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Achieving New Levels of Datacenter Performance and Efficiency with Software-optimized Flash Storage

Overview

Escalating data growth, ongoing budgetary pressures, and increasing performance demands on IT infrastructure pose significant challenges to datacenters today. Enterprise Flash storage technology promises a balanced solution. However, the full potential of Flash to economically improve service levels has yet to be realized. This is primarily due to datacenter unfamiliarity with Flash technology and perceptions that it increases complexity and cost. Oracle has addressed this issue by developing innovative data management software that helps businesses to realize the full benefits of Flash in powerful new ways. With no management overhead required, the Oracle software automatically optimizes Flash to:

- Accelerate database and application performance
- Improve efficiency and simplify operations
- Lower total cost.

A Perfect Storm

A perfect storm is brewing in the datacenter:

- Digital data is growing at 50% annually (IDC- IVIEW, Sponsored by EMC, "The Digital Universe Decade - Are You Ready?" Doc.# IDC_925, May 2010)
- IT budgets are flat or declining
- Storage bottlenecks increasingly limit system performance (due to conventional storage technologies that cannot keep pace with processor speeds advances and application demands).

Balancing these financial and system challenges with ongoing data growth is increasingly difficult using traditional means. For instance, the common remedy of 'short stroking' hard disk drives (HDDs) optimizes for performance by 'striping' or spreading data across the outermost and fastest spinning tracks of each drive in the storage pool. Datacenters can meet response time targets – and capacity requirements – by aggregating more and more HDDs in this manner. However, the method is extremely inefficient and costly.

With short stroking, the lion's share of HDD capacity – frequently exceeding 90% of each drive – becomes unavailable for storage purposes. Zero value is derived from the vast amount of pre-purchased capacity that goes unused. This becomes an expensive proposition, as thousands of underutilized HDDs are frequently deployed to meet the requirements. Add in ongoing expenses of manual data management, maintenance support, datacenter footprint, and the energy required to power and cool all the spinning drives, and it becomes clear that short stroking merely replaces one problem with another.

Enterprise Flash Storage Comes of Age

Since its introduction a few years ago, Enterprise-grade Flash technology has caused considerable IT industry excitement. The excitement is justified. Enterprise Flash provides datacenters the balance needed to weather the storm. Flash accelerates system performance, helps accommodate data growth, and lowers total overall cost. It features outstanding performance, low power consumption, non-volatile data persistence, and highly durable, solid-state reliability. Honed by extensive market experience across a wide number consumer applications and devices including mobile phones, digital cameras, laptop computers, and MP3 players, enterprise Flash is ready for primetime datacenter deployment. Enterprise Flash may very well be the most important datacenter storage technology of the past 10 or even 20 years.

In addition to these benefits, several related factors drive datacenter adoption of Flash technology:

- Rapidly declining cost of Flash technology
- Ongoing improvements in Flash capacity and performance
- General availability of reliable enterprise-grade Flash Solid State Drives (which are easily deployed in place of, or alongside HDDs)
- Market acceptance and critical acclaim of integrated Flash-based systems (such as the Oracle Exadata Database Machine and the Oracle ZFS Storage Appliance).

While these factors are significant, it is the advent of powerful data management software that optimizes the service level and economic advantages of Flash that ultimately justifies its wider datacenter deployment.

Software-Optimized Flash Storage

To understand the benefits of software-optimized Flash storage, it is helpful to consider how conventional systems operate. To maintain service levels, skilled IT staff will typically spend significant time monitoring system performance and tuning internal parameters. More time is spent identifying critical data and manually placing – or ‘pinning’ – data on the appropriate high performing storage asset. Pinning ensures that critical data is readily available to support the business. These manual efforts are ongoing as the relative value of most business data is constantly in flux. Overall complexity compounds as the volume of newly created data continually increases the total amount of data under management.

Software-optimized Flash storage greatly simplifies and improves this process. It ensures the right data is in the right place at the right time – and at the right cost – all without management overhead. While

the system operates 24/7, administrators are free to focus on other business-critical tasks. Meanwhile, system performance, operational efficiency, and total cost of ownership (TCO) automatically improve.

Software-optimized Flash storage works in two interwoven ways:

First, Flash-enabled data management software uses Flash technology to extend DRAM cache memory capacity. Super fast DRAM, which resides in the server, improves performance by making frequently accessed data readily available to applications and users. However, DRAM has limited capacity and scales poorly. It is also extremely expensive. Thus, only a relatively small amount of data can benefit from being stored there. This keeps users and applications waiting as far slower HDDs (or inefficiently configured short stroked HDDs) service the majority of data requests.

To remedy this, the software integrates Flash technology as a new tier in the storage hierarchy. Flash is logically positioned between the DRAM and HDD tiers to extend DRAM capacity while circumventing the limited capabilities of HDDs. This accelerates system performance in ways not otherwise possible. Database and application transaction times improve as fast, solid state Flash now serves the majority of data requests— not slow mechanical HDDs. In many environments, software-optimized Flash achieves this at much lower cost, as well. Deploying the Flash tier inside of the host (or directly attaching it) also avoids Storage Area Network (SAN) latencies. These latencies often keep users waiting for data and adversely affect service levels.

Second, Flash-enabled software uses Flash technology to place data across the storage hierarchy according to its relative and changing business value. The software automatically places data across DRAM, Flash, and HDDs tiers based upon data age and usage history. In sophisticated systems available from Oracle, the software also intelligently considers the context for how data is used.

For example, the software will recognize that newly created data, such as the day's sales receipts, is likely to be of immediate importance to the business. It dynamically places this 'hot' data on the highest performing storage tier where it is most quickly accessible – usually DRAM cache. As requests for the receipts diminish, the software will seamlessly move the data to more economical and higher capacity Flash. While not quite as fast as DRAM, Flash will still serve the data at impressive solid-state speeds. Eventually, as the data cools further, it is moved the 'cheap seats' of hard disk. In most cases, the data will remain on lower tier HDDs until the software recognizes that it has become hot again. In such instances, the software will re-promote the data back to a higher tier to serve the new business imperative.

In concert with the software, administrators can retain control over the data at any time. They can:

- Pin the data to a higher tier (to absolutely ensure it is readily available to the business)
- Archive the data on tape for long-term safekeeping (to serve other business or compliance needs)
- Delete the data from the system altogether (because it no longer has potential business value).

The Oracle Software-optimized Flash Advantage

To help businesses realize the full potential of enterprise Flash technology, Oracle pioneered the development of intelligent Flash-enabled data management software. The Oracle software automatically leverages Flash to accelerate database and application performance. It eliminates the management complexity and risk introduced by the new Flash storage tier. It also eliminates the need for short stroked environments. This stretches datacenter budget dollars and accommodates data growth by reclaiming pre-paid and unused HDD storage capacity.

In “Software, Hardware, Complete” fashion, Oracle designed the software from an integrated systems point of view. The result is a set of innovative software offerings engineered to work with the industry-leading portfolio of Oracle Flash storage products. Together, the Oracle software and hardware boosts system speed, simplifies operations, and lowers costs – all without management overhead. This shortens business cycles, promotes new efficiencies, and enhances customer experience.

Oracle offers two sophisticated software solutions designed to optimize Flash technology: Oracle Database Smart Flash Cache and Oracle Solaris ZFS.

Oracle Database Smart Flash Cache is a unique software feature included with Oracle 11gR2, the world’s premier enterprise database and the first to be Flash-enabled. Using Flash, the Oracle software applies extensive knowledge of dynamic database usage patterns to boost performance and promote simplicity. Oracle Database Smart Flash Cache also works in concert with other powerful Oracle 11gR2 database offerings including Advanced Compression and Range Partitioning to deliver enhanced service level and financial benefits.

Oracle Solaris ZFS is the second Oracle software offering that optimizes Flash storage technology. ZFS focuses on accelerating performance and reducing complexity in file-based storage environments. ZFS is included as an integrated feature with Oracle Solaris, the world’s premier enterprise operating system. It also helps power the award-winning Oracle ZFS Storage Appliance family to leverage Flash for new levels of networked storage management ease, performance, and value.

Where Software-optimized Flash Storage Best Applies

Software-optimized Flash storage will benefit a variety of common datacenter environments and workloads. Storage bottlenecks that hamper performance are a strong indication that software-enabled Flash can improve performance. Administrators can easily identify bottlenecks with readily available tools. Deployment of short-stroked HDDs is another indication that bottlenecks are limiting performance. Software-optimized Flash storage will also benefit environments with large numbers of users, high transaction rates, and I/O intensive applications. Other prime candidates include environments with read-intensive databases that exceed DRAM capacity, and those with high concurrent access rates, and frequently accessed tables or indices.

Summary

Conventional data storage solutions are inadequate in balancing escalating data growth, ongoing budgetary pressures, and increasing performance demands on datacenter infrastructure. The significant benefits of reliable, enterprise-grade Flash storage technology have promised to remedy the situation. Flash is making increasing datacenter inroads as market prices of Flash storage continue to drop, capacities increase, and proven datacenter-ready offerings become available. Enterprise Flash storage technology combined with optimizing data management software provides the ultimate justification for its wide scale datacenter adoption. The integration of hardware and software leverages Flash in new ways. It automatically increases performance, reduces complexity, and provides superior financial advantages. Oracle leads the industry with the broadest portfolio software-optimized Flash offerings. These offerings include innovative Flash-enabling data management software, and a suite of industry-leading enterprise Flash hardware products. Software-optimized Flash offerings from Oracle easily integrate with existing multi-tiered storage environments to achieve new levels of business advantage and opportunity.



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Hardware and Software, Engineered to Work Together

