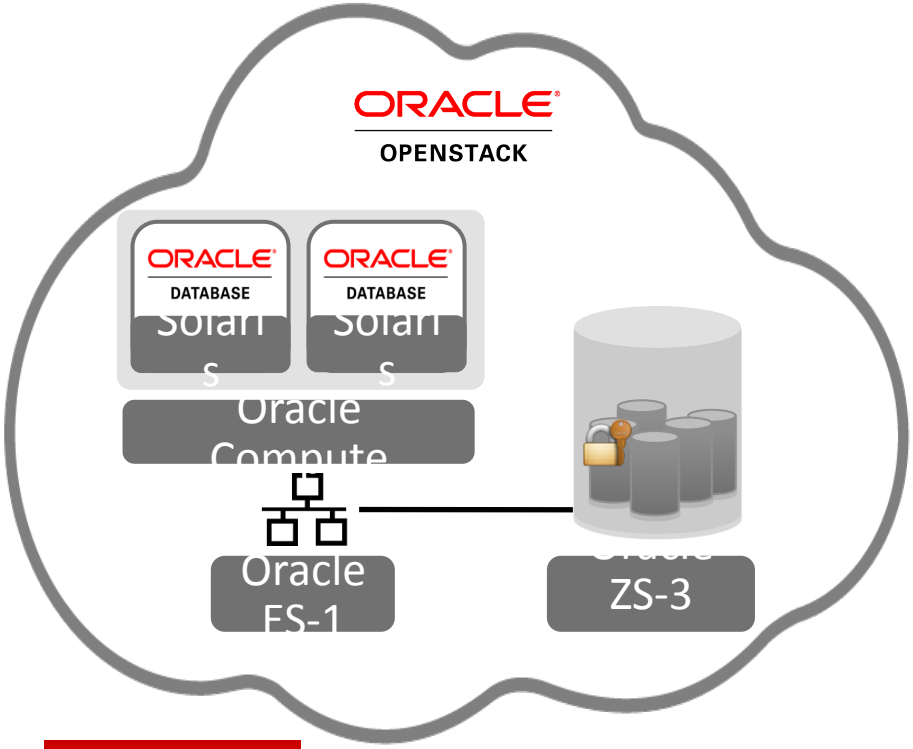
- Secure live migration of VMs
- Open Virtual Switch to manage Solaris and Linux nodes
- OpenStack installer automatically configures all services across nodes
  - Integration and support of Puppet OpenStack modules
- Open Daylight for fully interoperable SDN



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Oracle OpenStack Database Cloud

Global financial and banking services



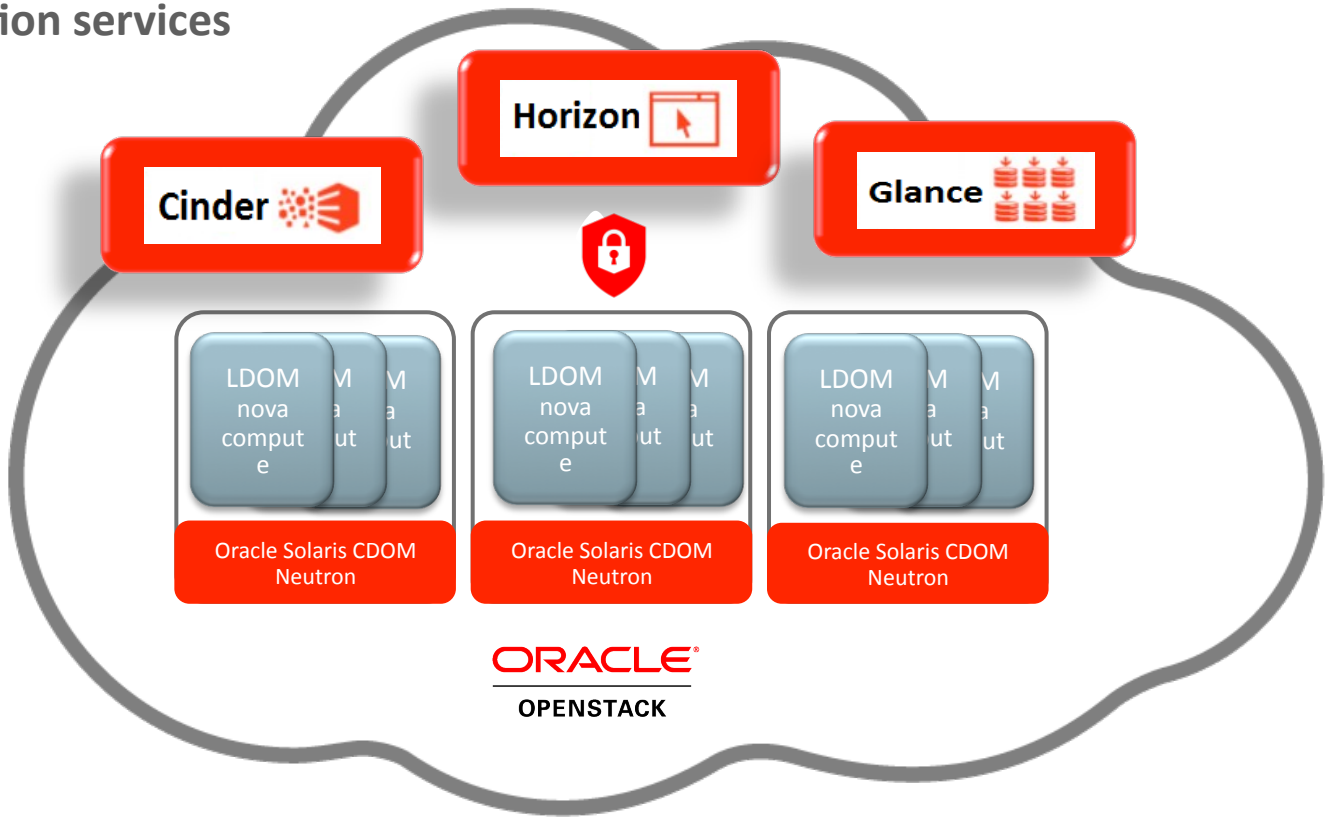
- Started with Linux but Solaris reached their goals more quickly
- Simplified support through end-to-end Oracle OpenStack solution:
  - Oracle DB, compute, networking and storage
- Enterprise-class DBaaS
- Zero overhead virtualization
- 10x faster self-provisioning of DBs

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OpenStack on Oracle Solaris IaaS

Global telecommunication services

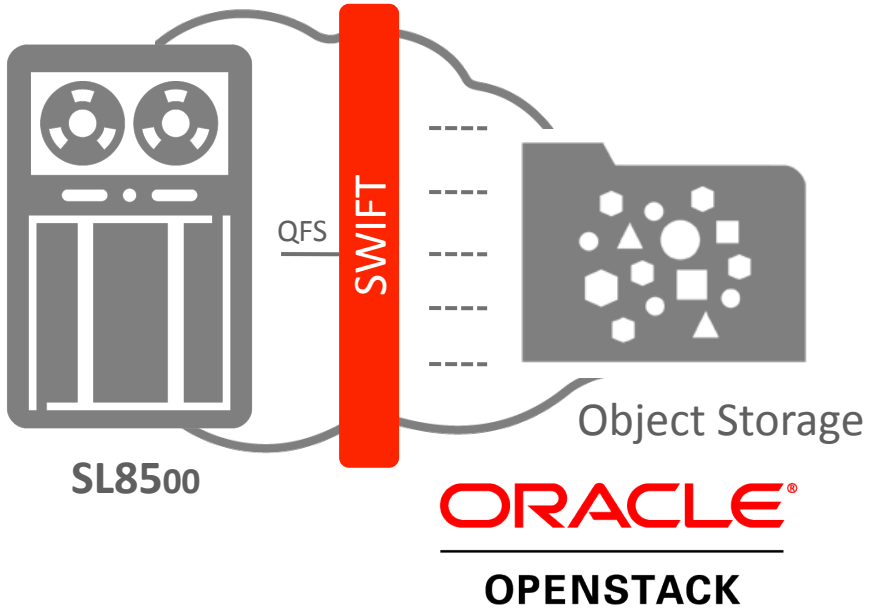
- Leverage existing infrastructure
- Secure live migration of VMs



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Cloud Ready Data Retention

Large US Web Technology Provider



- Reliable storage for **7 billion images**
  - Scales **50X** for growth
  - Increases capacity to 850 PB
- Low cost storage for additional copies required for data protection
  - OpenStack Swift on Solaris 11.2 integration with Oracle HSM

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OpenStack for Solaris Engineering Cloud

- OpenStack APIs are de-facto standard for compute, network and storage products
- OpenStack integrated into Solaris 11.2
- Started running dev cloud in mid-2014
- Based on initial success, building out as primary Solaris development environment for all teams within Oracle



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General Goals: Phase 1

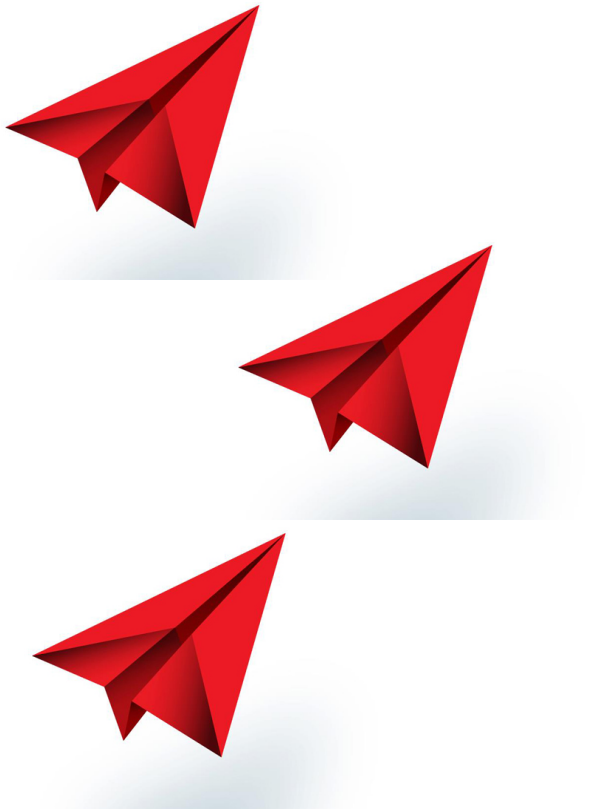
- Fly our own plane - Build and operate a OpenStack cloud that results in product improvements
  - Modernize our environment by providing on-demand compute resources
  - Improve resource utilization through virtual environments
- Develop recommendations and best practices for customers implementing OpenStack clouds



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General Goals Past Phase 1

- Fly our own airline
  - Increase scale to shake out enterprise-level issues
  - One integrated cloud for all, not separate smaller clouds
  - Specialized requirements of some groups are opportunities to improve the product
- Increase Oracle Solaris developer productivity
  - Oracle app and DB dev teams get easy access
  - Includes Solaris 11, Solaris 12, both SPARC and x86



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Resource Management and Tenancy Plan

- Each user is a tenant and gets 48 GB memory and 400 GB block storage
- Users run self-registration process (currently CLI, eventually BUI) to create tenant, set up quotas
- Additional project/consolidation tenants for long-term usage, created & managed by cloud operations staff



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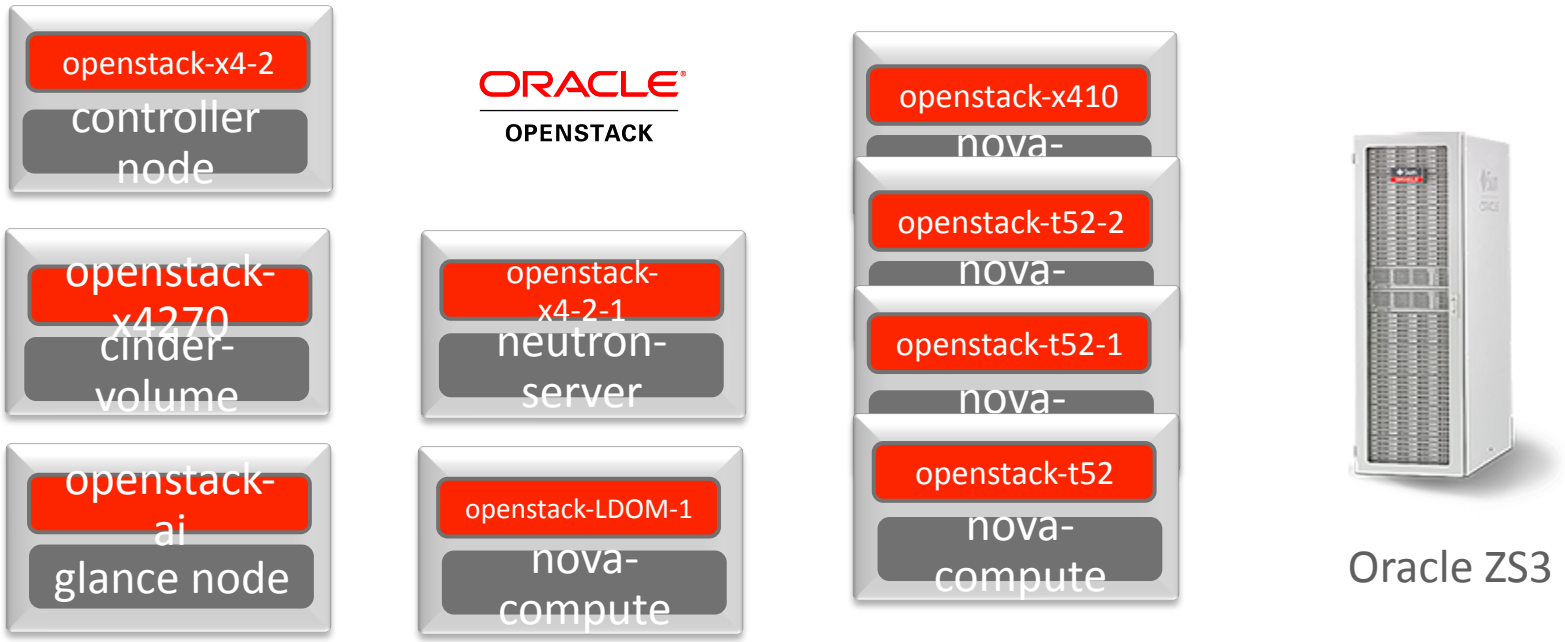
Sizing and Resource Requirements: Phase 1

- Current cloud capacity: 1.8 TB memory, 23 TB storage; 8 compute nodes + 4 infrastructure
  - Hosting 180 instances, average usage = 8 GB memory + 60 GB block storage
- Memory is primary resource limit, can't over-commit
- For a 350 user environment (initial design goal):
  - 32 GB memory for each user => 11.2 TB memory – 24x512 GB compute nodes (50/50 SPARC & x86)
  - 200 GB block storage for each user => 70 TB block storage – 1 ZS-3 cluster



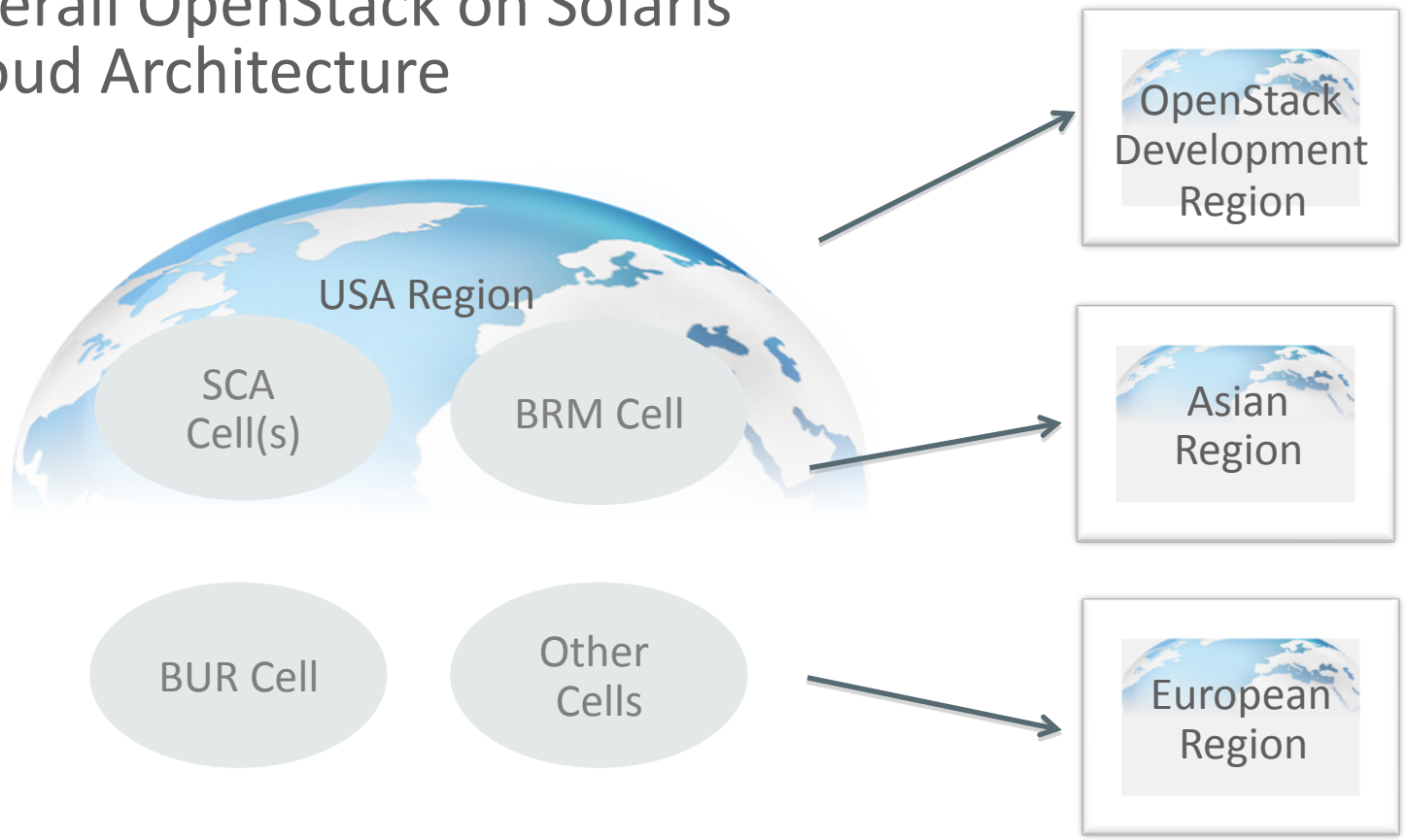
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Current Cloud Configuration



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Overall OpenStack on Solaris Cloud Architecture



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What's an OpenStack Development Region?

- Provide smaller scale region to testbed in advance of main region upgrades
- Run as region rather than separate cloud to get experience with regional operations, leverage centralized Keystone, Glance
- Resources generally available and not quota'ed so can handle overflow/burst needs
- Goal of implementing continuous upgrades with nightly builds



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Building Out Past Phase 1

- Each region/cell requires
  - Small number of control plane systems; cluster and load balance for HA and scale. Roughly 10% of region resources for control plane
  - At least 1 ZFS SA cluster
  - 10+ GbE network infrastructure
  - Compute nodes for anticipated workload
- Convert existing systems and redirect future system purchases for compute nodes
- Add Ironic bare metal support for non-virtual uses



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Operational Environment

- Deploy nodes automatically using Solaris Automated Installer and Image Packaging System (IPS)
- Solaris Unified Archives for disaster recovery and system cloning
  - UAs also used by Solaris OpenStack to deploy guests
- Puppet (currently 3.6.2) for operations management
  - Solaris RBAC manages administrative access
- Fast, safe upgrades using IPS and Boot Environments



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Results from First Year

- Approximately 200 users, 1000s of VMs recycled
- 125+ Solaris and OpenStack bugs filed, most fixed
- 10 upgrades, including Havana to Juno
  - One upgrade failed, rolled back in less than 1 hour
- One significant unplanned outage
- **99.84% availability running development builds, no HA, ad-hoc monitoring**
- Apply what we've learned to support customer deployments



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What's Next

- **Go BIG!**
- Implement HA and scale-out architecture:
  - Solaris Cluster
  - Solaris Integrated Load Balancer
  - Memcached
- Centralized logging and monitoring
- Ironic bare-metal provisioning support
- Add Linux compute nodes



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More Details, Further Adventures

- http://blogs.oracle.com/openstack
- http://blogs.oracle.com/dminer

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Integrated Cloud

Applications & Platform Services

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Required Benchmark Disclosure Statement

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- Two-tier SAP Sales and Distribution (SD) Standard Application benchmarks SAP Enhancement package 5 for SAP ERP 6.0 as of 3/26/14:SPARC M6-32 (32 processors, 384 cores, 3072 threads) 140,000 SAP SD users, 32 x 3.6 GHz SPARC M6, 16 TB memory, Oracle Database 11g, Oracle Solaris 11, 0.58 resp time, Cert# 2014008. IBM Power 780 (12 processors, 96 cores, 384 threads) 57,024 SAP SD users, 12 x 3.72 GHz IBM POWER7+, 1536 GB memory, DB210, AIX7.1, 0.98 resp time, Cert#2012033. Fujitsu PRIMEQUEST 2800E (8 processors, 120 cores, 240 threads) 47,500 SAP SD users, 8 x 2.8 GHz Intel Xeon Processor E7-8890 v2, 1024 GB memory, SQL Server 2012, Windows Server 2012 Standard Edition, 0.97 resp time, Cert# 2014003. 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 chips, 48 cores, 192 threads) 25,488 SAP SD users, 8 x 3.41 GHz IBM POWER7+, 1024 GB, DB2 10, AIX 7.1, Cert#2013004. IBM Power S824 (4 processors, 6-cores/chip 24cores, 192threads) 21,212 SAP SD users, 4x 3.52GHZ Power8, 512 GB memory DB2 10.5, AIX 7.1, Cert# 2014016. 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 &other countries. info www.sap.com/benchmark SPEC & benchmark names

- SPEC and the benchmark name SPECvirt_sc are registered trademarks of the Standard Performance Evaluation Corporation. Results from www.spec.org as of 3/5/2014. SPARC T5-2, SPECvirt_sc2010 4270 @ 264 VMs; HP ProLiant DL380p Gen8, SPECvirt_sc2010 2442 @ 150 VMs; IBM x3850 X5, SPECvirt_sc2010 3824 @ 234 VMs; IBM Flex System x240, SPECvirt_sc2010 2741 @ 168 VMs; HP Proliant BL620c G7, SPECvirt_sc2010 1878 @ 120 VMs.

- Intel's server virtualization benchmark as found 2/28/2014 in the presented pdfs at http://www.intel.com/content/www/us/en/processors/xeon/xeon-intel-server-processor-comparison-guide.html, http://www.intel.com/content/www/us/en/data-center/server-consolidation-and-virtualization-brief.html, and http://www.intel.com/content/www/us/en/processors/xeon/xeon-e5-brief.html. The pdfs can be found directly at Intel xeon-intel-server-processor-comparison-guide.pdf, Intel server-consolidation-and-virtualization-brief.pdf, and Intel xeon-e5-brief.pdf with local copies available xeon-intel-server-processor-comparison-guide.pdf, server-consolidation-and-virtualization-brief.pdf, and xeon-e5-brief.pdf. The Intel information reads: "New Configuration and Score on Benchmark: Intel Server Board S2600CP platform with two Intel Xeon Processor E5-2697 v2 (2.7 GHz, 12-core, 30 MB L3 cache, 8.0 GT/s, 130W, C0-stepping), Virtualization Technology Enabled, Turbo Enabled, HT Enabled, NUMA Enabled, MLC Spatial Prefetcher Enabled, DCU Data Line Prefetcher Enabled, 256 GB memory (16x 16 GB DDR3-1866 DR REG ECC), 128 GB SATA SSD, ESXi 5.1(build 799733). Source: Intel TR#1359 as of 24 July 2013. Score: 2246 @ 144VMs"

- TPC Benchmark C, tpmC, and TPC-C are trademarks fo the Transaction Processing Performance Council (TPC). SPARC T5-8 (www.tpc.org/1792) 8,552,523 tpmC at $0.55 USD/tpmC available 9/25/2013. Oracle Sun Server X2-8 (www.tpc.org/1787) 5,055,888 tpmC at $0.89 USD/tpmC, available 7/10/12. Oracle SPARC SuperCluster (www.tpc.org/1780) 30,249,688 tpmC at $1.01 USD/tpmC, historical result. IBM Power780 Cluster (www.tpc.org/1777) 10,366,254 tpmC at $1.38 USD/tpmC, historical result. IBM Power 780 Server (www.tpc.org/1773) 1,200,011 tpmC at $0.69 USD/tpmC, historical result. Cisco UCS C240 M3 (www.tpc.org/1789) 1,609,186 tpmC at $0.47 USD/tpmC, available 9/27/12. Results as of 8/22/14. Source: http://www.tpc.org/tpcc.

- TPC Benchmark, TPC-H, QphH, QthH, QppH are trademarks of the Transaction Processing Performance Council (TPC). Results as of 8/22/14, prices are in USD. SPARC T5-4 (www.tpc.org/3288) 409,721 QphH@3,000GB at $3.94 USD/QphH@3,000GB, available 9/24/13; SPARC T4-4 (www.tpc.org/3278) 205,792 QphH@3,000GB at $4.10 USD/QphH@3,000GB, available 5/31/12; SPARC Enterprise M9000 (www.tpc.org/3262) 386,478 QphH@3,000GB, $18.19 USD/QphH@3,000GB, historical result; SPARC Enterprise M9000 (www.tpc.org/3258) 198,907 QphH@3,000GB at $15.27 USD/QphH@3,000GB, historical result; IBM Power 780 (www.tpc.org/3277) 192,001 QphH@3,000GB at $6.37 USD/QphH@3,000GB, available 11/30/11.

- 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. ZS3-2 Results as of June 25, 2014, for more information go to http://www.storageperformance.org/results SPC-2. Results for Oracle ZFS Storage ZS3-4 are 16,212.66 SPC-2 MBPS™, $12.08 SPC-2 Price-Performance. 3.67 SPC-2 MBPS™ / WATT. Full results are available at http://www.storageperformance.org/results/benchmark_results_spc2#be00002

- 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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