MICROSOFT EXCHANGE SERVER 2010 PERFORMANCE REVIEW USING THE EMC VNX5300 UNIFIED STORAGE PLATFORM
An Architectural Overview

EMC GLOBAL SOLUTIONS

Abstract

This white paper focuses on the performance of the EMC® VNX5300™ unified storage platform, with Microsoft Exchange Server 2010 virtualized using Microsoft Hyper-V. Building-block design methodologies and the use of FAST Cache optimization features are discussed.

February 2012
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Executive summary

Business case
IT administrators supporting Microsoft Exchange Server 2010 are charged with maintaining the highest possible levels of performance and application efficiency. At the same time, most struggle to keep pace with relentless data growth while working to overcome diminishing budgets, and limited expertise in storage administration. Whether you are looking to move to Exchange 2010, or virtualize your current environment—the EMC® VNX™ unified storage platform powered by the Intel® Xeon® processor provides the performance and flexibility required for success.

Today, organizations have made a decisive move to revamp the existing storage strategy by running critical applications like Exchange on a virtualized infrastructure. By consolidating application servers on a virtualized platform, customers can achieve significant cost reductions, and increase the environment’s ability to scale.

This white paper presents customers and field personnel with valuable data that demonstrates how midtier and enterprise organizations can use the VNX5300™ storage platform to meet or exceed performance and scalability objectives, including how to:

- Design well-performing and scalable Exchange 2010 building-blocks
- Increase Exchange 2010 application efficiency
- Achieve faster provisioning
- Achieve balanced performance
- Increase productivity, and simplify storage management and provisioning with the Unisphere™ management interface

Solution overview
This white paper presents methodologies and guidelines for designing and scaling Microsoft Exchange Server 2010 on Microsoft Hyper-V with the EMC VNX5300 unified storage platform. The focal point of VNX5300 performance and functionality testing is to identify:

- Design guidelines and best practices for configuring Exchange 2010 storage on an EMC VNX5300 unified storage platform
- Recommended storage building-block design methodology
- VNX5300 performance validation with Exchange 2010 type I/Os using the Microsoft Jetstress tool
- Results of FAST Cache used with Exchange 2010 I/O types
- Performance impact if one storage processor (SP) fails
Introduction

Purpose
This white paper profiles how partners, customers, and EMC field personnel can deploy the VNX5300 in a similar Exchange 2010 configuration supporting an enterprise-level organization.

The purpose of this white paper is to:
- Provide design guidance for the VNX5300 storage array
- Identify the performance impact if one SP fails
- Identify the increased performance levels when FAST Cache is enabled

Scope
The scope of this white paper is to examine VNX5300 storage system performance characteristics with a simulated Exchange 2010 I/O workload. Guidelines include the recommended storage building-block design, and best design practices.

Customers and field personnel will learn:
- How to design a well-performing Exchange 2010 building-block for the VNX5300 storage array
- Benefits of EMC VNX FAST Cache with Exchange 2010 data
- Steps for using the Unisphere storage management GUI to provision storage quickly and easily

Audience
This white paper is intended for:
- EMC employees
- EMC partners
- Customers, including IT planners, storage architects, and Exchange administrators
- Field personnel, who are tasked with designing and implementing VNX5300 storage in a virtual Microsoft Exchange Server 2010 application environment
Terminology
Table 1 defines terms used in this document.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Background Database Maintenance (BDM)</td>
<td>Process of the Exchange 2010 database maintenance that involves checksumming both active and passive database copies.</td>
</tr>
<tr>
<td>Building-block</td>
<td>Represents the required amount of disk and server resources required to support a specified number of Exchange 2010 users. The amount of required resources is derived from:</td>
</tr>
<tr>
<td></td>
<td>• A specific user profile type</td>
</tr>
<tr>
<td></td>
<td>• Mailbox size</td>
</tr>
<tr>
<td></td>
<td>• Disk requirements</td>
</tr>
<tr>
<td>Database Availability Group (DAG)</td>
<td>A DAG is an Exchange 2010 base component that provides HA and site resilience. A DAG can contain up to 16 Mailbox servers. The servers host a set of databases that provide automatic database-level recovery from failures affecting individual databases. Any server in a DAG can host a copy of a mailbox database from any other server in the DAG.</td>
</tr>
<tr>
<td>FAST Cache</td>
<td>FAST Cache is a performance optimization feature unique to EMC® CLARiiON® CX4, Celerra® NS, and VNX unified storage platforms. FAST Cache uses Flash drives to extend existing cache capacities for accelerated system performance and automatic absorption of unpredicted “spikes” in application workloads.</td>
</tr>
<tr>
<td>Service-level agreement (SLA)</td>
<td>Policies defined by administrators that set the levels of availability, serviceability, and performance of an organization's environment.</td>
</tr>
<tr>
<td>Storage pool</td>
<td>A collection of drives with a specified RAID type.</td>
</tr>
<tr>
<td>Storage pool (heterogeneous)</td>
<td>A storage pool that uses multiple drive types (for example, a mix of SAS and NL-SAS in one pool).</td>
</tr>
<tr>
<td>Storage pool (homogeneous)</td>
<td>A storage pool that uses the same drive types (for example, all NL-SAS).</td>
</tr>
</tbody>
</table>
Technology overview
The following sections identify, and briefly describe the technology and components used in the configuration.

Microsoft Exchange Server 2010
Microsoft Exchange Server 2010 is an enterprise email and communication system that allows businesses and customers to collaborate and share information. EMC enhances Exchange Server 2010 with the industry’s broadest choice of storage platforms, software, and services.

With the new version of Exchange 2010 Microsoft presents a number of new features including, but not limited to:

- DAG for database high availability
- Online mailbox moves
- Larger mailboxes (5 to 10+ GB)

Mailbox servers can now be implemented in database resiliency configurations with database-level replication and failover. Major improvements with the application database structure and I/O reduction include support for a larger variety of disk and RAID configurations including high-performance Flash drives, SAS drives, and high-capacity NL-SAS drives.

Microsoft Windows Server 2008 R2 with Hyper-V
Hyper-V is a hypervisor-based virtualization technology from Microsoft that makes it easier than ever to take advantage of the cost savings of virtualization through Windows Server 2008.

Hyper-V enables customers to make the best use of server hardware investments by consolidating multiple server roles as separate virtual machines running on a single physical machine. It can also efficiently run multiple different operating systems—Windows, Linux, and others—in parallel, on a single server.

VNX family of unified storage platforms
The EMC VNX family delivers industry-leading innovation and enterprise capabilities for file, block, and object storage in a scalable, easy-to-use solution. This next-generation storage platform combines powerful and flexible hardware with advanced efficiency, management, and protection software to meet the demanding needs of today’s enterprises.

All of this is available in a choice of systems ranging from affordable entry-level solutions to high-performance, petabyte-capacity configurations servicing the most demanding application requirements. The VNX family includes the VNXe™ series, purpose-built for the IT manager in entry-level environments, and the VNX series, designed to meet the high-performance, high-scalability requirements of midsize and large enterprises.
The VNX family includes two platform series:

- The VNX series, delivering leadership performance, efficiency, and simplicity for demanding virtual application environments that includes VNX7500™, VNX5700™, VNX5500™, VNX5300, and VNX5100™
- The VNXe (entry) series with breakthrough simplicity for small and medium businesses that includes VNXe3300™ and VNXe3100™

Customers can benefit from new VNX features as follows:

<table>
<thead>
<tr>
<th>Feature</th>
<th>VNX series</th>
<th>VNXe series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Next-generation unified storage, optimized for virtualized applications</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Capacity optimization features including compression, deduplication, thin provisioning, and application-centric copies</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>High availability, designed to deliver five 9s availability</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Automated tiering with FAST VP (Fully Automated Storage Tiering for Virtual Pools) and FAST Cache that can be optimized for the highest system performance and lowest storage cost simultaneously</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Multiprotocol support for file and block protocols</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Object access through Atmos™ Virtual Edition (Atmos VE)</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Simplified management with EMC Unisphere for a single management framework for all NAS, SAN, and replication needs</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Up to three times improvement in performance with the latest Intel multicore CPUs, optimized for Flash</td>
<td>✔️</td>
<td></td>
</tr>
</tbody>
</table>

**Note**
VNXe does not support block compression.

The EMC VNX family utilizes the Intel Xeon 5600 series processors, which help make it 2-3x faster overall than its predecessor. The VNX quad-core processor supports the demands of advanced storage capabilities such as virtual provisioning, compression, and deduplication. Furthermore, performance of the Xeon 5600 series enables EMC to realize its vision for FAST on the VNX, with optimized performance and capacity, without tradeoffs, in a fully automated fashion.

EMC provides a single, unified storage plug-in to view, provision, and manage storage resources from VMware vSphere™ across EMC Symmetrix®, VNX family, CLARiiON, and Celerra storage systems, helping users to simplify and speed up VMware® storage management tasks.

The VNX family includes five new software suites and three new software packs, making it easier and simpler to attain the maximum overall benefits.
Software suites available

- FAST Suite—Automatically optimizes for the highest system performance and the lowest storage cost simultaneously (not available for the VNXe series or the VNX5100).
- Local Protection Suite—Practices safe data protection and repurposing (not applicable to the VNXe3100 as this functionality is provided at no additional cost as part of the base software).
- Remote Protection Suite—Protects data against localized failures, outages, and disasters.
- Application Protection Suite—Automates application copies and proves compliance.
- Security and Compliance Suite—Keeps data safe from changes, deletions, and malicious activity.

Software packs available

- Total Efficiency Pack—Includes all five software suites (not available for the VNX5100 and VNXe series).
- Total Protection Pack—Includes local, remote, and application protection suites (not applicable to the VNXe3100).
- Total Value Pack—Includes all three protection software suites and the Security and Compliance Suite (the VNX5100 and VNXe3100 exclusively support this package).
EMC VNX5300

The VNX5300 model provides high-performing, unified storage with unsurpassed simplicity and efficiency, and is optimized for virtual applications. Organizations will achieve new levels of performance, protection, compliance, and ease-of-management.

The storage array delivers a single-box block and file solution, which offers a centralized point of management for distributed environments. This makes it possible to dynamically grow, share, and cost-effectively manage multiprotocol file systems and provide multiprotocol block access.

Table 2 lists VNX5300 model features for the block only option. For additional VNX specifications visit:


<table>
<thead>
<tr>
<th>Table 2. VNX5300 model features summary (for block option only)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>System feature</strong></td>
</tr>
<tr>
<td>Minimum/Maximum drives per system</td>
</tr>
<tr>
<td>Drive Enclosure Options (DAE)</td>
</tr>
<tr>
<td>Array enclosure</td>
</tr>
<tr>
<td>Drive Enclosure Options (DAE)</td>
</tr>
<tr>
<td>Array enclosure</td>
</tr>
<tr>
<td>Drive types</td>
</tr>
<tr>
<td>I/O architecture</td>
</tr>
<tr>
<td>RAID options</td>
</tr>
<tr>
<td>CPU / Memory per array</td>
</tr>
<tr>
<td>File protocols</td>
</tr>
<tr>
<td>Blocks (Number of SPs)</td>
</tr>
<tr>
<td>Block protocols</td>
</tr>
<tr>
<td>Max block flex I/O modules per array</td>
</tr>
<tr>
<td>Max raw capacity</td>
</tr>
<tr>
<td>Max SAN hosts</td>
</tr>
<tr>
<td>Max number of pools</td>
</tr>
<tr>
<td>Max number of LUNs</td>
</tr>
<tr>
<td>Max total ports per array</td>
</tr>
<tr>
<td>2/4/8 Gb/s FC Max ports per array</td>
</tr>
<tr>
<td>1 GBaseT iSCSI Max total ports per array</td>
</tr>
<tr>
<td>10 GbE iSCSI Min/Max total ports per array</td>
</tr>
<tr>
<td>FCoE Max total ports per array</td>
</tr>
<tr>
<td>6 Gb/s SAS buses for DAE connections</td>
</tr>
</tbody>
</table>
EMC Unisphere

EMC Unisphere provides a flexible, integrated experience for managing CLARiiON and Celerra systems and the new, next-generation VNX series storage platforms in a single pane of glass. This new approach to midtier storage management fosters simplicity, flexibility, and automation. Unisphere’s unprecedented ease-of-use is reflected in intuitive task-based controls, customizable dashboards, and single-click access to real-time support tools and online customer communities.

Unisphere features include:

- Task-based navigation and controls that offer an intuitive, context-based approach to configuring storage, creating replicas, monitoring the environment, managing host connections, and accessing the Unisphere support ecosystem.
- A self-service Unisphere support ecosystem, accessible with one click from Unisphere, that provides users with quick access to real-time support tools, including live chat support, software downloads, product documentation, best practices, FAQs, online communities, ordering spares, and submitting service requests.
- Customizable dashboard views and reporting capabilities that enable at-a-glance management by automatically presenting users with valuable information in terms of how they manage their storage. For example, customers can develop custom reports up to 18 times faster with Unisphere.
- Common management provides a single sign-on and integrated experience for managing CLARiiON, Celerra, and VNX series platforms.

<table>
<thead>
<tr>
<th>Management and base software</th>
<th>Integrated software includes:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Unisphere</td>
</tr>
<tr>
<td></td>
<td>• File Deduplication/Compression</td>
</tr>
<tr>
<td></td>
<td>• Block Compression</td>
</tr>
<tr>
<td></td>
<td>• Virtual Provisioning™</td>
</tr>
<tr>
<td></td>
<td>• SAN Copy™</td>
</tr>
</tbody>
</table>
**Physical environment**
The following sections present the configuration details of the simulated test environment.

**Targeted customer profile**
Table 3 details the targeted simulated customer profile.

**Note**
The 20,000 Exchange 2010 user profile is not the limiting factor for the VNX5300. The maximum user configuration will depend on the number of Exchange 2010 users, and mailbox size. Contact an EMC sales representative for information on determining your specific calculation.

<table>
<thead>
<tr>
<th>Item</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Exchange 2010 users simulated</td>
<td>20,000 users</td>
</tr>
<tr>
<td>Number of hypervisor hosts</td>
<td>2 (1 used in testing)</td>
</tr>
<tr>
<td>Number of simulated Exchange Mailbox server virtual machines</td>
<td>5 used, with 10 simulated</td>
</tr>
<tr>
<td>Number of Exchange users per virtual machine</td>
<td>4,000 users in a switchover condition (2,000 active/2,000 passive)</td>
</tr>
<tr>
<td>Number of DAGs and database copies</td>
<td>1 DAG with 2 copies</td>
</tr>
<tr>
<td>User profile (in Mailbox Resiliency configuration)</td>
<td>150 messages/user/day (0.15 IOPS)</td>
</tr>
<tr>
<td>Mailbox size</td>
<td>2 GB</td>
</tr>
<tr>
<td>Database read/write ratio (in Mailbox Resiliency configuration)</td>
<td>3:2</td>
</tr>
<tr>
<td>Background Database Maintenance (BDM)</td>
<td>Enabled 24 x 7</td>
</tr>
<tr>
<td>Number of databases per virtual machine</td>
<td>8</td>
</tr>
<tr>
<td>Number of users per database</td>
<td>500</td>
</tr>
<tr>
<td>Database LUN size</td>
<td>1.6 TB</td>
</tr>
<tr>
<td>Log LUN size</td>
<td>50 GB</td>
</tr>
<tr>
<td>Total database size used for performance testing</td>
<td>~ 40 TB</td>
</tr>
</tbody>
</table>
Physical architecture diagram

Figure 1 depicts the physical architecture of the simulated test environment.

Figure 1.  Simulated Exchange 2010 reference architecture with EMC VNX5300
**Hardware**

Table 4 lists the hardware used in testing.

<table>
<thead>
<tr>
<th>Item</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage platform</td>
<td>EMC VNX5300</td>
</tr>
<tr>
<td>Storage connectivity to host (FC, iSCSI)</td>
<td>FC (iSCSI is also tested)</td>
</tr>
<tr>
<td>FAST Cache</td>
<td>Two 200 GB Flash drives providing 200 GB read/write cache (was enabled and used only during the FAST Cache testing phase)</td>
</tr>
<tr>
<td>Number of storage controllers</td>
<td>2</td>
</tr>
<tr>
<td>Number of storage ports used</td>
<td>4 (2 per storage controller)</td>
</tr>
<tr>
<td>Maximum bandwidth of storage connectivity to host</td>
<td>2 x 8 Gb/s</td>
</tr>
<tr>
<td>Fabric switch</td>
<td>8 Gb/s FC switching module</td>
</tr>
<tr>
<td>Ethernet switch</td>
<td>1 Gb/s Ethernet switch for iSCSI connectivity testing</td>
</tr>
<tr>
<td>Physical host servers</td>
<td>Quad eight-core @ 1.87 GHz, 128 GB RAM</td>
</tr>
<tr>
<td>Host bus adapters (HBAs)</td>
<td>8 GB HBAs (2 per hypervisor host)</td>
</tr>
<tr>
<td>Total number of disks tested in the solution</td>
<td>80 disks 2 TB NL-SAS (7.2k rpm)</td>
</tr>
<tr>
<td>Maximum number of spindles that can be hosted in the storage</td>
<td>125</td>
</tr>
</tbody>
</table>

**Software**

Table 5 lists the software used in testing.

<table>
<thead>
<tr>
<th>Item</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypervisor host servers</td>
<td>Windows Server 2008 R2 Enterprise Edition with Hyper-V</td>
</tr>
<tr>
<td>Exchange Server virtual machines</td>
<td>Windows Server 2008 R2 Enterprise Edition</td>
</tr>
<tr>
<td>Exchange Server ese .dll</td>
<td>Exchange Server 2010 SP1 (14.01.0218.012)</td>
</tr>
<tr>
<td>Multipath and I/O balancing</td>
<td>EMC PowerPath® 5.5</td>
</tr>
<tr>
<td>VNX5300 block operating system</td>
<td>VNX5300 Operating Environment for Block 05.31.000.5.003</td>
</tr>
</tbody>
</table>
Exchange Server 2010 storage design guidance on the VNX5300

The following sections provide design guidance for creating a virtualized Exchange 2010 building-block on the EMC VNX5300 series midrange storage platform. The process is essentially the same for virtual as for a physical environment, except that a physical server is required for each virtual machine.

Design guidelines for implementing Exchange 2010 on the VNX5300 platform

The following list details the storage sizing guidelines followed during deployment of Exchange 2010 on the VNX storage platform:

- Isolate the Exchange server database workload to a different set of spindles from other I/O-intensive applications or workloads. This ensures the highest level of performance for Exchange and simplifies troubleshooting in the event of a disk-related Exchange performance issue.

- Always calculate I/O spindle requirements first, then capacity requirements.

- When calculating the IOPS requirements, apply any I/O overhead factor like antivirus, BDM, and other applications such as mobile device applications to your user profile.

- Balance LUNs across the array storage processors to take best advantage of VNX5300 performance and HA.

- In a mailbox resiliency deployment, It is not required that the database file and logs from the same mailbox database are placed onto different physical disks.

- Microsoft recommends a maximum database size of 200 GB in an environment where DAG is not being used. When DAG is being used with a minimum of two database copies, the maximum database size can be up to 2 TB. Consider backup (if applicable) and restore times when calculating the database size.

- Always format Windows volumes with an Allocation Unit size of 64k to optimize Exchange performance on VNX systems.

- Thick LUNs are recommended for Exchange 2010 databases and logs on the VNX storage platform.

- Use the default page size value (16k) on the VNX5300.

For more information about Exchange 2010 Mailbox server storage design, visit the following website:


Exchange 2010 storage design methodology

Sizing and configuring storage for use with Exchange Server 2010 can be a complicated process, driven by many variables and factors, which vary from organization to organization. Properly configured Exchange storage, combined with properly sized server and network infrastructure, can guarantee smooth Exchange operation and the best user experience.

One of the methods that can be used to simplify the sizing and configuration of large Microsoft Exchange Server 2010 environments is to define a unit of measure—a building-block.
What is a building-block?

A building-block represents the required amount of resources needed to support a specific number of Exchange 2010 users on a single virtual machine. You derive the number of required resources from a specific user profile type, mailbox size, and disk requirement. Using the building-block approach removes the guesswork and simplifies the implementation of Exchange virtual machines.

Why use the building-block approach?

After designing the initial Exchange Mailbox server virtual machine building-block, you can easily reproduce it to support all of the users in your organization that share similar user profile characteristics. By using this approach, Exchange administrators can create their own building-blocks based on their company’s Exchange environment requirements. This approach is very helpful when a customer expects future growth, as it makes Exchange environment additions much easier and straightforward. You can apply this methodology when deploying Exchange in either a physical or a virtual environment.

EMC’s best practices involving the building-block approach for an Exchange Server design has been very successful for many customer implementations.

Exchange 2010 building-block design process overview

The high-level building-block design process for Exchange 2010 is similar to that used for previous versions, such as Exchange 2003 and 2007. The process is divided into three phases:

- **Phase 1**—Collect user requirements
- **Phase 2**—Design the storage architecture based on user requirements
- **Phase 3**—Validate the design

Note

If the user profile is unknown, use the Microsoft Exchange Server Profile Analyzer tool to collect the estimated statistical information from a single mailbox store, or across an Exchange Server organization. Download the Microsoft Exchange Server Profile Analyzer tool:

## Building-block design process flow

Table 6 outlines the process flow applied to develop and validate the test environment’s storage design.

### Table 6. Building-block design phases

<table>
<thead>
<tr>
<th>Phase</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Collect user requirements</strong>&lt;br&gt;In this phase, the Exchange administrator identifies:&lt;br&gt;  - Number of users&lt;br&gt;  - User I/O profile = Sent/received messages per user per day, and average message size&lt;br&gt;  - Mailbox size&lt;br&gt;  - Deleted item retention&lt;br&gt;  - Concurrency&lt;br&gt;  - High-availability&lt;br&gt;  - Replication required, number of DAG database copies&lt;br&gt;  - Backup/restore requirements (recovery time objective (RTO) and/or recovery point objective (RPO))&lt;br&gt;  - Third-party software that affects space or I/O (BlackBerry, antivirus software)</td>
</tr>
<tr>
<td>2</td>
<td><strong>Design the storage architecture based on user requirements</strong>&lt;br&gt;In this phase, the Exchange design is developed using the following tools:&lt;br&gt;  - Building-block methodology for deploying Exchange 2010 solutions&lt;br&gt;  - EMC and Microsoft published best practices&lt;br&gt;  - Exchange 2010 Solution Review Program (ESRP) documentation: <a href="http://technet.microsoft.microsoft.com/en-us/exchange/ff182054.aspx">http://technet.microsoft.com/en-us/exchange/ff182054.aspx</a></td>
</tr>
<tr>
<td>3</td>
<td><strong>Validate the design</strong>&lt;br&gt;In this phase, the Exchange design is validated using the following tools:&lt;br&gt;  - Microsoft Exchange Server Jetstress 2010 to validate storage performance&lt;br&gt;  - Microsoft Exchange Load Generator 2010 (LoadGen) to validate end-to-end Exchange server performance.</td>
</tr>
</tbody>
</table>

**Note** This paper provides performance results based on testing with the Jetstress tool only.
Applying the building-block design process to Exchange 2010

The following sections walk you through the storage design process.

Phase 1—Collect user requirements

Table 7 details the user requirements used to validate both the building-block storage design methodology, and VNX5300 performance levels.

**Note**
The 20,000 Exchange 2010 users configuration is not the limiting factor for the VNX5300. The maximum user configuration will depend on the Exchange 2010 user profile and mailbox size. Contact an EMC sales representative for information on determining your specific calculation.

<table>
<thead>
<tr>
<th>Item</th>
<th>User requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of mailboxes in the environment</td>
<td>20,000 users</td>
</tr>
<tr>
<td>Mailbox size</td>
<td>2 GB per user</td>
</tr>
<tr>
<td>User profile (in Mailbox Resiliency configuration)</td>
<td>150 messages/user/day (0.15 IOPS)</td>
</tr>
<tr>
<td>Additional IOPS overhead requirement</td>
<td>Yes, 20%</td>
</tr>
<tr>
<td>Target average message size</td>
<td>75 KB</td>
</tr>
<tr>
<td>Outlook mode</td>
<td>100% MAPI</td>
</tr>
<tr>
<td>Number of Exchange Mailbox servers</td>
<td>10</td>
</tr>
<tr>
<td>Number of active mailboxes/server</td>
<td>4,000 in a switchover situation (2,000 active / 2,000 passive)</td>
</tr>
<tr>
<td>HA requirements</td>
<td>Two database copies in a DAG</td>
</tr>
<tr>
<td>Deleted items retention window (&quot;dumpster&quot;)</td>
<td>14 days</td>
</tr>
<tr>
<td>Logs protection buffer</td>
<td>3 days</td>
</tr>
<tr>
<td>Database read/write ratio</td>
<td>3:2 in mailbox resiliency configurations</td>
</tr>
<tr>
<td>24 x 7 BDM configuration</td>
<td>Enabled</td>
</tr>
</tbody>
</table>

Phase 2—Design the storage architecture based on user requirements

Based on the user requirements identified in Phase 1, we can design an Exchange 2010 DAG configuration for our test customer environment. In this configuration each Exchange database is RAID-protected by the VNX5300 storage platform, and replicated to a different Exchange mailbox server that is a member of the same Exchange 2010 DAG.

All 20,000 users in our example are placed in one DAG and evenly distributed across ten Mailbox servers, as shown in Figure 1. These ten Mailbox servers are configured as virtual
machines across two Hyper-V servers with five server virtual machines on each hypervisor host. Each Mailbox server virtual machine is designed to accommodate a failure or maintenance condition of other Exchange mailbox virtual machines. During such an event, each Mailbox server virtual machine is sized to accommodate 4,000 users.

As mentioned earlier, Exchange virtual machines on each Hyper-V host are designed to support 4,000 users in the active/passive configuration, 2,000 active users during normal operation, and an additional 2,000 users in case of database switchover from the other Mailbox server. If the Exchange Mailbox server within the same Hyper-V server fails, its passive copies are activated on the other DAG member located on a different Hyper-V server.

**Calculating I/O requirements**

The number of disks and final storage requirements are determined from two factors:

- User IOPS requirements
- User capacity requirements

The following basic formula is used to calculate how many disks are required for the Exchange 2010 databases and logs:

\[(\text{IOPS} \times \%R) + \text{WP} \times (\text{IOPS} \times \%W) / \text{Physical Disk Speed} = \text{Required Physical Disks}\]

Where:

- **IOPS**—the number of Exchange 2010 input/output operations per second, plus any overhead
- **\%R**—the percentage of I/Os that are reads
- **\%W**—the percentage of I/Os that are writes
- **WP**—the RAID write penalty multiplier (RAID 1=2, RAID 5=4, RAID 6=6)
- **Physical Disk Speed**—It was determined that 7.2k rpm NL-SAS drives can deliver 65 Exchange 2010 IOPS.

Additional factors such as archiving, journaling, and virus protection can also be added in the calculation. In addition specific user profiles (for example, BlackBerry users) may exhibit a much higher I/O load than the average loads. Refer to the vendor-specific documentation to understand the additional IOPS overhead that may be introduced. These factors, in addition to a prudent amount of overhead for unexpected spikes in the user load, must be considered.

**Important**

First calculate the user IOPS for each building-block \((\text{Users} \times \text{IOPS per user}) + 20\% \text{ (overhead and BDM)}\). Next, add in the write penalty and divide by \text{I/O per spindle} for Exchange 2010.
The following example shows IOPS calculations requirements for a 4,000-user building-block with a 150 messages per user/per day profile @ 0.15 IOPS.

4,000 users x 0.15 IOPS per user = 600 IOPS
600 PS + 20% overhead = 720 IOPS

Note
600 IOPS is the target to use during storage validation with Jetstress.
720 IOPS is the number to use for disk calculations.

Determining disk requirements based on different RAID types

Exchange 2010 is optimized to work on different types of drives and RAID configurations. To choose the best option, calculate the potential IOPS achieved for different RAID types.

Table 8 shows calculation examples to determine disk requirements that are based on using 7.2k rpm NL-SAS drives with different RAID types. From our example you can see that 16 disks in RAID 10, 26 disks in RAID 5, or 34 disks in RAID 6 are needed to meet the I/O requirement for a 4,000-user building-block. The final disk requirements and RAID type are determined when the capacity requirements are finalized.

<table>
<thead>
<tr>
<th>RAID 10</th>
<th>RAID 5</th>
<th>RAID 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>(720 x .60) + 2(720 x .40) = 1,008 / 65 = 16 disks</td>
<td>(720 x .60) + 4(720 x .40) = 1,584 / 65 = 26 disks</td>
<td>(720 x .60) + 6(720 x .40) = 2,160 / 65 = 34 disks</td>
</tr>
</tbody>
</table>

Note  Each customer scenario and application requires specific consideration for the disk types and RAID groups associated with the environment. While RAID 6 is often recommended for most situations that leverage drives over 1 TB, this specific configuration leveraged far fewer drives using RAID 10.

Calculating capacity requirements

Now that IOPS calculations are finalized, the next step is to calculate capacity requirements in order to determine how many disks will be required for a final configuration. There are a number of factors that impact the storage capacity requirements for the Mailbox database. It is recommended that you review the Microsoft TechNet article Understanding Mailbox Database and Log Capacity Factors for additional information.

Use the Microsoft Mailbox Server Role Requirements Calculator to calculate the capacity requirements:


It is important to note that the Microsoft Exchange 2010 Role Calculator recommends that you consult a storage vendor, because it does not provide storage design recommendations such as RAID groups, storage pools, number of disks, disk types, IOPS per disk, and others. This is because the storage design largely depends on the type of storage array used.
Table 9 summarizes Exchange 2010 capacity requirements using the Microsoft calculator. Calculations are based on the user profile requirements used in the test environment.

### Table 9. Capacity requirements per server

<table>
<thead>
<tr>
<th>Total database LUN size requirements per server</th>
<th>Total log LUN size requirements per server</th>
<th>Total LUN size and capacity required per server</th>
</tr>
</thead>
<tbody>
<tr>
<td>13,200 GB (1,650 GB x 8 LUNs per server)</td>
<td>400 GB (50 GB x 8 LUNs per server)</td>
<td>13,600 GB (16 LUNs)</td>
</tr>
</tbody>
</table>

Total required capacity per server:

- **Total space needed** =
  \[(\text{Database LUN size} + \text{Log LUN size}) \times \text{LUN count} = (1,650 + 50 \text{ GB}) \times 8 = 13,600 \text{ GB}\]

A 2 TB NL-SAS drive will provide around 1,834 GB of usable capacity on VNX systems. To determine spindle requirements, divide the total capacity required for databases and logs by the spindle capacity:

- **Spindles needed** = \[
  \frac{13,600 \text{ GB}}{1,834 \text{ GB}} = 8 \text{ (sixteen 2 TB drives in RAID 1/0)}
  \]

Therefore, sixteen 2 TB NL-SAS disks are the best choice to meet the capacity requirement for one building-block of 4,000 users per server with a 2 GB mailbox quota. This totals 80 disks for five building-blocks supporting a 20,000 user configuration.

Table 10 summarizes the database and log LUN sizes used in the configuration.

### Table 10. Database LUN and log LUN sizes

<table>
<thead>
<tr>
<th>Database LUN size</th>
<th>Log LUN size</th>
<th>Number of LUNs per server</th>
<th>Number of mailboxes per database</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,650 GB</td>
<td>50 GB</td>
<td>16 LUNs (8 database and 8 logs)</td>
<td>500 users</td>
</tr>
</tbody>
</table>

The calculations performed in the previous sections indicate that both capacity and IOPS require the same number of disks. Therefore, 16 disks are the best choice to support 4,000 users for a Mailbox server virtual machine.

**Phase 3 - Validate the design**

To validate our storage design and verify the performance and stability of the VNX5300, we used Microsoft Jetstress 2010. Jetstress helps verify storage performance by simulating Exchange I/O load. Specifically, Jetstress simulates the Exchange database and log file loads produced by a specified number of users. The detailed test configuration and results are provided in the Performance validation and test results section of this white paper.

Using storage pools for the VNX5300 configuration with Exchange 2010 storage

Now that we have determined the number of spindles required to support the IOPS and capacity requirements of the building-block, we need to determine the best way to provision LUNs on the array for that building-block. There are two main methods that can be used to configure Exchange storage on VNX systems:

- Traditional RAID groups
- Storage pools

Using homogeneous, thick storage pools for deploying Exchange storage on VNX systems can help to simplify LUN provisioning. There are three main models that can be used when designing storage pools for Exchange 2010:

- **Single storage pool**: One large, homogeneous storage pool for all Exchange database and logs is the simplest method and provides the best space utilization. However, a single pool is not recommended when multiple copies of the same database are located on the same physical array.

- **One storage pool per Mailbox server**: A storage pool for each Exchange Mailbox server provides more granularity when laying out LUNs on the array. If designed properly it will provide isolation of database copies to separate sets of spindles and can minimize any disk contention issues that can surface during activities such as seeding and reseeding, backup, and online maintenance (BDM). However, depending on the number of Mailbox servers you have, this model may result in many pools, which can exceed the limit of the specific storage array model.

- **One storage pool per database copy**: If Exchange 2010 is deployed in a mailbox resiliency model with multiple database copies, a storage pool for each database copy ensures that each copy is isolated on a different set of spindles on the array. In this model, multiple Mailbox servers have database LUNs in the same storage pool; therefore there is a chance that activities such as seeding, reseeding, backup, and online maintenance (BDM) on one Mailbox server could impact performance on another Mailbox server.

In our test environment for example, we have configured one homogeneous RAID 10 storage pool with sixteen 2 TB NL-SAS disks per each Mailbox server. This configuration provides just over 14.6 TB of usable storage, and meets the total mailbox capacity requirements for one building-block of 4,000 users.
Figure 2 provides details about this configuration from the VNX Unisphere management interface.

<table>
<thead>
<tr>
<th>Pools</th>
<th>RAID Type</th>
<th>Drive Type</th>
<th>User Capacity (GB)</th>
<th>Free Capacity (GB)</th>
<th>% Consumed</th>
<th>Subscribed (GB)</th>
<th>% Subscribed</th>
<th>FAST Cache</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pool 1</td>
<td>RAID1/0</td>
<td>NL SAS</td>
<td>14050.569</td>
<td>647.262</td>
<td></td>
<td>10,979.25</td>
<td>95.4%</td>
<td>Off</td>
</tr>
<tr>
<td>Pool 2</td>
<td>RAID1/0</td>
<td>NL SAS</td>
<td>14050.569</td>
<td>647.262</td>
<td></td>
<td>10,979.25</td>
<td>95.4%</td>
<td>Off</td>
</tr>
<tr>
<td>Pool 3</td>
<td>RAID1/0</td>
<td>NL SAS</td>
<td>14050.569</td>
<td>647.262</td>
<td></td>
<td>10,979.25</td>
<td>95.4%</td>
<td>Off</td>
</tr>
<tr>
<td>Pool 4</td>
<td>RAID1/0</td>
<td>NL SAS</td>
<td>14050.569</td>
<td>647.262</td>
<td></td>
<td>10,979.25</td>
<td>95.4%</td>
<td>Off</td>
</tr>
<tr>
<td>Pool 5</td>
<td>RAID1/0</td>
<td>NL SAS</td>
<td>14050.569</td>
<td>647.262</td>
<td></td>
<td>10,979.25</td>
<td>95.4%</td>
<td>Off</td>
</tr>
</tbody>
</table>

**Figure 2. Storage pool configuration details**

From each storage pool we have configured eight Exchange database LUNs and eight log LUNs. All LUNs within the pool were automatically balanced between the two SPs during the creation process.

Figure 3 shows the detailed information about the database and log LUNs in Unisphere.

<table>
<thead>
<tr>
<th>Name</th>
<th>ID</th>
<th>State</th>
<th>RAID Type</th>
<th>Storage Pool</th>
<th>User Capacity</th>
<th>Current Owner</th>
</tr>
</thead>
<tbody>
<tr>
<td>VM1_DB_1</td>
<td>1</td>
<td>Ready</td>
<td>RAID1/0</td>
<td>Pool 1</td>
<td>1650.000 SP B</td>
<td>B</td>
</tr>
<tr>
<td>VM1_DB_2</td>
<td>2</td>
<td>Ready</td>
<td>RAID1/0</td>
<td>Pool 1</td>
<td>1650.000 SP B</td>
<td>A</td>
</tr>
<tr>
<td>VM1_DB_3</td>
<td>3</td>
<td>Ready</td>
<td>RAID1/0</td>
<td>Pool 1</td>
<td>1650.000 SP B</td>
<td>A</td>
</tr>
<tr>
<td>VM1_DB_4</td>
<td>4</td>
<td>Ready</td>
<td>RAID1/0</td>
<td>Pool 1</td>
<td>1650.000 SP B</td>
<td>A</td>
</tr>
<tr>
<td>VM1_DB_5</td>
<td>5</td>
<td>Ready</td>
<td>RAID1/0</td>
<td>Pool 1</td>
<td>1650.000 SP B</td>
<td>A</td>
</tr>
<tr>
<td>VM1_DB_6</td>
<td>6</td>
<td>Ready</td>
<td>RAID1/0</td>
<td>Pool 1</td>
<td>1650.000 SP B</td>
<td>A</td>
</tr>
<tr>
<td>VM1_DB_7</td>
<td>7</td>
<td>Ready</td>
<td>RAID1/0</td>
<td>Pool 1</td>
<td>1650.000 SP B</td>
<td>A</td>
</tr>
<tr>
<td>VM1_DB_8</td>
<td>8</td>
<td>Ready</td>
<td>RAID1/0</td>
<td>Pool 1</td>
<td>1650.000 SP B</td>
<td>A</td>
</tr>
<tr>
<td>VM1_Lcq_1</td>
<td>9</td>
<td>Ready</td>
<td>RAID1/0</td>
<td>Pool 1</td>
<td>50.000 SP B</td>
<td>B</td>
</tr>
<tr>
<td>VM1_Lcq_2</td>
<td>10</td>
<td>Ready</td>
<td>RAID1/0</td>
<td>Pool 1</td>
<td>50.000 SP B</td>
<td>A</td>
</tr>
<tr>
<td>VM1_Lcq_3</td>
<td>11</td>
<td>Ready</td>
<td>RAID1/0</td>
<td>Pool 1</td>
<td>50.000 SP B</td>
<td>A</td>
</tr>
<tr>
<td>VM1_Lcq_4</td>
<td>12</td>
<td>Ready</td>
<td>RAID1/0</td>
<td>Pool 1</td>
<td>50.000 SP B</td>
<td>A</td>
</tr>
<tr>
<td>VM1_Lcq_5</td>
<td>13</td>
<td>Ready</td>
<td>RAID1/0</td>
<td>Pool 1</td>
<td>50.000 SP B</td>
<td>A</td>
</tr>
<tr>
<td>VM1_Lcq_6</td>
<td>14</td>
<td>Ready</td>
<td>RAID1/0</td>
<td>Pool 1</td>
<td>50.000 SP B</td>
<td>A</td>
</tr>
<tr>
<td>VM1_Lcq_7</td>
<td>15</td>
<td>Ready</td>
<td>RAID1/0</td>
<td>Pool 1</td>
<td>50.000 SP B</td>
<td>A</td>
</tr>
</tbody>
</table>

**Figure 3. Exchange server database and log LUNs configuration**
Performance validation and test results
The following section provides information and performance results based on VNX5300 testing with Exchange 2010 Jetstress, as follows:

- **Test 1**: Validate VNX5300 performance with four building-blocks (16,000 users at 0.15 IOPS per user)
- **Test 2**: Scale configuration, and validate VNX5300 performance with five building-blocks (20,000 users at 0.15 IOPS per user)
- **Test 3**: Validate VNX5300 performance during an SP failure (simulate the loss of a SP with four building-blocks, 16,000 users at 0.15 IOPS per user)
- **Test 4**: Impact and characterization of FAST Cache with Exchange 2010 I/O (Jetstress validates VNX5300 performance with 16,000 users, and FAST Cache enabled on database LUNs)
- **Test 5**: Identify Exchange 2010 performance on VNX5300 with iSCSI

**Note**
In all tests, one Hyper-V root server with five virtual machines is used to simulate the Exchange 2010 environment, and validate storage performance. Testing simulates a worst-case scenario, where all databases are active on five Mailbox server virtual machines.
Test 1: Validation of VNX5300 performance with four building-blocks (16,000 users at 0.15 IOPS per user)

In this initial test, Jetstress is run on four virtual machines, simulating 16,000 active users at 0.15 IOPS with a 2 GB mailbox quota. In other words, testing targets four building-blocks with a total of 32 TB Exchange 2010 data. A single RAID 1/0 storage pool, which consists of sixteen 2 TB NL-SAS drives, is configured to support each building-block.

Figure 4 displays VNX5300 performance results with four Exchange 2010 building-blocks. A two-hour Jetstress test was run against four Mailbox virtual machines simultaneously to simulate a load of 4,000 users per server with a user profile of 150 messages per user per day at 0.15 IOPS, with a 2 GB mailbox.

![Figure 4. Exchange 2010 performance and scalability on VNX5300 with 16,000 users](image)

In the first performance test, 2,651 Jetstress (Exchange user) IOPS are achieved. This is 251 IOPS more than the target of 2,400 IOPS. All latencies are well under Microsoft’s suggested thresholds referenced in Table 11. Table 11 details an IOPS and disk response time summary across all four servers.

<table>
<thead>
<tr>
<th>Database I/O</th>
<th>Target</th>
<th>Four servers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Achieved Exchange transactional IOPS</td>
<td>2,400 IOPS (4 x 600)</td>
<td>2,651 IOPS</td>
</tr>
<tr>
<td>Average database disk read latency (ms)</td>
<td>&lt;20 ms</td>
<td>16 ms</td>
</tr>
<tr>
<td>Average database disk write latency (ms)</td>
<td>&lt;20 ms and</td>
<td>3 ms</td>
</tr>
<tr>
<td>Average log disk write latency (ms)</td>
<td>&lt;10 ms</td>
<td>2 ms</td>
</tr>
</tbody>
</table>

In the second performance test, 3,452 Jetstress (Exchange user) IOPS are achieved. This is 452 IOPS more than the target of 3,000 IOPS. All latencies are well under Microsoft’s suggested thresholds referenced in Table 11. Table 11 details an IOPS and disk response time summary across all four servers.

<table>
<thead>
<tr>
<th>Transaction log I/O</th>
<th>Target</th>
<th>Four servers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average log disk write latency (ms)</td>
<td>&lt;10 ms</td>
<td>2 ms</td>
</tr>
</tbody>
</table>
It is important to note that the achieved transactional IOPS reported by Jetstress only represent Exchange user IOPS (DB reads/sec and DB writes/sec). Table 11 and Figure 4 detail total I/Os produced by Jetstress.

Figure 5 provides back-end I/O throughput on the VNX5300 during a two-hour Jetstress test with 16,000 users at a 0.15 IOPS user profile. During this test, the VNX5300 storage platform produces approximately 4,560 total Exchange 2010 I/Os (~2,280 per SP). This total I/Os number consisted of Exchange user I/Os, BDM I/Os, transactional logs I/O, and log replication I/Os.

Figure 5.  VNX5300 total throughput with 16,000 Exchange 2010 users

After further analysis of VNX5300 performance using the Unisphere Analyzer, it is observed that array utilization is very low (approximately 12 percent). Then, a fifth building block is added for a total configuration of 20,000 users with eighty 2 TB NL-SAS drives.

**Test 2: Validation of VNX5300 performance with five building-blocks (20,000 users at 0.15 IOPS per user)**

In this test, Jetstress is run on five virtual machines, simulating 20,000 active users at 0.15 IOPS and a 2 GB mailbox quota on five building-blocks (40 TB Exchange 2010 data in total). A single RAID 1/0 storage pool, which consists of sixteen 2 TB NL-SAS drives, is configured to support each building-block.

Even with five building-blocks running on VNX5300, the IOPS achieved exceeded the target, and the database and log latencies are almost unchanged, and still well below the threshold recommended by Microsoft.
Figure 6 displays VNX5300 performance results with four Exchange 2010 building-blocks. A two-hour Jetstress test is run against four Mailbox virtual machines simultaneously to simulate the load of 4,000 users per server with a user profile of 150 messages per user per day at 0.15 IOPS, and a 2 GB mailbox per user.

Table 12 shows the sum of IOPS achieved and the latencies observed across all five servers in this test.

![Figure 6. Exchange 2010 performance and scalability on the VNX5300 with 20,000 users](image)

**Table 12. Exchange 2010 Jetstress test performance results for 20,000 users (five servers)**

<table>
<thead>
<tr>
<th>Database I/O</th>
<th>Target</th>
<th>Five servers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Achieved Exchange transactional IOPS</td>
<td>3,000 IOPS (5 x 600)</td>
<td>3,269 IOPS</td>
</tr>
<tr>
<td>Average database disk read latency (ms)</td>
<td>&lt;20 ms</td>
<td>16.4 ms</td>
</tr>
<tr>
<td>Average database disk write latency (ms)</td>
<td>&lt;20 ms and &lt; Average DB read latency</td>
<td>3 ms</td>
</tr>
</tbody>
</table>

**Transaction log I/O**

<table>
<thead>
<tr>
<th>Average log disk write latency (ms)</th>
<th>Target</th>
<th>Five servers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;10 ms</td>
<td>2 ms</td>
</tr>
</tbody>
</table>
Figure 7 provides back-end I/O throughput on the VNX5300 during a two-hour Jetstress test with 20,000 users at a 0.15 IOPS user profile. During this test, the VNX5300 produces approximately 5,650 total Exchange 2010 I/Os (~2,825 per SP). The total I/Os consist of Exchange user I/Os, BDM I/Os, transactional logs I/O, and log replication I/Os.

![Graph showing VNX5300 total throughput with 20,000 Exchange 2010 users](image-url)

**Figure 7.** VNX5300 total throughput with 20,000 Exchange 2010 users
Test 3: Validation of VNX5300 performance during an SP failure

During this test, one of the SPs on the VNX5300 is shut down to simulate a failure. All database and log LUNs assigned to a failed SP are automatically trespassed to the other surviving SP without any interruption in I/O, and with minimal performance impact. Jetstress is then run over a two-hour period against four Exchange Mailbox servers on a single Hyper-V root server, hosting 16,000 active users in total.

Table 13 shows the performance results of the SP failure test. Even with only one SP functioning, the VNX5300 provided the same level of performance and delivered the required I/Os without an increase in response times.

Table 13. VNX5300 performance during an SP failure

<table>
<thead>
<tr>
<th>Item</th>
<th>Normal</th>
<th>1-SP scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>Database disks transfers/sec</td>
<td>2,651</td>
<td>2,695</td>
</tr>
<tr>
<td>Target Exchange transactional IOPS</td>
<td>2,400</td>
<td>2,400</td>
</tr>
<tr>
<td>Average database disk read latency (ms)</td>
<td>16.1</td>
<td>16.0</td>
</tr>
<tr>
<td>Average database disk write latency (ms)</td>
<td>3.2</td>
<td>4.3</td>
</tr>
<tr>
<td>Average log disk write latency (ms)</td>
<td>2.2</td>
<td>2.4</td>
</tr>
</tbody>
</table>

Test 4: Validate Exchange 2010 performance with FAST Cache enabled on database LUNs

The same four building-blocks (16,000 active users with a 2 GB mailbox size) are tested to obtain a direct comparison between the performance results with and without FAST Cache enabled. Ultimately, the objective of this test is to verify if FAST Cache helps to improve the I/O performance of high-capacity NL-SAS drives (7.2k rpm) with Exchange 2010 I/O.

FAST Cache with Exchange 2010

FAST Cache is a performance optimization feature unique to EMC VNX family platforms. FAST Cache uses Flash drives to extend existing cache capacities for accelerated system performance, and to absorb unpredicted “spikes” in application workloads automatically.

FAST Cache:

- Supports up to 2 TB of usable capacity (4 TB raw)—maximum capacities vary per system model
- Supports read and write operations
- Provides simple configuration and monitoring through the VNX Unisphere management interface
- Is supported on CLARiiON CX4, Celerra NS, and VNX platforms (file and block)
- Accelerates performance to address unexpected spikes in application workloads
- FAST Cache can be considered with Exchange 2010 in high I/O environments where I/O is the determining factor for storage requirements, and not space
Performance validation of Exchange 2010 with FAST Cache

Jetstress is run against four Exchange Mailbox servers on a single Hyper-V root server. Without FAST Cache, the 64 NL-SAS drives are able to support 16,000 users at a 0.15 IOPS user profile. With FAST Cache enabled, the same number of NL-SAS drives can support the same number of users, but at a much higher (0.28 IOPS) user profile. All four Exchange Mailbox servers passed Jetstress with latencies below Microsoft's recommended guidelines.

In another words, 81 percent more Exchange 2010 Jetstress IOPS can be achieved with a very small amount of FAST Cache enabled. Only 10 percent of the available FAST Cache was used to produce these results. FAST Cache is a global resource so it can be used by other workloads on the array.

Figure 8 shows how FAST Cache can improve the performance of NL-SAS drives and accommodate much higher Exchange 2010 user profiles without adding additional storage.

Figure 8. Exchange 2010 performance on VNX5300 with FAST Cache enabled
Test 5: Identify Exchange 2010 performance on VNX5300 with 1 Gb/s iSCSI connectivity

iSCSI testing is performed to provide data to customers who are interested in using this method for host to storage connectivity. In this test, Hyper-V root servers are reconfigured from 8 Gb/s FC connectivity to 1 Gb/s iSCSI connectivity. One building-block is used during testing (4,000 users at a 0.15 IOPS user profile). Additional building-blocks are also tested. But due to the 1 Gb/s iSCSI network connectivity, only a single server is able to pass the test with the 0.15 IOPS profile.

Table 14 details the iSCSI test configuration environment.

### Table 14. iSCSI test configuration

<table>
<thead>
<tr>
<th>Item</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network switch</td>
<td>1 Gb/s Ethernet network switch</td>
</tr>
<tr>
<td>Virtual networks</td>
<td>Dedicated virtual networks separate the iSCSI network from the production network</td>
</tr>
<tr>
<td>Number of storage ports used on VNX5300</td>
<td>4 (2 * 1 Gb/s iSCSI FE ports per storage controller)</td>
</tr>
<tr>
<td>Number of storage ports used on Hyper-V root servers</td>
<td>2 (2 * 1 Gb/s iSCSI network interface cards (NICs))</td>
</tr>
<tr>
<td>Ethernet switch</td>
<td>1 Gb/s network switch</td>
</tr>
<tr>
<td>iSCSI initiator</td>
<td>Microsoft iSCSI initiator (Windows Server 2008 R2)</td>
</tr>
</tbody>
</table>

**iSCSI best practices**

The following summarizes best practices for iSCSI connectivity to the VNX5300. These recommendations are intended to provide a high-performing, stable environment.

- Use dedicated switches for production and iSCSI networks. If this is not possible, create and configure vLANs to isolate iSCSI traffic from all other network traffic.
- Configure network redundancy to provide fault tolerance and improve performance.
- Ensure all ports on the switch are set to **Auto-negotiate: 1000**.
- For iSCSI solutions, a minimum 1 Gb NIC is recommended.
• On each iSCSI NIC, perform the following actions:
  – Set the speed of all 1 Gb iSCSI NICs to **1 Gb full**
  – Disable power management on the NIC
  – Disable **Client for Microsoft Networks**
  – Disable **File and Printer Sharing for Microsoft Networks**
  – Disable **IPv6** (if not used)
  – Disable **IPv4 Checksum Offload**
  – Disable **IPv4 Large Send Offload**
  – Disable **IPv6 Checksum Offload**
  – Disable **IPv6 Large Send Offload**
  – Disable **TCP Connection Offload (IPv4)**
  – Disable **TCP Connection Offload (IPv6)**

• Modify the following registry keys on the physical servers with iSCSI connection to the VNX5300 to improve iSCSI performance:
  – HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\Tcpip\Parameters\Interfaces\Interface GUID
    * TcpAckFrequency=DWORD:1 (Decimal)
    * For more information, visit [http://support.microsoft.com/kb/328890](http://support.microsoft.com/kb/328890)
  – HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\Tcpip\Parameters
    * KeepAliveTime=DWORD:300000 (Decimal)
    * For more information, visit [http://support.microsoft.com/kb/324270](http://support.microsoft.com/kb/324270)
VNX5300 with iSCSI performance test results

Figure 9 illustrates the results of Exchange 2010 performance on the VNX5300 with iSCSI:

- **1-VM test**
  Run Jetstress on one virtual machine only, which hosts 4,000 users at a 0.15 IOPS user load and a 2 GB mailbox quota.

- **2-VM test**
  Run Jetstress simultaneously on two virtual machines located in the same Hyper-V root server. Each virtual machine hosts 4,000 users at a 0.12 IOPS user load and a 2 GB mailbox quota.

The results show the reduction achieved Exchange 2010 transactional I/Os with two virtual machines due to higher utilization of the 1 Gb/s iSCSI network. Customers should be aware of these performance differences when scaling their Exchange 2010 environment with an iSCSI configuration.

![Exchange 2010 performance results on iSCSI](image)

**Figure 9.** Exchange 2010 performance results on iSCSI
Figure 10 and Figure 11 illustrate network utilization during the 1-VM and 2-VM Jetstress tests. The iSCSI network utilization remains approximately 35 percent in a 1-VM test. Utilization increases to approximately 70 percent in the 2-VM test. With more virtual machines added, more network resources are consumed on iSCSI connections.

![Figure 10. iSCSI network utilization during the 1-VM test](image)

![Figure 11. iSCSI network utilization during the 2-VM test](image)
Using Unisphere for simplified storage administration

The following sections demonstrate how Unisphere simplifies storage management in the test environment.

Note
This section provides high-level steps specific to solution testing within the documented Exchange 2010 test environment. For complete procedures, see the appropriate EMC Unisphere user documentation available on www.EMC.com.

Overview

Unisphere is a task-based storage management interface that integrates:

- A graphical, task-oriented framework
- Simplified management for the storage novice so that users can easily:
  - Create storage for an application
  - Monitor and manage that application’s storage
  - Customize the interface according to personal preferences or local language requirements

Additionally, with Unisphere all file and block systems can be managed through one simple interface. Its easy-to-use, intuitive interface provides a simple, integrated management experience for storage environments.

The Unisphere interface

The Unisphere interface provides several views to display different sets of information. These are available from the menu bar, as shown in Figure 12. When you move the mouse over the menu bar, a series of sub-menus appear. The sub-menus allow you to view detailed settings.

For example, under the Storage menu, you can see the detailed information about storage pools and LUNs. Or, you can click the Create Storage Pool link to launch the interface for storage pool provisioning.

![Unisphere menu bar](image)

Figure 12. Unisphere menu bar
View and create LUNs

After creating storage pools, use Unisphere to set up LUNs and storage groups. For example, the following steps demonstrate how Unisphere can easily create eight LUNs of the same size with just a few clicks.

1. Click the LUNs link under the Storage menu to view LUNs or create new LUNs, as shown in Figure 12.

2. In the Create LUN dialog box, select the RAID type and the storage pool where you want the LUNs to reside. Type the required capacity in the User Capacity field, and select how many LUNs you would like to create, as shown in Figure 13.

Note
You can also specify a customized name in the dialogue box, without having to change the name after its creation. In this example, we will create eight LUNs named VM1_DB_1 to VM1_DB_8. In addition, you can assign LUN IDs as the LUN names.

![General tab when creating LUNs in Unisphere](image)
3. The **Advanced** tab allows you to assign default SP owners to LUNs. Under **Default Owner**, select **Auto** to balance LUNs between the two SPs, as shown in Figure 14.

![Figure 14. Advanced tab in Unisphere](image)

4. Click **Apply**. Unisphere completes the LUN provisioning according to the values entered. The following confirmation message appears, as shown in Figure 15.

![Figure 15. LUNs confirmation prompt](image)
5. To present the LUNs to a specific host or multiple hosts:
   a. Select all the LUNs you want to present to the host(s). To select multiple LUNs, select the first LUN, then select the last LUN, and press **Shift**.
   b. Click **Add to Storage Group** (on the bottom of the screen) as shown in Figure 16.

   ![Figure 16. Adding LUNs to a storage group](image)

   c. Next, select the appropriate storage group from the list on the left. Click the arrow to add the LUNs, as shown in Figure 17.

   ![Figure 17. Selecting the storage groups](image)
The LUN provisioning process is now complete. View the host information for your LUNs, as shown in Figure 18.

![EMC Unisphere LUNs](image)

**Figure 18.** Host information
Conclusion

Summary

Exchange 2010 administrators and storage architects for midrange organizations have turned to virtualizing the application environment to optimize performance levels and improve system efficiency. Until recently, storage systems have not kept pace with the many benefits that virtualization has to offer. The VNX family for unified storage now includes the highly scalable and flexible VNX5300 powered by the Intel Xeon processor. Further, the VNX5300 is fine-tuned to support virtual applications with Hyper-V integration.

Rigorous performance testing outlined here validates VNX5300 functionality in a simulated test environment comprised of 20,000 Exchange 2010 users with a 2 GB mailbox quota. By consolidating Exchange servers on a virtualized infrastructure with the VNX platform, testing proves that organizations will achieve significant capacity savings, and improve hardware consolidation while exceeding core performance objectives.

Findings

This white paper validates the following key results:

Proven Mailbox server design: Using a building-block approach, Exchange 2010 combined with the high-performing, VNX5300 can be deployed using a modular design, resulting in predictable performance for all Mailbox servers.

Validated performance: Test results show that the VNX5300 storage array can be an excellent platform to house Exchange 2010 mailboxes.

EMC’s FAST Cache: Significantly increases Exchange I/Os performance on VNX5300 with large-capacity drives (that is, NL-SAS). Systems with FAST Cache will benefit all applications running on the systems, not just Exchange.

Simplified storage management with the Unisphere interface: Unisphere provides an easy, intuitive, and highly efficient mechanism for managing EMC storage. Testing demonstrates that provisioning storage with Unisphere Manager is an automated, quick process.

Next steps

To learn more about this and other solutions, contact an EMC representative or visit www.EMC.com.
References
Refer to the following documents for additional information.

White papers
For white papers that provide similar solutions, see the following:

- *EMC Unified Storage for Microsoft Exchange 2010 Enabled by FAST Cache—A Detailed Review*

Product documentation
For additional information on the products discussed in this white paper, see the following:

- *VNX Family Data Sheet*
- *VNX Series Specification Sheet*
- *VNX Software Suites Data Sheet*