



# Boosting storage performance for I/O-intensive enterprise applications

By Julita Kusmaul, Dan Bock, Justin Braun, Doug Bernhardt, Mark Boeser and Darin Schmitz

The business-critical applications that keep enterprises humming place ever-increasing I/O demands on storage. The Dell™ Compellent™ Storage Center™ platform optimizes I/O-intensive workloads in virtual desktop, messaging and database environments.

## Innovations in virtualized storage

Automated tiered storage is designed to maximize storage performance, efficiency, flexibility, reliability and manageability. Download this white paper to learn more about how innovative tiering capabilities are built into the Dell Compellent virtualized storage platform.

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Advances in virtualization, networking and storage technology have stimulated the growth of infrastructure to heighten performance for transaction- and I/O-intensive applications. And yet accelerating online and cloud activity continues to generate enormous amounts of data for enterprises, which places heavy demand on mission-critical applications. In response, many IT administrators are looking to transition to powerful, flexible and scalable systems designed to handle escalating storage demands for virtual desktop infrastructure (VDI), messaging and database environments.

For example, widespread adoption of virtualization has led to a rising number of VDI implementations that help streamline desktop management, enhance security and simplify OS migrations. VDI also facilitates efficient backup and restore of desktop states, minimizes power and cooling costs, and helps enrich the end-user experience for applications that extend communication and collaboration across the workplace.

Along with the growth of such applications, including instant messaging and social networking, I/O-intensive email systems continue to be a communication nerve center in the workplace. Plus, many organizations utilize enterprise-scale databases as the backbone for web-based applications that handle heavy transactions, online analytical processing (OLAP) and online transaction processing (OLTP).

In particular, Microsoft® Exchange Server messaging and Microsoft® SQL Server® database applications are fueling a demand for top-performing storage systems. Dell Compellent Storage Center storage area network (SAN) arrays based on the next-generation Dell Compellent SC8000 controller and utilizing the Dell Fluid Data™ architecture enable tremendous performance advances in these environments.

The Dell Compellent Storage Center 6.3 platform is an enterprise-scale SAN designed to cost-effectively enhance performance



# Storage efficiency for business applications

Dell Compellent Storage Center 6.3 advancements enhance an existing suite of powerful tools, built-in automation and intelligence features to elevate storage performance and efficiency in enterprise data centers.

- **Replication:** Enhanced synchronous replication rounds out the Dell Compellent replication portfolio to provide a comprehensive set of feature-rich options.
- **Directory services:** Lightweight Directory Access Protocol (LDAP) and the Microsoft® Active Directory®

directory service help simplify management of administrator accounts in Dell Compellent storage arrays.

- **Alerts management:** Enhancements to Simple Network Management Protocol (SNMP) are designed to improve centralized management of alerts.
- **Host OS support:** Microsoft Windows Server 2012 OS support includes recent storage area network (SAN) integrations to help offload processes from host to array and free host resources.
- **Volume monitoring:** The Volume Advisor feature enables intelligent

volume placement guidance across multiple systems, helping reduce errors and avoid the need for additional monitoring tools.

- **IP protocol:** Support for IP version 6 (IPv6) allows organizations to capitalize on recent IP protocol advances, including the capability to use more IP addresses than ever before.

These automated tools enable organizations to keep operating costs low while helping increase the efficiency of business-critical application environments.

for write-heavy or I/O-intensive workloads. It utilizes the Fluid Data architecture and optimizes data placement through Dell Compellent Data Progression™ automated tiering by moving data where it is needed based on actual use and performance needs. Moreover, Storage Center 6.3, built on a flexible, persistent hardware platform, scales easily and nondisruptively, allowing data center environments to expand without the need to rip and replace existing hardware. Through perpetual software licensing, organizations with existing

Storage Center systems can easily upgrade to Storage Center 6.3. (See the sidebar, "Fast, flexible expansion.")

## Elevating I/O performance

The introduction of 64-bit architecture in Dell Compellent Storage Center 6.0 established the foundation for enhanced storage performance capabilities. Coupled with SC8000 controller hardware, Storage Center 6.3 builds on this foundation in several important ways. Write optimization with a flash-based stack, accelerated page

allocation, driver tuning and optimization of the software stack help increase performance. End-to-end 16 Gbps Fibre Channel connectivity — from server to switch to storage — is designed to double bandwidth and accelerate access to business-critical applications and data. Along with these enhancements, Storage Center 6.3 is designed to simplify management and improve administration, which helps reduce operating costs. (See the sidebar, "Storage efficiency for business applications.")

## Fast, flexible expansion

Upgrades to Storage Center 6.3 are easy for existing deployments of Dell Compellent Storage Center storage area network (SAN) arrays — enabling organizations to enhance performance without replacing hardware. Storage Center 6.3 is designed to run on Dell Compellent SC8000- and Series 40–based arrays.

Perpetual software licensing available from Dell allows enterprises with a current maintenance agreement to download Storage Center 6.3 features at no additional charge. Moreover, perpetual software licensing helps organizations save up to 87 percent in software costs during the maintenance agreement period; modular hardware expansion helps organizations save up to 47 percent in hardware costs.\*

\* Based on a Dell Compellent Storage Center system with 60 TB capacity estimated to grow 30 percent annually in an organization with a 10-year agreement.

## Assessing performance requirements

Implementing enterprise applications can be a complex undertaking for IT organizations. Successful deployments depend on high-performance storage systems that are easy to manage and quick to scale. Dell Compellent Storage Center 6.3 arrays address specific storage challenges to help optimize workload performance in business-critical application environments.

## Virtual desktops

VDI deployments are a paramount concern for decision makers and stakeholders in today's enterprises. VDI workloads can be extremely taxing on storage resources

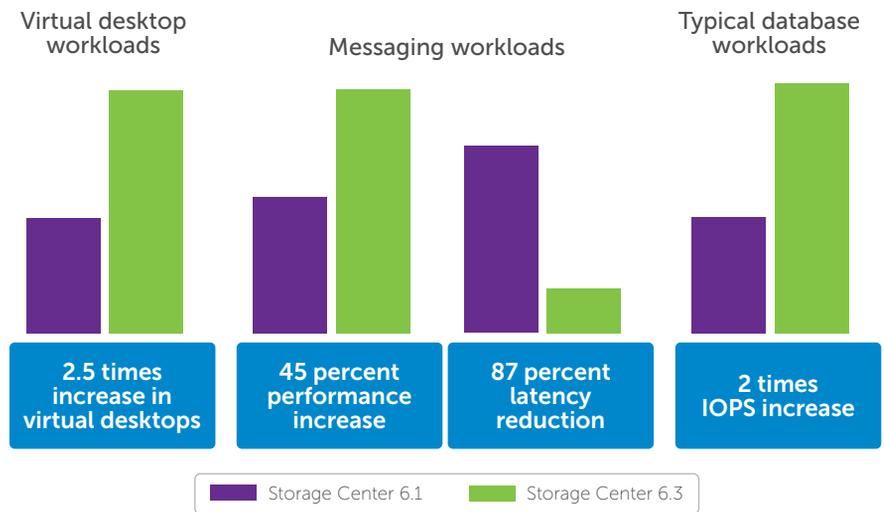
because of the high number of write operations they require. In a typical SAN, disk usage is usually heavier on reads than writes — a typical read-to-write percentage ratio is 70:30. But in a VDI environment, the write ratio is often considerably higher, as much as 90 percent, which may result in significant storage latency that slows overall performance. Voluminous, write-heavy I/O activity stems not only from thousands of employees using applications at the same time, but also from near-continuous communication from the operating systems to centralized storage. A VDI initiative may be doomed if line-of-business users complain to their managers that their virtual desktops are too slow, and they want their old desktop computers back.

### Messaging

Email is active continuously in just about any enterprise workplace, including Microsoft Exchange Server environments. This messaging volume places high demand on storage, and Exchange environments may be write heavy and I/O intensive, particularly in large deployments. Heavy write-I/O and read-I/O spikes may also be experienced when end users start their computers at the same time in the morning and after lunchtime, when they simultaneously pull data down to their local cache from the mailbox server. Exchange servers are often constantly busy communicating with background databases as well. In addition, virtualizing an Exchange environment can add latency to storage operations.

### Databases

In most Microsoft SQL Server database environments, OLTP activity occurs during business hours, and then maintenance occurs during an off-hour window of time. These maintenance activities, which include database backups, restores and re-index activity, can be particularly



Based on testing performed in October 2012 and updated January 2013 at Dell Compellent Technical Solutions Labs by Dell engineers to evaluate performance comparisons between Storage Center 6.3 and Storage Center 6.1 for VDI deployment, Exchange messaging, and SQL Server database workloads. Note: Actual results may vary based on configuration, usage and manufacturing variability.

*Dell Compellent Storage Center 6.3 performance gains when compared with Storage Center 6.1*

demanding on storage systems. Many IT groups are under intensifying pressure to speed maintenance processing and shrink the maintenance window to maximize uptime for online end users.

Moreover, OLTP activity supported by SQL Server databases is prone to bursts from rapid-fire I/O requests, and storage systems need to efficiently handle these I/O surges. Automated storage tiering, together with I/O performance enhancements, helps support I/O spikes without having to add more drives or accelerate response times.

### Measuring storage performance

In testing conducted October 2012 and updated in January 2013 at Dell Compellent Technical Solutions Labs, Dell engineers compared three types of business-critical application workloads. The goal was to assess potential performance improvements that may result from upgrading to Dell Compellent Storage Center 6.3. This test study demonstrated several Storage Center 6.3 performance gains for VDI, Microsoft Exchange Server messaging and Microsoft SQL Server

database environments compared with Storage Center 6.1 (see figure).

### Virtual desktop workloads

The VMware® View™ Planner testing configuration included Dell storage and servers. Storage consisted of Storage Center 6.3 equipped with 200 GB solid-state drives (SSDs) and 600 GB Serial Attached SCSI (SAS) drives. Servers included Dell PowerEdge™ M620 blade servers capable of running approximately 170 Windows 7-based virtual machines per host.

Using VMware View Planner for load generation, the results in this test study showed that Storage Center 6.3 ran 2.5 times more virtual desktops than Storage Center 6.1, while keeping disk latency under the generally accepted 20 ms standard for VDI performance. This increase in the performance ceiling allows the storage system to scale up significantly, helping to delay the need for procuring additional hardware and reduce data center complexity. In addition, fast storage for VDI enables an improved end-user experience with a corresponding productivity boost.



### Messaging workloads

The Jetstress configuration for testing Exchange Server workloads included Dell storage and virtual servers. Storage consisted of Storage Center arrays equipped with 900 GB SAS drives with RAID-5-9 volumes for databases and RAID-10 volumes for transaction logs. Six VMware vSphere® 5.0 ESX servers each hosted two virtual machines running the Microsoft® Windows Server® 2008 R2 OS and Exchange 2010 Jetstress. Two 14 TB volumes and two 800 GB volumes were mapped to the ESX hosts to be used as Virtual Machine File System (VMFS) data stores, and each ESX server had a single 500 GB datastore for boot drives.

The messaging platform consisted of Microsoft Exchange Server 2010 Service Pack 2 (SP2) configured with 50,000 mailboxes. The two Storage Center arrays with independent disks provided isolation of database copies for mailbox resiliency.

Key Exchange Server performance factors between Storage Center 6.3 and Storage Center 6.1 were compared in this benchmark study. Storage Center 6.3 demonstrated a 14 percent latency improvement for database reads and a 76 percent latency improvement for database writes. Averaging read and write latency reductions in these test results indicates that Storage Center 6.3 has the potential to increase Exchange database performance by up to 45 percent. In addition, these test findings indicate that Storage Center 6.3 can decrease Exchange log latency by up to 87 percent.

These latency improvements, combined with the increase in usable I/O, help organizations meet escalating storage demands generated by the growth of busy email environments. Organizations can provide a fast, responsive end-user experience, even during extremely I/O-intensive periods such as computer start-up spikes.

### Database workloads

The Quest Benchmark Factory™ testing configuration included Dell servers and storage. Storage consisted of Dell Compellent Storage Center 6.3 equipped with SSDs and 300 GB 15,000 rpm hard drives. The database was stored on an SSD, and backups were stored on 15,000 rpm hard drives. A 780 GB Microsoft SQL Server 2012 database was hosted on a PowerEdge R820 server running Microsoft Windows Server 2012.

Comparing Storage Center 6.3 to Storage Center 6.1 in this test study, backups required 4 percent less time, restores required 25 percent less time and full database re-indexing required 145 percent less time. These findings indicate that large reductions in maintenance windows are possible using Storage Center 6.3 compared to Storage Center 6.1. The performance results can be particularly advantageous for websites with a high number of online purchase transactions, which typically result in frequent but small I/O requests.

Scalability is also greatly enhanced by the ability to handle more I/Os per second (IOPS) in Storage Center 6.3 than Storage Center 6.1. Depending on the workload, the results of this test study indicate Storage Center 6.3 has the potential to increase IOPS performance up to 100 percent over Storage Center 6.1 when running enterprise workloads.<sup>1</sup>

### Upgrading storage firmware for performance gains

Transaction- and I/O-intensive VDI, Microsoft Exchange Server and Microsoft SQL Server application environments are creating a demand for increased storage performance, including support for extremely heavy write activity. Results from the test study reported in this article

demonstrate significant performance gains achieved by Storage Center 6.3 compared with Storage Center 6.1. As end-user demands continue unabated, the substantial performance advantages enabled by Storage Center 6.3 help organizations bolster enterprise storage environments to meet requirements for business-critical applications. **PS**

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<sup>1</sup> Testing was performed with prerelease Storage Center code version 6.3 and ran OLTP workloads using the Iometer benchmark with a 100 percent random 70:30 read-write mix and 4 KB transfer sizes.