

# ORACLE ZFS STORAGE APPLIANCE



Oracle's premier application-engineered storage for multiprotocol environments delivers extreme performance, superior efficiency for VM and cloud storage environments, and deep Oracle integration. Oracle ZFS Storage Appliance is designed to run applications fast and more efficiently, increase business and IT productivity, save valuable resources and reduce risk—lowering total cost of ownership. Further, codevelopment with Oracle Database maximizes the return on your Oracle software investment.

## KEY FEATURES

- Unparalleled integration with Oracle Database
- Optimal storage architecture for enterprise cloud and virtualization
- Dynamic caching between DRAM, flash cache, and disk drives
- Best SPC-2 price performance with ZS3-2<sup>1</sup>
- Efficient and economical storage inline data services including compression, clones, encryption, and replication
- Advanced, intuitive management and granular analytics tools
- Data protection with highly secure AES granular analytics tools

## KEY BENEFITS

- Maximize return on Oracle software investments
- Reduce headcount per gigabyte under management
- Achieve extreme performance
- Avoid the risk and cost of security breaches
- Operate with high availability
- Gain superior price per performance and price per gigabyte

## Extreme Enterprise Storage Performance

Oracle ZFS Storage Appliance is based on an advanced hardware and software architecture, including a highly intelligent multithreading storage OS that makes the most of modern enterprise hardware, enabling you to run multiple workloads and advanced data services without performance detriment. Its unique feature, Hybrid Storage Pool architecture, automatically caches data on dynamic random access memory (DRAM) or flash to provide optimal performance and exceptional efficiency, while ensuring that data remains safely stored on reliable and high capacity hard-disk drive (HDD) storage. This enables heavily accessed data to be served mostly from cache—up to 90 per cent—for extremely high performance without spindle speed limitations, while securing and storing data on cost-effective HDDs. High-availability features such as active-active controller clustering for failover, a self-healing file system architecture that ensures end-to-end data integrity, and a rich set of enterprise-class data services make Oracle ZFS Storage Appliance an ideal choice for enterprise storage. Furthermore, the aggressive price point makes it extremely attractive to employ in environments where extreme performance and superior efficiency are required.



Figure 1. DRAM-centric architecture

<sup>1</sup> Results as of December 1, 2014. For more information see the *SPC-2 Results - "Top Ten" by Price-Performance at* [http://www.storageperformance.org/results/benchmark\\_results\\_spc2\\_top-ten/#spc2\\_top10\\_price](http://www.storageperformance.org/results/benchmark_results_spc2_top-ten/#spc2_top10_price)

As proof of exceptional performance in varied workloads, Oracle publishes high results in many industry-standard public benchmarks<sup>2</sup>.

### Superior Efficiency

Oracle ZFS Storage Appliance features an advanced set of management and analytics tools that allows storage administrators to provision, manage, and troubleshoot storage in less time than is possible with competitors' systems<sup>3</sup>. Rapid deployment of powerful advanced data services such as snapshots, clones, thin provisioning, four different compression algorithms, and replication is possible via the intuitive browser user interface (BUI) or the command-line interface (CLI).

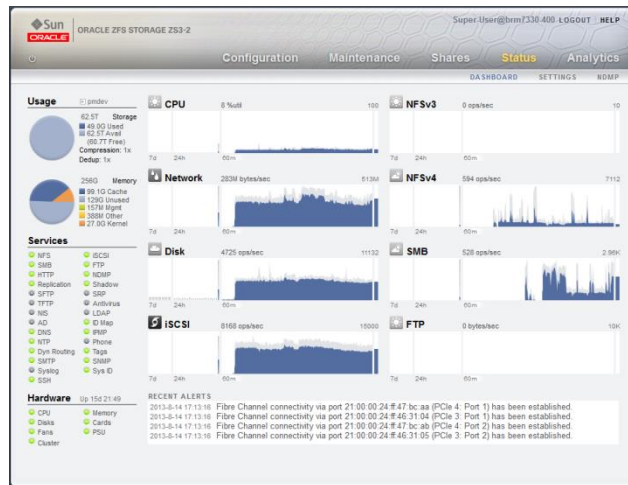


Figure 2. Status view of management software

The ZS Analytics feature of Oracle ZFS Storage Appliance provides real-time analysis and monitoring functionality, enabling unparalleled fine-grained visibility into disk, controller CPU, networking, cache, virtual machine, and other statistics. It does this in a way that uniquely ties client network interface activity back to the disks with everything in between.

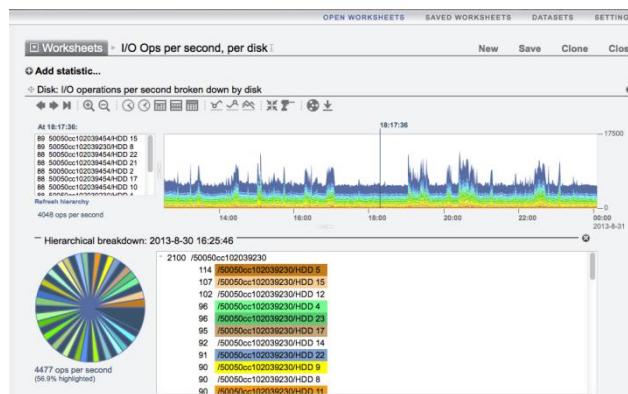


Figure 3. ZS Analytics example showing I/O ops per second, per disk

2 [Oracle.com storage benchmarks](#)

3 [Strategic Focus Study](#)

This granular visibility—at the IO or VM level—supports rapid identification and resolution of bottlenecks for overall IT system performance tuning and troubleshooting, particularly in large-scale virtual server environments. The Oracle ZFS Storage Appliance management efficiency has a positive and tangible resource impact, evident in Oracle IT testing and independent studies: Oracle ZFS Storage Appliance improves headcount per gigabyte under management metrics by speeding administrative tasks, resulting in significant operational cost savings.

## Oracle Integration

Oracle ZFS Storage Appliance offers deep integration with Oracle Database to dramatically reduce risk, increase efficiencies, and lower TCO. Through engineering, developing, testing, and supporting hardware and software together, Oracle storage delivers unique advantages to ensure Oracle software runs fastest and most efficiently on Oracle storage. Coengineered with Oracle software and with countless documented solutions and best practices, Oracle ZFS Storage Appliance removes guesswork from configuring the total system for success.

- **Oracle Intelligent Storage Protocol**

The Oracle Intelligent Storage Protocol feature is exclusive to Oracle Database 12c and Oracle ZFS Storage Appliance. Oracle Intelligent Storage Protocol enables the storage to receive cues from Oracle Database, providing storage visibility of the database on an unprecedented level. Oracle Database sends cues to Oracle ZFS Storage Appliance about each operation, allowing the storage to intelligently process I/O and automatically and dynamically tune itself for optimal performance, reducing risk and speeding provisioning by alleviating tedious manual operations. With OS 8.3 and above, Oracle Intelligent Storage Protocol 1.1 includes per-database (or pluggable database) analytics. This capability allows drill downs on the advanced statistics by database name provided by ZS Analytics for rapid resolution of database issues in consolidated Oracle Database environments.

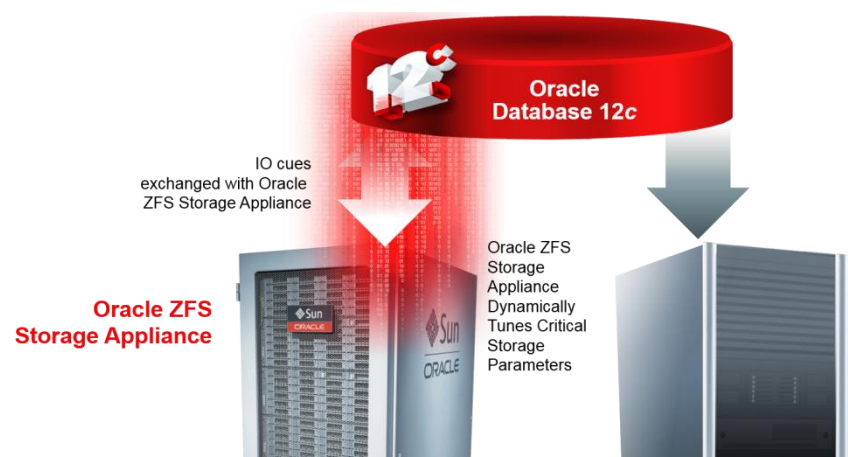


Figure 5. Oracle Database 12c and Oracle Intelligent Storage Protocol

- **Oracle Hybrid Columnar Compression**

Enterprises running archival Oracle Database workloads for data warehousing or mixed workloads can achieve a 10x to 50x reduction in their data volumes, and they can accelerate queries by 3x to 8x by using Oracle Hybrid Columnar Compression on Oracle ZFS Storage Appliance. Available only on Oracle storage, this capability helps you achieve a 3x to 5x reduction in your storage footprint and associated data center costs. Furthermore, with Oracle Database 12c, the Automatic Data Optimization feature enables you to set policies to initiate Hybrid Columnar Compression and data tiering based on actual data usage to manage data throughout its lifecycle.

- **Management plug-ins for Oracle Enterprise Manager and Oracle VM Storage Connect**

The plug-in for Oracle Enterprise Manager enables monitoring and provisioning at the share, LUN or project level for all Oracle ZFS Storage Appliance models for end-to-end management visibility across the enterprise. . The plug-in for The Oracle VM Storage Connect framework enables Oracle VM to provision and manage Oracle ZFS Storage Appliances for streamlined virtualization implementation. The plug-ins enable easier implementation, better visibility, and holistic management efficiencies.

- **Oracle Snap Management Utility for Oracle Database**

The Oracle Snap Management Utility for Oracle Database feature is a standalone management tool engineered to work with Oracle ZFS Storage Appliance. It provides database administrators with an efficient and automatic way to create logical backups, and restore, clone, and provision Oracle Database when one or more databases are stored on Oracle ZFS Storage Appliance. Oracle Snap Management Utility for Oracle Database reduces costs while increasing overall business productivity in demanding development/test environments, reducing product development cycles.

## Virtualization and Cloud Integration

Virtualization and cloud workloads have fundamentally changed the stresses placed on storage systems. Traditional storage architectures that rely on disk spindles for performance (either conventional or flash) are poorly designed to meet the challenge. Layer upon layer of abstraction, combined with highly consolidated infrastructure, can inadvertently overwhelm back-end disk capabilities. Oracle ZFS Storage has a vastly superior design for these highly consolidated environments. Symmetric multiprocessing is part of the core OS, and has been for more than 20 years. Massive DRAM cache, and software that optimizes its use, allow up to 90 percent of I/O to come from the fastest possible medium—an order of magnitude faster than flash disks. This dramatic consolidation capability is complemented by fine-grained analytics capabilities that enable administrators to find and resolve issues on a per-VM basis.

## Hardware Architecture and Configuration Options

Oracle ZFS Storage Appliance is based upon three primary components:

- **Software:** a unique, intelligent multithreading SMP storage OS with enterprise-class data services, robust data protection, and Hybrid Storage Pool technology that manages the dynamic caching. Most data services, including ZS Analytics, are included in the base system.
- **Controller:** a robust, powerful storage controller based on cost-effective, enterprise-grade x86 servers from Oracle that contain the high-performance compute power, massive DRAM, and read flash. Optional dual-controller cluster configurations provide high availability with rapid failover.
- **Storage:** enterprise grade disk enclosures that contain SAS-2 hard disk drives and

write flash accelerators for high-performance, high-availability persistent storage.

Two controller models are available:

- **Oracle ZFS Storage ZS3-2:** a midrange enterprise multiprotocol storage system ideal for use in performance-intensive workloads at an attractive price point
- **Oracle ZFS Storage ZS4-4:** a high-end enterprise multiprotocol storage system for workloads demanding extreme performance and scalability at a price point that rivals competitors' midrange and high-end systems

Both models use the same intelligent storage OS and enterprise SAS-2 disk enclosures, but feature different storage controllers to meet the appropriate level of performance required for particular environments.

## Optional Software

In addition to the rich software suite included with the base system, you can acquire other separately licensed software features: remote replication, clones, encryption, and Oracle Snap Management Utility for Oracle Database.

	Oracle ZFS Storage ZS3-2	Oracle ZFS Storage ZS4-4
<b>Architecture</b>	Single-controller or dual-controller HA cluster with external disk shelf storage (stated specs assume active-active cluster)	Single-controller or dual-controller HA cluster with external disk shelf storage (stated specs assume active-active cluster)
<b>Processor</b>	4x 8-core 2.1 GHz Intel® Xeon® Processors	8x 15-core 2.8 GHz Intel® Xeon® processors
<b>DRAM cache</b>	512 GB or 1 TB	3 TB
<b>Read flash cache</b>	0–12.8 TB	0–12.8 TB
<b>Storage Configurations</b>		
<b>Configuration options</b>	<ul style="list-style-type: none"> <li>• 6 TB to 3.1 PB scalability</li> <li>• Choose 20 or 24 HDDs per disk shelf</li> <li>• If 20 HDDs, choose 0–4 SSD write accelerators per disk shelf</li> <li>• Attach 1–16 disk shelves for storage</li> </ul> ZS3-2 default (one SAS HBA) can support up to 12 disk shelves. One additional HBA is required to support the maximum configuration. Two HBAs is the maximum supported.	<ul style="list-style-type: none"> <li>• 6 TB to 6.9 PB scalability</li> <li>• Choose 20 or 24 HDDs per disk shelf</li> <li>• If 20 HDDs, choose 0–4 SSD write accelerators per disk shelf</li> <li>• Attach 1–36 disk shelves for storage</li> </ul> ZS4-4 default (two SAS HBA's) can support up to 24 disk shelves. One additional HBA is required to support the maximum configuration. Four HBAs is the maximum supported.
<b>Disk shelf/HDD options</b>	<ul style="list-style-type: none"> <li>• Oracle Storage Drive Enclosure DE2-24C: 8 TB SAS-2 3.5" 7,200 RPM HDDs</li> <li>• Oracle Storage Drive Enclosure DE2-24P: 300 GB / 900 GB SAS-2 2.5" 10,000 RPM HDDs</li> </ul>	
<b>Standard and Optional Interfaces</b>		
<b>Integrated network</b>	8x 10 Gb Base-T Ethernet ports	8x 10 Gb Base-T Ethernet ports
<b>Optional network connectivity</b>	1 Gigabit Ethernet, 10 Gigabit Ethernet, QDR InfiniBand HCA, 8 Gb FC HBA, 16 Gb FC HBA	
<b>Optional tape backup HBA</b>	Dual channel 8 Gb/16 Gb FC HBA	
<b>Maximum ports per system</b>		
<b>1 GbE/10 GbE Base-T/10 GbE Optical/IB/8 Gb FC/16 Gb FC</b>	32/16/16/16/16/16	40/24/24/16/16/16
<b>Environmental</b>		
<b>Nonoperating temperature/humidity (standalone, nonrack system)</b>	-40°C to 70°C (-40°F to 158°F), up to 93% relative humidity, noncondensing	
<b>Altitude (operating)</b>	Up to 3000 m, temperature is derated by 1C per 300 m of elevation above 900 m	
<b>Regulations (meets or exceeds the following requirements)</b>		

Safety	IEC 60950, UL/CSA 60950, EN60950, CB Scheme with all country differences
RFI/EMI	FCC CFR 47 Part 15 Class A, EN 55022 Class A, EN 61000-3-2, EN 61000-3-3, EN 300-386
Immunity	EN55024:1998+A1:2001:+A2:2003

**POWER AND THERMAL**

Item Description		Typical	Maximum
Oracle ZFS Storage ZS3-2 (controller only)	Power (W)	379 W	889 W
	Thermal (BTU/hr)	1,293 BTU/hr	3,032 BTU/hr
Oracle ZFS Storage ZS4-4 (controller only)	<a href="#">Refer to Power Calculator</a>		
Oracle Storage Drive Enclosure DE2-24C	Power (W)	469 W	699 W
	Thermal (BTU/hr)	1,600 BTU/hr	2,385 BTU/hr
Oracle Storage Drive Enclosure DE2-24P	Power (W)	325 W	699 W
	Thermal (BTU/hr)	1,108 BTU/hr	2,385 BTU/hr

**Physical Specifications**

Oracle ZFS Storage ZS3-2 (controller only)	Height	87 mm (3.43 in.) 2RU (Rack Units)
	Width	445 mm (17.52 in.)
	Depth	527.8 mm (20.78 in.)
	Weight	18.5 kg (40.8 lb.)
Oracle ZFS Storage ZS4-4 (controller only)	Height	129.85 mm (5.1 in) 3RU (Rack Units)
	Width	436.5 mm (17.2 in.)
	Depth	732 mm (28.8 in.)
	Weight	38.5 kg (85 lb.) max.
Oracle Storage Drive Enclosure DE2-24C (fully loaded with drives)	Height	175 mm (6.89 in.) 4RU (Rack Units)
	Width	483 mm (19 in.)
	Depth	630 mm (24.8 in.)
	Weight	46 kg (101.41 lb.)
Oracle Storage Drive Enclosure DE2-24P (fully loaded with drives)	Height	87.9 mm (3.46 in.) 2RU (Rack Units)
	Width	483 mm (19 in.)
	Depth	630 mm (24.8 in.)
	Weight	24 kg (52.91 lb.)

## ORACLE ZFS STORAGE APPLIANCE SOFTWARE

Included Features	Details
Oracle Intelligent Storage Protocol	Oracle Database 12c sends metadata to Oracle ZFS Storage Appliance about each I/O, enabling storage to dynamically tune itself for optimal performance; provides visibility at the database and per pluggable database level for actionable insight
File system	Oracle Solaris ZFS (128-bit addressability)
File-level protocol	NFS v2/v3/v4, SMB1/2/2.1, HTTP, WebDAV, FTP/SFTP/FTPS
Block-level protocol	ISCSI, Fibre Channel, iSER, SRP, IP over InfiniBand, RDMA over InfiniBand
Data compression	Four distinct compression options to balance data reduction with performance for specific workloads
Hybrid Columnar Compression	3x to 5x reduction in storage footprint with existing instances of Oracle Database for OLTP, data warehousing, or mixed workloads
Data deduplication	Inline, block-level deduplication
Monitoring	ZS Analytics (for system tuning and debugging), dashboard monitoring for key system performance metrics, plug-in available for Oracle Enterprise Manager
Automated serviceability	"Phone home" capability with automatic case creation, configurable alerts
RAID	Striping, mirroring, triple mirroring, single-parity RAID, double-parity RAID, triple-parity RAID, wide stripes
Remote management	HTTPS, SSH, SNMP v1/v2c, IPMI, RESTful API, OpenStack Cinder
Snapshots	Read only, restore, Microsoft Volume Shadow Copy Service support
Directory services	NIS, AD, LDAP
Data security	Checksum data and metadata, antivirus quarantine
Network services	NTP, DHCP, SMTP
Backup	NDMP v3/v4, ZFS NDMP
Local replication	Replication within same Oracle ZFS Storage Appliance configuration (single or cluster)
Separately Licensed Features	Details
Clones	Writable snapshots
Remote replication	Replication from one Oracle ZFS Storage Appliance product to another. 1:N, N:1, manual, scheduled, or continuous
Oracle Snap Management Utility for Oracle Database	Fast, efficient, and automatic way to back up, restore, clone, and provision Oracle Database when one or more databases are stored on Oracle ZFS Storage Appliance
Encryption	Highly secure, easy to implement two-level AES 256/192/128-bit granular data encryption at project/share/LUN level and key management flexibility for data breach protection and security



## Oracle Support

Oracle Premier Support services provide the complete system support you need to proactively manage your Oracle storage systems, with swift resolution and rapid-response hardware service when problems do arise, keeping your business information available 24/7.

With Oracle Advanced Customer Support Services, you get mission-critical support with a focused support team, proactive guidance to tailor storage systems for optimal performance and increased competitiveness, and preventative monitoring to help you achieve high availability and optimized system performance.

For more information about Oracle support and Oracle Advanced Customer Support Services, please speak with your Oracle representative or Oracle authorized partner, or visit <http://www.oracle.com/support> or <http://www.oracle.com/acs>

## Oracle Upgrade Advantage Program

The upgrade advantage program (UAP) is a trade-in program that offers up-front discounts on new Oracle systems for the trade-in of older Oracle and competitors' eligible systems. Oracle also provides free return shipping and free state-of-the-art recycling of the old systems so you don't need to worry about the disposal of hazardous waste.

For more information about UAP, go to:





<http://www.oracle.com/us/products/servers-storage/upgrade-advantage-program/index.html>



### CONTACT US

For more information about Oracle ZFS Storage Appliance, visit [oracle.com](http://oracle.com) or call +1.800.ORACLE1 to speak to an Oracle representative.

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### Hardware and Software, Engineered to Work Together

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