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Oracle ZFS Storage Appliance: Ideal Storage for Virtualization and Private Clouds

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Table of Contents

Introduction

The Oracle ZFS Storage Appliance family of products can support 10x more virtual machines (VMs) per storage system (compared to conventional NAS filers), while reducing cost and complexity and improving performance. Data center managers have learned that virtualization environment service-level agreements (SLAs) can live and die on the behavior of the storage supporting them. Oracle ZFS Storage Appliance products are rapidly becoming the systems of choice for some of the world's most complex virtualization environments for three simple reasons. Their cache-centric architecture combines DRAM and flash, which is ideal for multiple and diverse workloads. Their sophisticated multithreading processing environment easily handles many concurrent data streams and the unparalleled analytics provides visibility into complex consolidation environments. These features combine to provide a breakthrough solution for deploying storage behind virtualization and private cloud computing.

The Value of Having the Right Storage for Virtualization and Private Cloud Computing

Private cloud computing extends the benefits of virtualization by increasing the efficiency of server and storage utilization: reducing costs, improving operational efficiency, and optimizing data center rack and floor space. This changes the way data center managers think about storage, shifting the conversation to these questions: how many virtual machines (VMs) can I run on each storage system, and can storage performance excel in random, mixed workloads generated by unpredictable VM utilization? The problem is no longer one of increasing connectivity to get to better utilization; instead, it's about how much a system (with thin provisioning, for example) can be pushed beyond 100 percent of its raw capacity. Nor is it a matter of adding more storage systems to gain a performance advantage; it's about finding a system that can handle virtual I/O peaks with ease.

How much does the storage you choose impact your virtualization scale and meet performance expectations? Oracle's IT environment ran on NetApp filers with 250 VMs per filer. To achieve its consolidation goals and support its extensive virtualization environment, Oracle's IT organization moved to Oracle ZFS Storage Appliance systems and found that the number of VMs jumped to 2,300 per system—with processing headroom to spare. Today, Oracle ZFS Storage Appliance systems can support and simultaneously boot as many as 16,000 VMs in under seven minutes.

Oracle ZFS Storage Appliance systems are Oracle's premier systems for NAS environments—from on-premises environments to the cloud—delivering extreme performance and superior efficiency for demanding enterprise applications as well for as unpredictable cloud workloads. As Oracle engineered storage, Oracle ZFS Storage Appliance systems are deeply integrated with Oracle Database, Oracle engineered systems, and Oracle Public Cloud to maximize the return on your Oracle software investment in ways that competitive storage systems are unable to achieve. These storage systems provide measurable benefits that you can count on when you need to accelerate mission-critical applications and increase business and IT productivity—enabling you to save valuable resources, reduce risk, and lower your total cost of ownership. And, these systems are ready for the cloud when you are.

Scalable Performance, Efficiency and Reliable Data Protection

The following capabilities are why Oracle ZFS Storage Appliance systems are ideal for private cloud and virtualization workloads:

» **Highly scalable performance to support increased VM density:** Heavily virtualized environments have thousands of VMs with simultaneous and diverse workloads stressing the storage environment—generating many hundreds of threads. Oracle ZFS Storage Appliance systems have a mature, highly threaded SMP operating system that takes full advantage of, in some cases, more than 100 processor cores per system. Competitors don't offer such highly scalable SMP operating systems or this level of multithreading capabilities.

» **High performance for better boot storm management:** Larger caches and an intelligent caching feature of Oracle ZFS Storage Appliance systems called Hybrid Storage Pool combine DRAM, solid-state drives (SSDs), and the ZFS file system. This architecture prevents the typical saturation of resources caused by intense concentration of I/O in virtual desktop and VM environments, and it delivers fast reads and writes critical for the high performance needed to meet the challenges posed by random I/O workloads. Oracle ZFS Storage Appliance systems handle boot storms better than other systems because they serve up to 90 percent of I/O out of DRAM, which allows boot images and hot data to be served more efficiently.

» **Highly granular insight to increase VM performance:** DTrace Analytics, another built-in capability of Oracle ZFS Storage Appliance systems, enables administrators to quickly determine why a particular VM is slow or which VM is making the other VMs slow. This granular level of analysis can prevent one or two VM users from corrupting a 10,000-VM system by, for example, identifying a performance issue to user number 43 on VM number 948 as the culprit. This kind of visibility in a highly virtualized environment makes Oracle ZFS Storage Appliance systems very appealing.
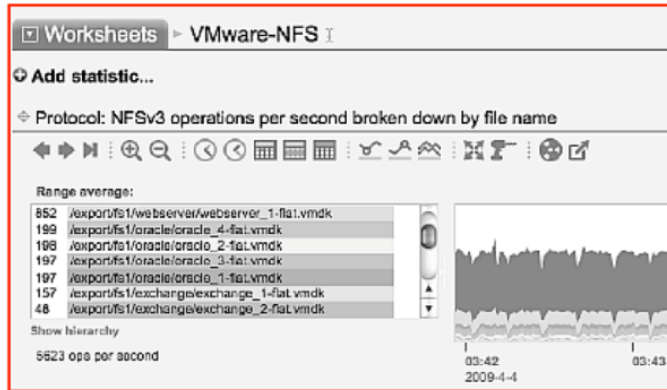
Figure 1. Storage analytics

No other vendor offers anything close to this level of granular analysis, and it's vital to operating VM environments at scale. When comparing storage analytics in a head-to-head test with the competition, Strategic Focus found that workload diagnosis took 73 percent less time with 19 percent fewer steps to achieve that analysis.

Improving Operational Efficiency

Consolidation increases risk. Prior to the deployment of a virtualization initiative, the day-to-day tasks associated with sustaining availability were labor intensive, complex, and difficult. These critical tasks are dramatically simplified with Oracle ZFS Storage Appliance systems' easy-to-use management interface, which takes the guesswork out of maintaining a reliable storage environment for virtualized applications. These systems also offer a full-featured RESTful management API and integrate with critical orchestration environments such as OpenStack and Oracle Enterprise Manager to further streamline operations.

A Single Solution for Multihypervisor or Single Hypervisor Environments

Key capabilities such as thin provisioning, compression, and deduplication work in concert with hypervisors such as Oracle VM, Microsoft Hyper-V, and VMware on Oracle ZFS Storage Appliance systems. They eliminate duplicate data blocks, compress data, and allocate the amount of storage being consumed by users compared to over-allocation, which wastes valuable storage capacity, leads to filer sprawl, and increases capital costs. The savings from the use of these features further extend to operational costs, which were found to be superior to those of the competition during a head-to-head comparison conducted by Strategic Focus. In the study, Oracle ZFS Storage Appliance systems took 73 percent less time to manage and troubleshoot.

Data services such as snapshots and clones provide instant, and optionally unattended, backups that can be used in the short term for recovery of business-critical data. Third-party backup/recovery solutions (such as Symantec OST, Commvault, VEEAM, and others) that are already integrated with Oracle ZFS Storage Appliance systems provide an all-important long-term backup and recovery solution leveraging Oracle's StorageTek tape and Oracle ZFS Storage Appliance systems for a cloud computing storage architecture.

Maximizing VMware VM Availability, Manageability, and Performance with Oracle ZFS Storage Appliance Systems

Oracle ZFS Storage Appliance systems interoperate with VMware vSphere versions 6.x, ESXi 6.x, and later to provide storage for highly available infrastructure-as-a-service (IaaS) and platform-as-a-service (PaaS) environments.

Availability

VMware vMotion allows applications running in VMs to remain available during scheduled outages by migrating VMs that host business-critical applications from one application server to another without disruption. Oracle ZFS Storage Appliance systems interoperate seamlessly with VMware vMotion to maintain connectivity with key data in file systems in NFS, iSCSI, and Fibre Channel environments.

VMware further extends this efficiency with a feature called Storage vMotion that migrates storage connectivity from one Oracle ZFS Storage Appliance system to another without disruption. These capabilities work to maintain high availability by making business-critical applications and their associated storage portable, thereby keeping applications running and improving productivity.

Furthermore, Oracle ZFS Storage Appliance systems are integrated with VMware Site Recovery Manager (SRM). VMware SRM provides a complete disaster recovery solution for VMs using NFS, iSCSI, or Fibre Channel.

Oracle ZFS Storage Appliance systems also work with VMware's Dynamic Resource Scheduler (DRS) to support real-time expansion or contraction of computing environments dependent on key performance indicators.

Manageability

The all-new and updated Oracle ZFS Storage Web Client Plug-in for VMware allows for quick NFS, iSCSI and Fibre Channel storage provisioning along with VMware-centric analytics. Click here for more information.
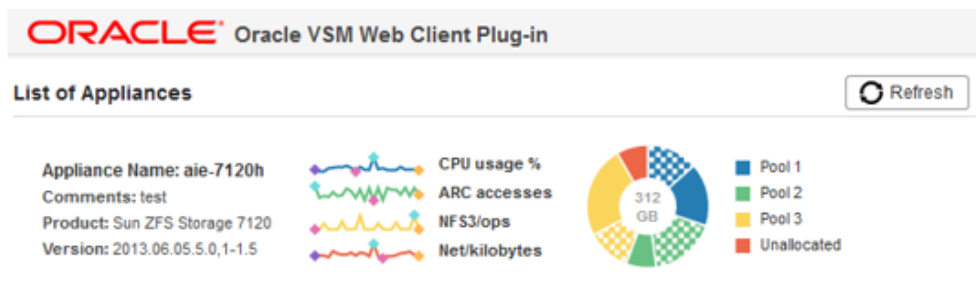

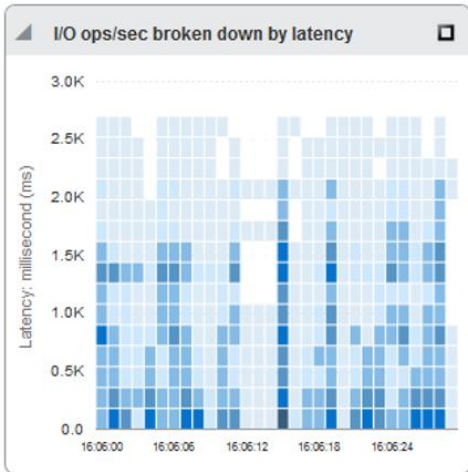Figure 2. Oracle ZFS Storage Web Client Plug-in for VMware

Figure 3. I/O operations/second broken down by latency

Additionally, Oracle ZFS Storage Appliance systems can be deployed with the VMware Horizon View for Horizon 6 solution. This combination provides a single platform and unified workspace for the delivery of virtual desktops, applications, and online services within a Microsoft Windows environment. Read more here.
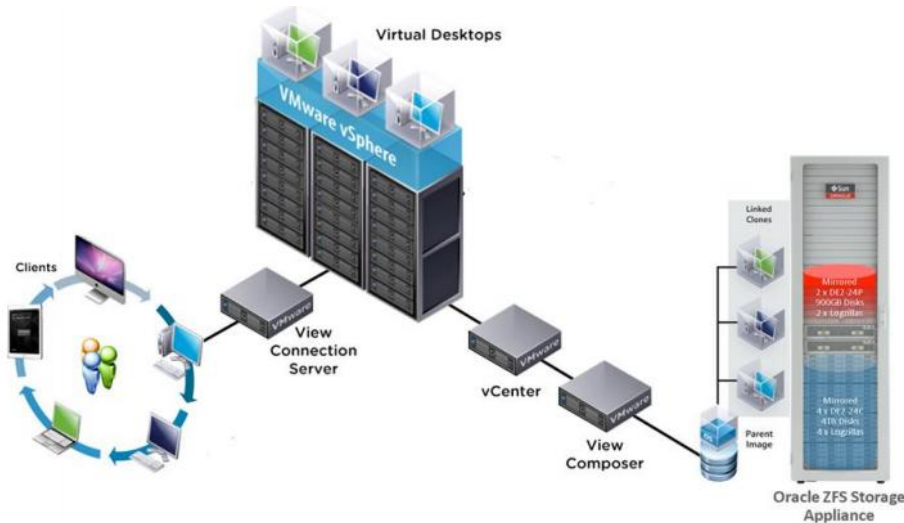

Figure 4. Deploying an Oracle ZFS Storage Appliance system with the VMware Horizon View for Horizon 6 solution

Performance

VMware vStorage API for Array Integration (VAAI) is an API that allows certain storage operations and tasks to be offloaded to a storage device. Oracle ZFS Storage Appliance systems can be integrated with this API. This allows for VMware to offload the cloning of virtual disks, VM snapshots, space visibility, or extended statistics, which enables provisioning and the creation of thick virtual disk files, among other things. Booting 10,000 VMs is no easy task, but the Oracle ZFS Storage Appliance systems' intelligent cache algorithms, architecture, and integration with VMware makes it so. Read more on booting 10,000 VMs here.

Highly Efficient Oracle VM Environments with Oracle ZFS Storage Appliance

Oracle ZFS Storage Appliance systems integrate and interoperate with Oracle VM both for server virtualization and private cloud computing, including single-pane-of-glass provisioning using the Oracle VM Storage Connect Plug-in for Oracle ZFS Storage Appliance feature. A key example of the value provided by this integration is an Oracle VM feature called Live Migration that enables data migration from one server to another. Oracle ZFS Storage Appliance integrates seamlessly with Oracle VM Live Migration to maintain access to data. Oracle VM, in concert with an Oracle ZFS Storage Appliance system, can also be used to migrate Oracle Real Application Clusters (Oracle RAC) and Oracle RAC One Node databases. Oracle RAC One Node databases can migrate across virtual nodes in a cluster using the Online Database Relocation feature. Oracle RAC databases can also be relocated by adding and dropping database instances. Oracle ZFS Storage Appliance system provide the required shared access to the database files, enabling seamless interoperability and delivering operational efficiencies in storage while working in concert to maintain business-critical application availability.
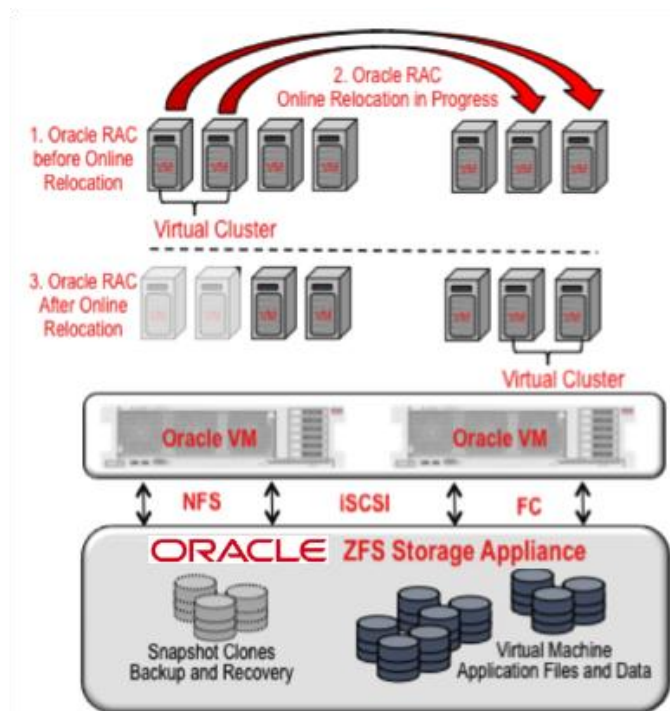
Figure 5. Using the Online Database Relocation feature

Private Cloud Integration

Cloud integration has fundamentally changed the way storage systems manage data. Traditional storage architectures lack direct cloud integration and data models, and they rely on disk spindles for performance. After layer upon layer of abstraction, cloud-consolidated infrastructure creates highly randomized I/O workloads that can overwhelm back-end disk capabilities and make troubleshooting extremely difficult. Oracle ZFS Storage Appliance systems are engineered for the cloud, and these systems avoid these issues, as follows:

» **Cloud-architected**. Based on the architectural advantages of an SMP operating system and Hybrid Storage Pool technology, Oracle ZFS Storage Appliance systems have a superior design for maintaining high performance in cloud-integrated environments. They optimize performance for mixed and unpredictable workloads automatically and avoid consolidation performance bottlenecks.

- » **Cloud-managed**. The dramatic consolidation and performance capabilities of Oracle ZFS Storage Appliance systems are complemented by fine-grained analytics that enable administrators to find and resolve issues even on a per-VM basis. Furthermore, these systems support cloud management frameworks including OpenStack and Oracle Enterprise Manager.
- » **Cloud-proven**. Oracle ZFS Storage Appliance systems have been proven in a variety of private and public cloud implementations worldwide, including serving as the NAS and data protection backbone of Oracle's own cloud.

Learn how Oracle's IT organization addresses more than six different use cases with Oracle ZFS Storage Appliance systems here.

Conclusion

The Oracle ZFS Storage Appliance family of products offers compelling architectural, performance, and VM analytic advantages when compared to competing storage solutions. As Oracle ZFS Storage Appliance systems become increasingly integrated with the features and functions of today's private cloud and virtualization environments, they have become the clear choice for private cloud consolidation.

For more information regarding Oracle ZFS Storage Appliance, visit:

oracle.com/us/products/servers-storage/storage/nas/overview/index.html

oracle.com/community/server_%26_storage_systems/storage/zfs-storage-appliance

For more information regarding Oracle virtualization, visit:

oracle.com/us/technologies/virtualization/index.html

Integrated Cloud Applications & Platform Services

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