Better enterprise storage performance

Intel® Xeon® processor E5-2690-based storage appliances provided 50% space savings by utilizing deduplication, compression, and thin provisioning while delivering

20% better user response time

10% better processor efficiency with more headroom

versus previous-generation

(intel®)

High-end storage appliances require powerful processors that not only deliver optimal workload performance, but also have enough power to fully take advantage of technologies that maximize storage capacity. Technologies such as inline data deduplication, inline data compression, and thin provisioning all make more efficient use of storage, to the ultimate benefit of your organization.

With the advent of storage appliances that run enterprise workloads directly, the processor that drives your storage is more important than ever. What processor best handles storage efficiency tasks while simultaneously delivering excellent workload performance for end-users?

In our tests at Principled Technologies' labs, we created two VMware® vSphere® 5-based storage appliances – one powered by the new Intel Xeon processor E5-2690, the other configured with an older Intel Xeon processor X5680 – and compared their enterprise workload performance while performing tasks that maximize storage efficiency. We found that the Intel Xeon processor E5-2690-based storage appliance deduplicated and compressed data, saving 50.2 percent in storage space while providing a 20.6 percent better response time for Exchange users and using 10.2 percent better processor efficiency (user/processor utilization), leaving room to complete more tasks as demands grow.

PT

A PRINCIPLED TECHNOLOGIES TEST REPORT

STORE DATA EFFICIENTLY

Intelligent storage features

•**Inline deduplication** - Deduplication replaces redundant data with a marker pointing to the original data to eliminate duplicate data while maintaining the integrity of the backup. Inline deduplication processes and removes duplicate data before it is ever written to disk so that only one copy remains, eliminating redundancy and saving storage capacity.

•**Inline data compression** - Inline data compression compresses files in blocks to reduce blank space and shrink the amount of space that data requires.

•**Thin provisioning** - Thin provisioning optimizes available storage usage by allocating blocks of data on demand instead of upfront, which eliminates blank space so more data can be stored.

With the technology of today, there is no need to waste valuable storage space. Storage appliances use features such as inline deduplication, inline data compression, and thin provisioning (see sidebar) to maximize storage space.

Storage appliances with powerful processors can perform these space-saving operations while still delivering excellent performance for end users. The Intel Xeon processor E5-2690 utilizes the latest I/O technologies including high-bandwidth memory interfaces, high-performance PCI interfaces, and 10 Gigabit Ethernet (10GbE) and Fibre Channel over Ethernet (FCoE) interconnects to maximize enterprise storage performance.

Save space without sacrificing performance

We used VMware vSphere 5 to create VMs on a server board, setting up one virtual machine (VM) as an Exchange server using Microsoft® Exchange Server® 2010, and another as an intelligent storage subsystem. On each storage appliance we created, we ran a 2,000-user Exchange workload while simultaneously performing inline deduplication, inline data compression, and thin provisioning tasks to see how the appliances stacked up.

The storage efficiency tasks we ran had a staggering impact on storage capacity. For testing the deduplication ratio was 1.25x and compression ratio was 1.61x, for a total space savings ratio of 2.01x (dedupe * compress/copies). This means that the deduplication, compression, and thin provisioning technologies saved slightly over 50 percent storage space that would have otherwise gone to waste. Due to these savings, our 618GB Exchange database used only 308 GB of physical disk space (see Figure 1).

Figure 1: Deduplication and compression reduced storage space the data used by 50.2 percent.
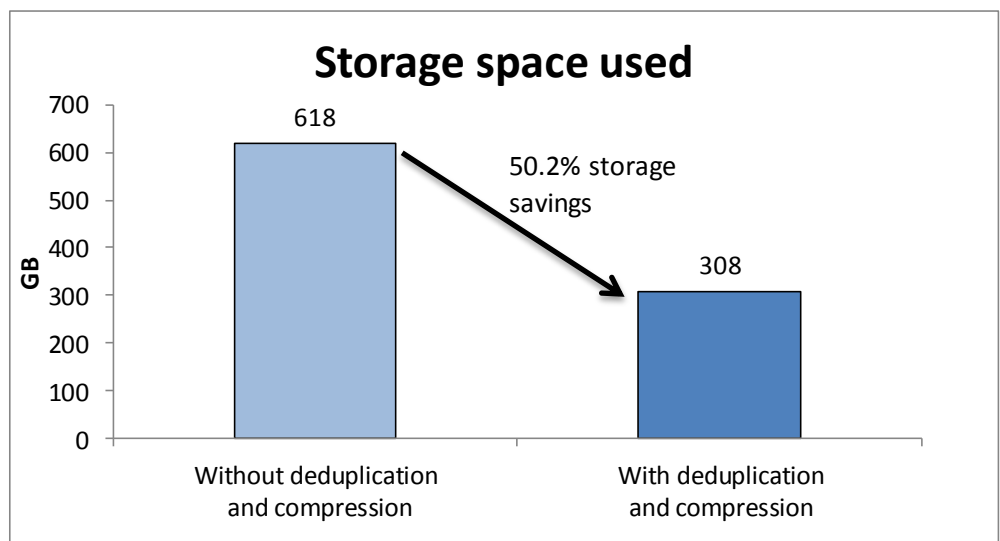
The response time the system provides for users is an important measure of performance. The Intel Xeon processor E5-2690-based storage appliance provided better response times for Exchange users – up to 20.6 percent faster response time than the Intel Xeon processor X5680-based storage appliance. Figure 2 shows the average response time (MSExchangeIS\RPC Average Latency counter), in milliseconds for the two systems.

Figure 2: Response times, in milliseconds, for the storage appliances. Lower times are better.

Response time for 2,000 Exchange users (lower numbers are better)
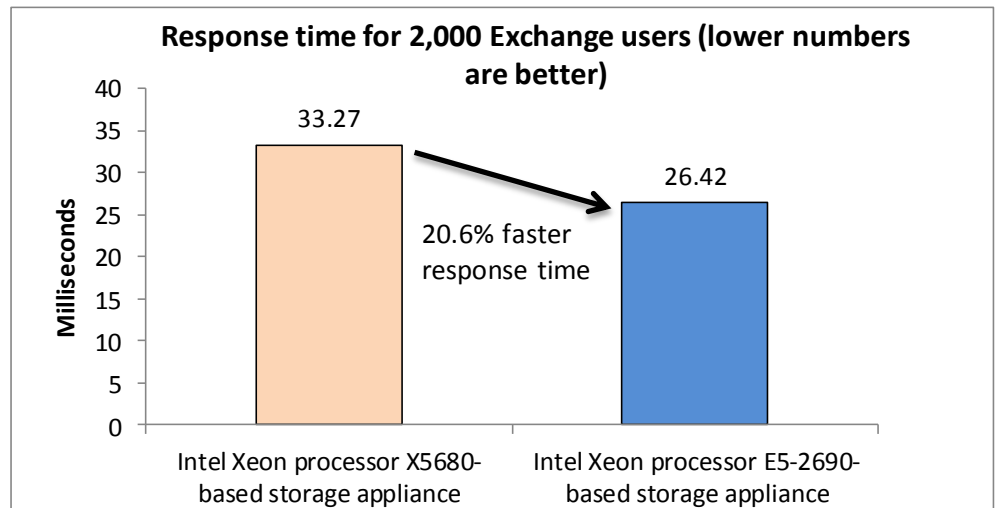
The Intel Xeon processor E5-2690-based storage appliance achieved a 20.6 percent better user response time than the Intel Xeon processor X5680-based storage appliance, while using only 11.1 percent more power (see Figure 3).

Figure 3 shows the average CPU utilization for the two storage appliances. The Intel Xeon processor E5-2690-based storage appliance had 10.2 percent better processor efficiency than the Intel Xeon processor X5680-based storage appliance. (We calculate processor efficiency as number of users/processor utilization.) The more unutilized processing resources, the more room the system has to handle more tasks. More processing power can support your solution as your business grows in the future.

	Intel Xeon processor E5-2690-based storage appliance	Intel Xeon processor X5680-based storage appliance
Idle power (W)	195.0	213.2
Active power (W)	322.5	290.3
CPU utilization	46.0%	50.7%

Figure 3: Percentage CPU utilization for the storage appliances. Lower numbers are better.

IN CONCLUSION

The storage you choose for your data center has as a significant impact on the workload performance your infrastructure delivers to end-users. New, more powerful processors allow storage to perform critical space-saving tasks like deduplication, compression, and thin provisioning without negatively affecting performance.

In our tests, an Intel Xeon processor E5-2690-based storage appliance delivered 20.6 percent faster Exchange response times and had 10.2 percent better processor efficiency than an Intel Xeon processor X5680-based appliance. By selecting a storage appliance that capitalizes on the processing power of the Intel Xeon processor E5-2690, you can take advantage of the latest storage efficiency technologies to make better use of your storage and provide top-of-the-line workload performance to deliver a better experience for users.

APPENDIX A –CONFIGURATION INFORMATION

Figure 4 provides detailed configuration information for the test systems.

System	Intel Xeon processor E5-2690-based storage appliance	Intel Xeon processor X5680-based storage appliance
Power supplies		
Total number	1	1
Vendor and model number	Delta Electronics DPS-1000HB A	Delta Electronics DPS-1000HB A
Wattage of each (W)	1000	1000
Cooling fans		
Total number	3	3
Vendor and model number	San Ace 80 9G0812P1G15	San Ace 80 9G0812P1G15
Dimensions (h x w) of each	4" x 4"	4" x 4"
Volts	12	12
Amps	1.1	1.1
General		
Number of processor packages	2	2
Number of cores per processor	8	6
Number of hardware threads per core	2	2
System power management policy	Balanced	Balanced
CPU		
Vendor	Intel	Intel
Name	Xeon	Xeon
Model number	E5-2690	X5680
Stepping	C1	B1
Socket type	LGA2011	LGA1366
Core frequency (GHz)	2.9	3.3
Bus frequency	8.0 GT/s	6.4 GT/s
L1 cache	32 KB + 32KB (per core)	32 KB + 32KB (per core)
L2 cache	256 KB (per core)	256 KB (per core)
L3 cache (MB)	20	12
Platform		
Vendor and model number	Custom Build	Custom Build
Motherboard model number	Rose City 2DPC	Intel S5520HCT
BIOS name and version	American Megatrends 2.11.1210	American Megatrends 1.23.114
BIOS settings	Enable VT-d	Enable VT-d
Memory module(s)		
Total RAM in system (GB)	64	48
Vendor and model number	Micron MT16JTF51264AZ-1G6M1	Kingston KVR1333D3E9S/4GI
Type	PC3-12800U	PC3-10600
Speed (MHz)	1,600	1,333
Speed running in the system (MHz)	1,600	1,333
Timing/Latency (tCL-tRCD-tRP-tRASmin)	11-11-11-32	9-9-9

System	Intel Xeon processor E5-2690-based storage appliance	Intel Xeon processor X5680-based storage appliance
Size (GB)	4	4
Number of RAM module(s)	16	16
Chip organization	Double-sided	Double-sided
Rank	Dual	Dual
Operating system		
Name	VMware ESXi 5.0.0 U1	VMware ESXi 5.0.0 U1
Build number	623860	623860
File system	EXT3	NTFS
Kernel	5.0.0 U1	5.0.0 U1
Language	English	English
Graphics		
Vendor and model number	Integrated graphics	Integrated graphics
Graphics memory (MB)	8	8
RAID controller		
Vendor and model number	Intel RAID Controller RS25DB080	Intel RAID Controller RS25DB080
Firmware version	v23.2.1-0023	v23.2.1-0023
Cache size (GB)	1	1
SAS controller		
Vendor and model number	Dell 6Gbps SAS HBA Controller	Dell 6Gbps SAS HBA Controller
Cache size(GB)	1	1
Hard drive 1		
Vendor and model number	Seagate ST3500414SS	Seagate ST3500414SS
Number of disks in system	6	6
Size (GB)	500	500
Buffer size (MB)	16	16
RPM	7,200	7,200
Type	SAS	SAS
Firmware version	KS64	KS64
Hard drive 2		
Vendor and model number	Intel SSDSA2BZ100G3	Intel SSDSA2BZ100G3
Number of disks in system	2	2
Size (GB)	100	100
Type	SSD (SATA)	SSD (SATA)
Firmware version	0303	0303
Hard drive 3		
Vendor and model number	Seagate ST373455SS	Seagate ST373455SS
Number of disks in system	60	60
Size (GB)	73	73
Buffer size (MB)	16	16
RPM	15,000	15,000
Type	SAS	SAS

System	Intel Xeon processor E5-2690-based storage appliance	Intel Xeon processor X5680-based storage appliance
Firmware version	S51A	S51A
Ethernet adapters		
Vendor and model number	Embedded Intel Quad Gigabit Controller 82580EB	Embedded Intel Dual Gigabit Controller 82575EB
Type	Integrated	Integrated
USB ports		
Number	2 external, 1 internal	2 external, 1 internal
Type	2.0	2.0

Figure 4: Configuration information for the storage appliances we tested.

APPENDIX B - HOW WE TESTED

About ZFS file systems

We tested the performance of the storage appliances using ZFS file systems. ZFS file systems are scalable, simply administrated, and manage data in a pooled storage model that eliminates wasted bandwidth stranded storage space. ZFS has built-in deduplication, compression, and thin provisioning capabilities, and uses variable block sizes to more efficiently pack data onto hard drives.

About the Microsoft Load Generator 2010 benchmark

To test the configuration's mail server performance, we used the Microsoft Load Generator 2010 (LoadGen) benchmark, which performs tasks to simulate a standard user generating mail activity. We simulated 2,000 users and used the following settings:

- Mailbox Profile: 250MB mailboxes
- Action Profile: Outlook_350
- Client Type: Outlook 2007 Cached

LoadGen simulates the mail activity for the 2,000 users and then reports a PASS/FAIL rating, which is based on acceptable response times.

For more details about LoadGen, see http://www.microsoft.com/downloads/details.aspx?FamilyId=DDEC1642-F6E3-4D66-A82F-8D3062C6FA98&displaylang=en.

Configuring the test bed

We configured four trays of Dell PowerVault MD1000 storage as one zpool of mirror storage using 60 73GB, 15,000 RPM, SAS disks for Exchange data. We configured the 60 drives into a single 4TB LUN. We made the LUN available via iSCSI on an internal virtual network and connected it to the Exchange VMs. We also configured two SSDs in a RAID 1 mirror for Exchange logs.
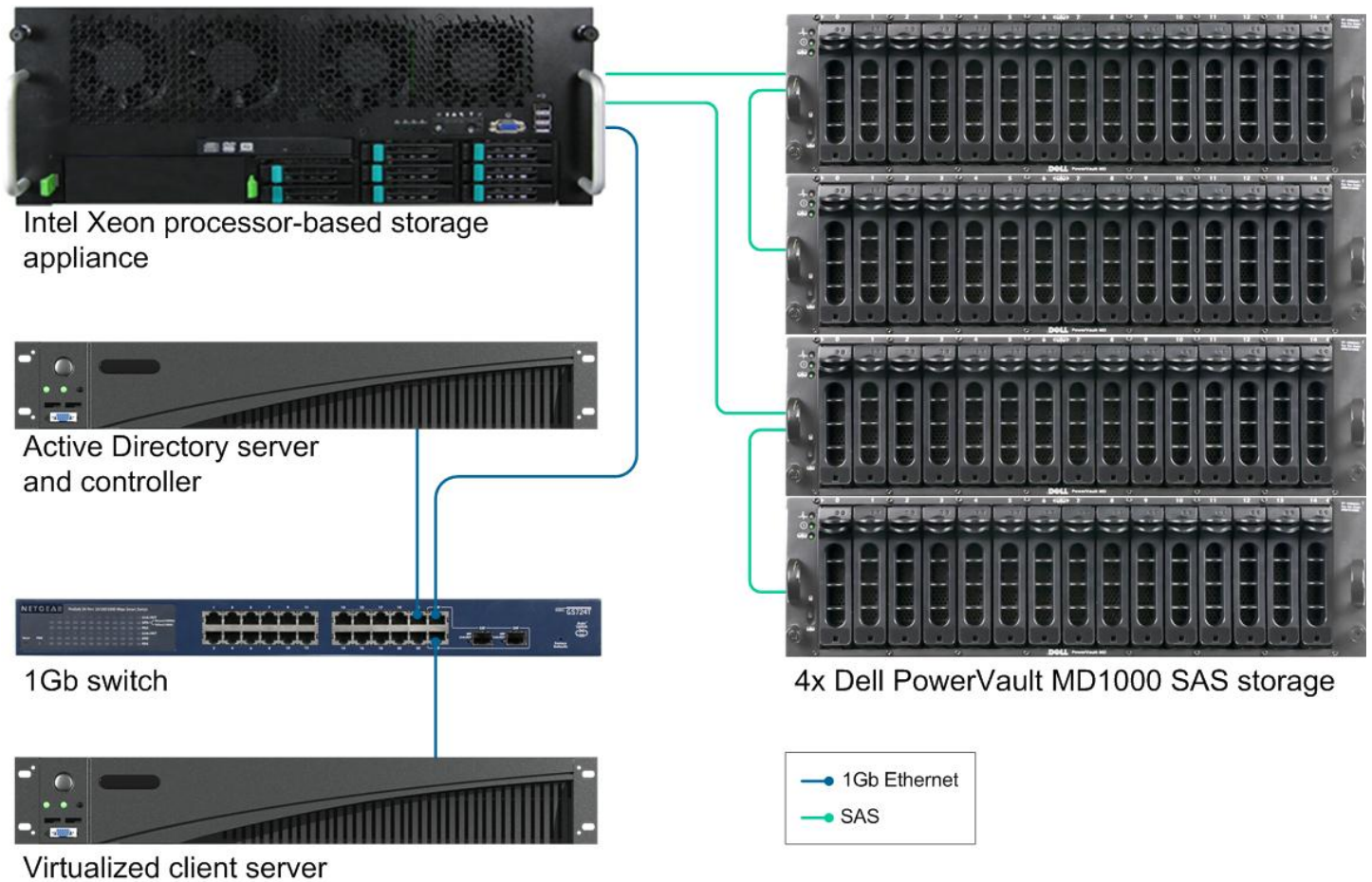
Figure 5 illustrates our test bed setup.

Figure 5: The test bed we used.

For our purposes, we configured the VM as a standalone Exchange server environment with all roles included. Results in your specific environment will vary. We used a separate server for Active Directory also running inside a VM. As Figure 6 shows, ESXi connects to AD1 and uses all client VMs.
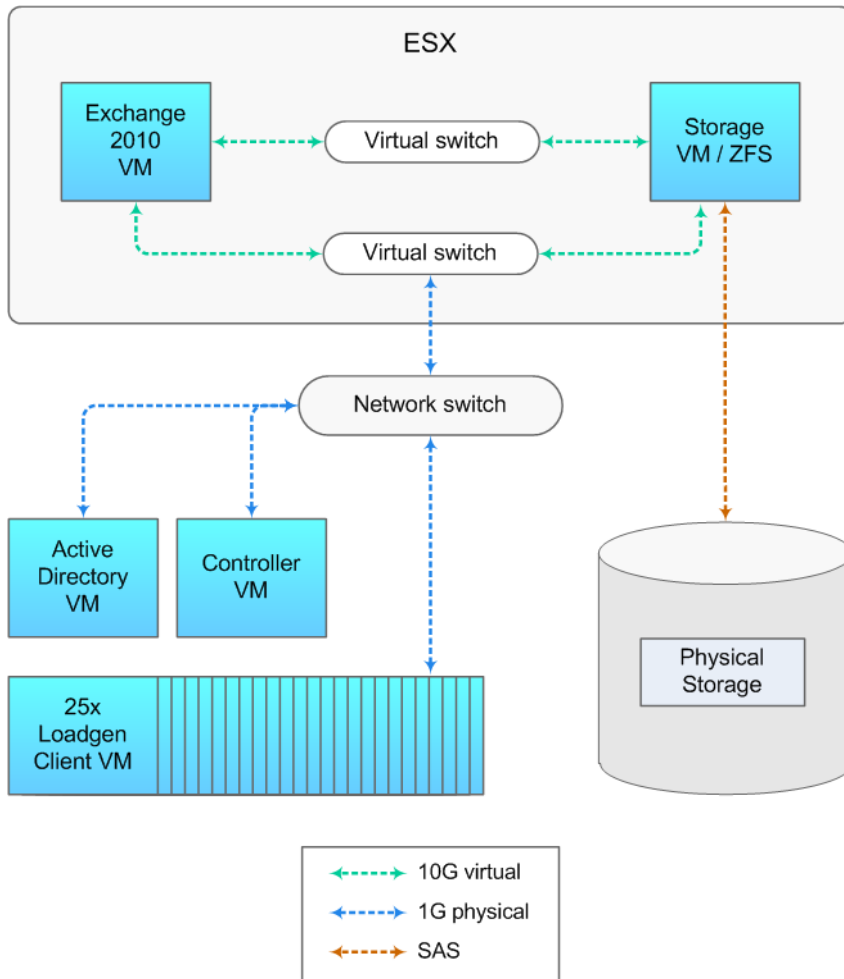
Figure 6: The logical test bed setup we used.

Adjusting BIOS settings

We used the latest released BIOS updates on all systems, and adjusted the default BIOS settings.

Installing VMware vSphere 5 (ESXi)

1. Insert the disk, and select Boot from disk.
2. On the Welcome screen, press Enter.
3. On the End User License Agreement (EULA) screen, press F11.
4. On the Select a Disk to Install or Upgrade Screen, select the relevant volume to install ESXi on, and press Enter.
5. On the Please Select a Keyboard Layout screen, press Enter.
6. On the Enter a Root Password Screen, assign a root password and confirm it by entering it again. Press Enter to continue.
7. On the Confirm Install Screen, press F11 to install.
8. On the Installation complete screen, press Enter to reboot.

Configuring ESXi after installation

1. On the 5.0.0 ESXi screen, press F2, enter the root password, and press Enter.
2. On the System Customization screen, select Troubleshooting Options, and press Enter.

3. On the Troubleshooting Mode Options screen:
    a. Select Enable ESXi Shell, and press Enter.
    b. Select Enable SSH, press Enter, and press ESC.
4. On the System Customization screen, select Configure Management Network.
5. On the Configure Management Network screen, select IP Configuration.
6. On the IP Configuration screen, select set static IP, enter an IP address, subnet mask, and default gateway, and press Enter.
7. On the Configure Management Network screen, press Esc. When asked if you want to apply the changes, press Y.

Updating ESXi to the latest build

1. Download the latest ESXi build from VMware.
2. Using the vSphere client from another machine, connect to the ESXi server.
3. Select the Configuration tab, and select Storage under the Hardware heading.
4. Right-click the OS datastore, and select Browse Datastore.
5. Click the upload button, and select the build update ZIP file.
6. Using a telnet/ssh client from another machine, connect to the ESXi server using root credentials.
7. Run the following command using the path and name of the ESXi update:
    - `esxcli software vib update –d /vmfs/volumes/OS/ update-from-esxi5.0-5.0_update01.zip`
8. Repeat steps 6 and 7 for any subsequent systems.

Configuring VM networking

1. Using the vSphere client from another machine, connect to the ESXi server.
2. Add the necessary vSwitch for the network that virtual iSCSI storage traffic will use:
    a. Click the host, click the Configuration tab, and click Networking.
    b. Click Add Networking.
    c. Choose Virtual Machine, and click Next.
    d. Choose create a vSphere standard switch.
    e. Do not select a NIC to associate with the vSwitch.
    f. Assign the network label and assign IP settings.
    g. Click Finish.

Configuring the external volumes

1. In the vSphere client, select the host.
2. Click the Configuration tab.
3. Click Storage, and click Add Storage…
4. Choose Disk/LUN.
5. Select the disk, and click Next.
6. Accept the default of VMFS-5 for the file system.
7. Review the disk layout, and click Next.
8. Enter the datastore name, and click Next.
9. Accept the default of using maximum capacity, and click Next.
10. Click Finish.
11. Repeat steps 3 through 10 for the remaining LUNs.

Creating VM1 (Exchange VM)

1. In the vSphere client, connect to the ESXi host.

2. Click the Virtual Machines tab.
3. Right-click, and choose New Virtual Machine.
4. Choose Custom, and click Next.
5. Assign a name to the virtual machine, and click Next.
6. Select the OS Datastore on the internal storage, and click Next.
7. Choose Virtual Machine Version 8, and click Next.
8. Choose Windows, select Microsoft Windows Server 2008 R2 (64-bit), and click Next.
9. Choose 2 virtual sockets, and 6 or 8 cores per socket, and click Next.
10. Choose 22GB, and click Next.
11. Click 2 for the number of NICs, select vmxnet3, and click Next.
12. Leave the default virtual storage controller, and click Next.
13. Choose to create a new virtual disk, and click Next.
14. Make the OS virtual disk size 40 GB, choose thick-provisioned lazy zeroed, specify the OS datastore on the internal storage, and click Next.
15. Keep the default virtual device node (0:0), and click Next.
16. Click Finish.
17. Right-click the VM, and choose Edit Settings.
18. On the Hardware tab, click Add…
19. Click Hard Disk, and click Next.
20. Click Create a new virtual disk, and click Next.
21. Specify 80GB for the virtual disk size, choose thick-provisioned lazy zeroed, and specify the Log datastore.
22. Choose SCSI(1:0) for the device node, and click Next.
23. On the Hardware tab, click Add…
24. Click Hard Disk, and click Next.
25. Click Create a new virtual disk, and click Next.
26. Specify 1TB for the virtual disk size, choose thick-provisioned lazy zeroed, and specify the OS datastore.
27. Choose SCSI(1:1) for the device node, and click Next.
28. Click SCSI Controller 1, and choose Change Type.
29. Choose VMware Paravirtual, and click OK.
30. Click Finish, and click OK.
31. Start the VM.
32. Attach the Windows Server 2008 R2 SP1 ISO image to the VM and install Windows Server 2008 R2 on your VM.

Installing the operating system on VM1

1. Insert the installation DVD for Windows Server 2008 R2 SP1 Enterprise into the DVD drive, and attach the physical DVD drive to the VM. Alternatively, use an ISO image and connect to the ISO image from the VM console.
2. Open the VM console on vSphere.
3. At the Language Selection Screen, click Next.
4. Click Install Now.
5. Select Windows Server 2008 R2 Enterprise (Full Installation), and click Next.
6. Click the I accept the license terms check box, and click Next.
7. Click Custom.
8. Click Next.
9. At the User's password must be changed before logging on warning screen, click OK.
10. Enter the desired password for the administrator in both fields, and click the arrow to continue.
11. At the Your password has been changed screen, click OK.
12. Install the latest VMware Tools package on the VM. Restart as necessary.

13. Connect the machine to the Internet, and install all available Windows updates. Restart as necessary.
14. Enable remote desktop access.
15. Change the hostname and reboot when the installation prompts you.
16. Create a shared folder to store test script files. Set permissions as needed.
17. Set up NIC 1:
    a. Click Start→Control Panel, right-click Network Connections, and choose Open.
    b. Right-click the VM Loadgen traffic NIC, and choose Properties.
    c. Select TCP/IP (v4), and choose Properties.
    d. Set the IP address, subnet, gateway, and DNS server for the virtual NIC, which will handle outgoing server traffic. Click OK, and click Close.
18. Set up NIC 2:
    a. Click Start→Control Panel, right-click Network Connections, and choose Open.
    b. Right-click the VM iSCSI traffic NIC, and choose Properties.
    c. Select TCP/IP (v4), and choose Properties.
    d. Set the IP address and subnet for the virtual NIC, which will handle internal iSCSI traffic. Click OK, and click Close.

Installing Exchange 2010 SP2 prerequisites on VM1

1. Select Start→Administrative Tools→Server Manager.
2. Click Add Roles.
3. At the Before You Begin screen, click Next.
4. At the Select Server Roles screen, click Web Server (IIS).
5. If prompted by an Add features required for Web Server (IIS) pop-up window, click Add Required Features.
6. Click Next.
7. At the Web Server (IIS) screen, click Next.
8. At the Select Role Services screen, select the IIS 6 Metabase Compatibility, IIS WMI Compatibility, HTTP Errors, HTTP Redirection, IIS 6 Management Console, Basic Authentication, Windows Authentication, Tracing, Digest Authentication, and Dynamic and Static content Compression checkboxes, and click Next.
9. At the Confirm Installation Selections screen, click Install.
10. At the Installation Results screen, click Close.
11. Select Start→Administrative Tools→Server Manager.
12. Click Features.
13. Click Add Features.
14. Select .NET Framework 3.5.1 Features.
15. When the Add Features Wizard pop-up window prompts you, click Add Required Role Services.
16. Click Next.
17. At the Introduction to Web Server (IIS) screen, click Next.
18. At the Select Role Services screen, click Next.
19. Click Install.
20. At the Installation Results screen, click Close.
21. Download the Microsoft Filter Pack 2.0. (http://www.microsoft.com/downloads/en/details.aspx?FamilyID=5cd4dcd7-d3e6-4970-875e-aba93459fbee)
22. Run FilterPackx64.EXE.
23. Click Next.
24. Click I accept the terms in the License Agreement, and click Next.
25. Click OK once installation is complete.
26. Click Start→Administrative Tools→Services.
27. Right-click the Net.Tcp Port Sharing service, and click Properties.

28. Change the Net.Tcp Port Sharing startup type to Automatic, and click OK.
29. Open command prompt, type `ServerManagerCmd –i RSAT-ADDS`, and press Enter.
30. Reboot the server.

Installing Exchange Server 2010 SP2 on VM1

1. Insert the Exchange Server 2010 installation DVD, and capture the DVD drive in the VM session. When the Autoplay window appears, click Run Setup.EXE.
2. The installer should consider steps 1 and 2 to be complete (they appear grayed out). Click the link to Step 3: Choose Exchange Language Option.
3. Click Install only languages from the DVD.
4. Click the link to Step 4: Install Microsoft Exchange Server.
5. To go past the introduction screen, click Next.
6. Accept the license agreement, and click Next.
7. Select No for error reporting, and click Next.
8. Select Typical Exchange Server Installation, and click Next.
9. Leave the organization name at default (First Organization), and click Next.
10. At the question about client computers running Outlook 2003 or Entourage, select No, and click Next.
11. To accept defaults for Configure Client Access server external domain, click Next.
12. At the Customer Experience Improvement Program screen, select I don't wish to join the program at this time, and click Next.
13. Click Install to start the installation process.
14. Once the installation has completed, click Finish. Exchange should automatically open the Exchange Management Console.

Creating VM2 (Storage VM)

1. In the vSphere client, connect to the ESXi host.
2. Click the Virtual Machines tab.
3. Right-click, and choose New Virtual Machine.
4. Choose Custom, and click Next.
5. Assign a name to the virtual machine, and click Next.
6. Select the OS Datastore on the internal storage, and click Next.
7. Choose Virtual Machine Version 8, and click Next.
8. Choose Other, and choose Solaris 11 (64-bit), and click Next.
9. Choose 2 virtual sockets, and 6 or 8 cores per socket, and click Next.
10. Choose 22GB, and click Next.
11. Click 2 for the number of NICs, select e1000 for NIC1 and vmxnet3 for NIC2, and click Next.
12. Leave the default virtual storage controller, and click Next.
13. Choose to create a new virtual disk, and click Next.
14. Make the OS virtual disk size 20 GB, choose thick-provisioned lazy zeroed, specify the OS datastore on the internal storage, and click Next.
15. Keep the default virtual device node (0:0), and click Next.
16. Click Finish.
17. Right-click the VM, and choose Edit Settings.
18. On the Hardware tab, click Add…
19. Click PCI Device, and click Next.
20. Specify the physical PCI/PCIe Device to connect, choose LSI 6Gbps SAS HBA Adapter, and click Next.
21. Click Finish, and click OK.

22. Start the VM.

Installing the operating system on VM2

1. Insert the installation CD for OpenIndiana 151a text install into the CD drive, and attach the physical CD drive to the VM. Alternatively, use an ISO image and connect to the ISO image from the VM console. (See http://openindiana.org/)
2. Open the VM console on vSphere.
3. Keep the default keyboard layout [47. US-English], and press Enter.
4. Keep the default language [7. English], and press Enter.
5. At the OpenIndiana oi_151a installation menu, press Enter to accept the default number [1].
6. At the Welcome to OpenIndiana screen, press F2.
7. Press F2 again.
8. Select Use the whole disk, and press F2.
9. Enter the computer name, select Automatically for the network connection configuration, and press F2.
10. Select the Time Zone, and press F2.
11. Enter the date and time, and press F2.
12. Enter and confirm the root password.
13. Create a user account with real name `Test User` and username `testuser`
14. Enter and confirm the user password, and press F2.
15. Review all the settings at the Installation Summary screen, and press F2 to begin installation.
16. Press F2 to reboot.
17. At the console login, use the login account testuser and the password entered during installation.
18. At the console, type `su` and enter the root password.
19. Type `pkg update`, and press Enter to update to the latest build (oi_151a2 as of 3/17/2012).
20. After the package update process completes, type `reboot` and press enter to apply the updates.
21. Once the console appears again, log in as testuser and su to gain root access.
22. Enter the following commands to install additional packages needed for iSCSI and VMware Tools:
    a. `pkg install storage-server`
    b. `pkg install pkg:/x11/server/xserver-common`
    c. `pkg install pkg:/x11/server/xorg`
    d. `pkg install pkg:/x11/server/xorg/driver/xorg-video-vesa`
23. Install the latest VMware Tools package on the VM (accept all the default settings). Restart as necessary.

Configuring the storage on VM2 (Storage VM)

1. Run the following commands to configure the storage:
    a. `zpool create data_pool mirror disk0 disk1 mirror disk2 disk3`
    b. `zfs create -sp -b 8K -o dedup=on -o primarycache=metadata -o compress=gzip-9 -V 4T data_pool/data_disk`
    c. `sbdadm create-lu /dev/zvol/rdsk/data_pool/data_disk`
    d. `stmfadm add-view `stmfadm list-lu | awk '{print $3}'``

Configuring LoadGen 2010 client VMs

We installed Windows Server 2008 R2 SP1 on all clients. We installed the latest updates on as of 3/19/2012.

Configuring client VM01

1. Change the Computer name to VM01
2. Set NIC to the following:

- IP address: `192.168.10.1xx (where xx is the VM##)`
- Subnet mask: `255.255.255.0`
- Default Gateway: `192.168.10.1`

3. Join the domain testbed.zfs.
4. Reboot when necessary.
5. Repeat steps 1-4 for all 25 client VMs, change settings as necessary.

Installing .Net 3.5.1

A prerequisite for LoadGen is that you have .NET 3.5.1 Installed on the client. Repeat these steps for each client after joining the domain.

1. On Client1, click Server Manager.
2. On Server Manager, expand Features.
3. At Features, click Add.
4. At the Features screen, check .Net Framework 3.5.1.
5. At the Add Features Wizard, click Add Required Role Services.
6. At the Select Features screen, click Next.
7. At the Web Server (ISS), screen click Next.
8. At the Select Role Services screen, click Next.
9. At the Confirm Installation Selections screen, click Install.

Installing LoadGen 2010

Repeat this for each client after joining the domain.

1. Double click loadgen2010.exe.
2. At the Welcome screen, click Next.
3. At the EULA screen, accept, and click Next.
4. At the Select Installation Folder screen, click Next.
5. At the Confirm Installation screen, click Next
6. At the Installation Complete screen, click Close.
7. At the Restart Your System prompt, click Yes.

Preparing LoadGen on the clients

1. Select Start→All Programs→Microsoft Exchange→Exchange Load Generator.
2. When the Load Generator window appears, select Start a new test.
3. Select Create a new test configuration, and click Continue.
4. In the Specify test settings window, type `Password1` as the Directory Access Password and Mailbox Account Master Password, and click Continue with recipient management.
5. Make 2,000 users in the Mailbox Database, and click Continue.
6. To accept defaults for Advanced recipient settings, click Continue.
7. In the Specify test user groups window, select the plus sign (+) to add a user group.
8. Change the Client Type to Outlook 2007 Cached and the Action Profile to Outlook_350, 250MB and click Continue.
9. Leave defaults in Remote configurations, and click Continue.
10. Click Save the configuration file as, and name it 250x2000.cfg
11. Click Start the initialization phase (recommended before running the test) to start initialization. The initialization process might take several hours.

ABOUT PRINCIPLED TECHNOLOGIES

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We provide industry-leading technology assessment and fact-based marketing services. We bring to every assignment extensive experience with and expertise in all aspects of technology testing and analysis, from researching new technologies, to developing new methodologies, to testing with existing and new tools.

When the assessment is complete, we know how to present the results to a broad range of target audiences. We provide our clients with the materials they need, from market-focused data to use in their own collateral to custom sales aids, such as test reports, performance assessments, and white papers. Every document reflects the results of our trusted independent analysis.

We provide customized services that focus on our clients' individual requirements. Whether the technology involves hardware, software, Web sites, or services, we offer the experience, expertise, and tools to help our clients assess how it will fare against its competition, its performance, its market readiness, and its quality and reliability.

Our founders, Mark L. Van Name and Bill Catchings, have worked together in technology assessment for over 20 years. As journalists, they published over a thousand articles on a wide array of technology subjects. They created and led the Ziff-Davis Benchmark Operation, which developed such industry-standard benchmarks as Ziff Davis Media's Winstone and WebBench. They founded and led eTesting Labs, and after the acquisition of that company by Lionbridge Technologies were the head and CTO of VeriTest.