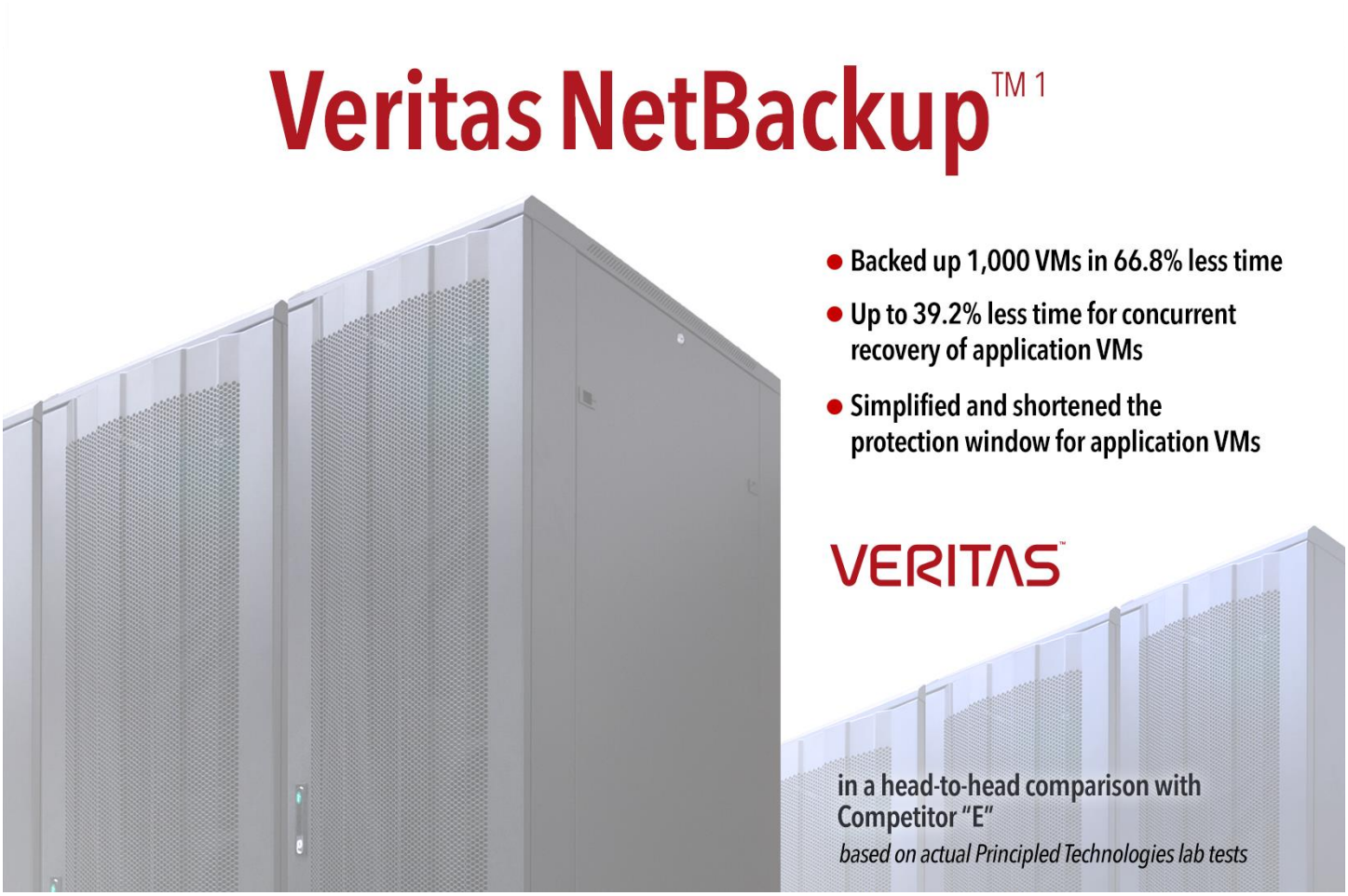
VERITAS NETBACKUP BENCHMARK COMPARISON: DATA PROTECTION IN A LARGE-SCALE VIRTUAL ENVIRONMENT (PART 2)



In our hands-on testing at Principled Technologies, we wanted to see how leading enterprise backup and recovery solutions handled large-scale VM deployments based on vSphere. We tested a solution using industry-leading Veritas NetBackup software and the Veritas NetBackup Integrated Appliance, with NetApp FAS3200-series arrays to host the virtual machines (VMs), and a solution from a leading competitor (Competitor "E"). We tested a scenario that utilized SAN storage for hosting VMs. In our scenario, we tested with increasing populations of VMs—as low as 100 and as high as 1,000–to see how each solution scaled as the environment grew.

We found that NetBackup 7.6 with the NetBackup Integrated Appliance, featuring capabilities such as Accelerator, Replication Director, and Instant Recovery—all for VMware vSphere—provided a more scalable solution than the Competitor "E" platform. With 1,000 VMs, the NetBackup solution provided 66.8 percent faster backup

[1] In August 2014, Symantec commissioned Principled Technologies to perform this study. In January 2015, Symantec selected Veritas Technologies Corporation as the name for its independent information management company and changed the name of the product from Symantec NetBackup to Veritas NetBackup. In July 2015, PT updated this report to reflect the new name. The original version of this report is available at www.principledtechnologies.com/Symantec/NBU_benchmark_comparison_(part_2)_1214.pdf.

AUGUST 2014 (Revised)
A PRINCIPLED TECHNOLOGIES TEST REPORT
(Second of a three-part series)
Commissioned by Veritas Corp.

times using SAN Transport in a Fibre Channel SAN environment than the Competitor "E" solution.

In our tests, Veritas NetBackup with the NetBackup Integrated Appliance provided superior scalability needed to protect the largest virtual server deployments, when compared to the Competitor "E" solution.

PROTECTING DATA IN A VIRTUAL ENVIRONMENT

The inclusion of virtualization into data centers introduces new perspectives on methods of operation. Technologies such as VMware® vSphere® shrink the physical footprint of computing hardware by increasing the number of virtual servers. Enterprises commonly deploy VMs by the thousands and protecting all of their data is a critical challenge, whether done by hardware snapshots, hypervisor-level backup (vStorage APIs for Data Protection (VADP) in the case of VMware technology), or traditional agent-in-guest methods. Using both block Storage Area Network (SAN) systems and file-based Network-Attached Storage (NAS) can allow for effective scaling, but backup and recovery systems must fully leverage the strengths of the platforms to offer reliable performance with minimal impact to the production environment.

WHAT WE COMPARED

Backups via Storage Snapshot Integration

Veritas NetBackup offers hardware snapshot integration with NetApp storage arrays via Replication Director. Replication Director allows Veritas NetBackup to offload the snapshot process of a backup to the NetApp array, creating recovery points almost instantly without consuming server and storage resources. The recovery points can then be archived to disk, tape, or any other supported media as necessary.

We were unable to compare the Veritas NetBackup Replication Director feature with Competitor "E" because, as of the commissioning of our tests, Competitor "E" did not support a competing technology that can utilize NetApp hardware snapshots. As a result, our testing focused on vStorage APIs for Data Protection (VADP) backups for comparison.

Backup via VMware vStorage APIs for Data Protection

Using the NetBackup Integrated Appliance as both media server and backup storage, we tested how long it took to execute backup with virtual application protection. Using the breakdown illustrated in Figure 4, we performed full backups with application protection on groups of VMs from 100 to 1,000, measuring the backup time elapsed.

OUR ENVIRONMENT

We set up the test environment using 20 Dell™ PowerEdge™ M420 server blades running VMware vSphere ESXi 5.5. Figure 1 shows our storage network for VADP-based backup testing.

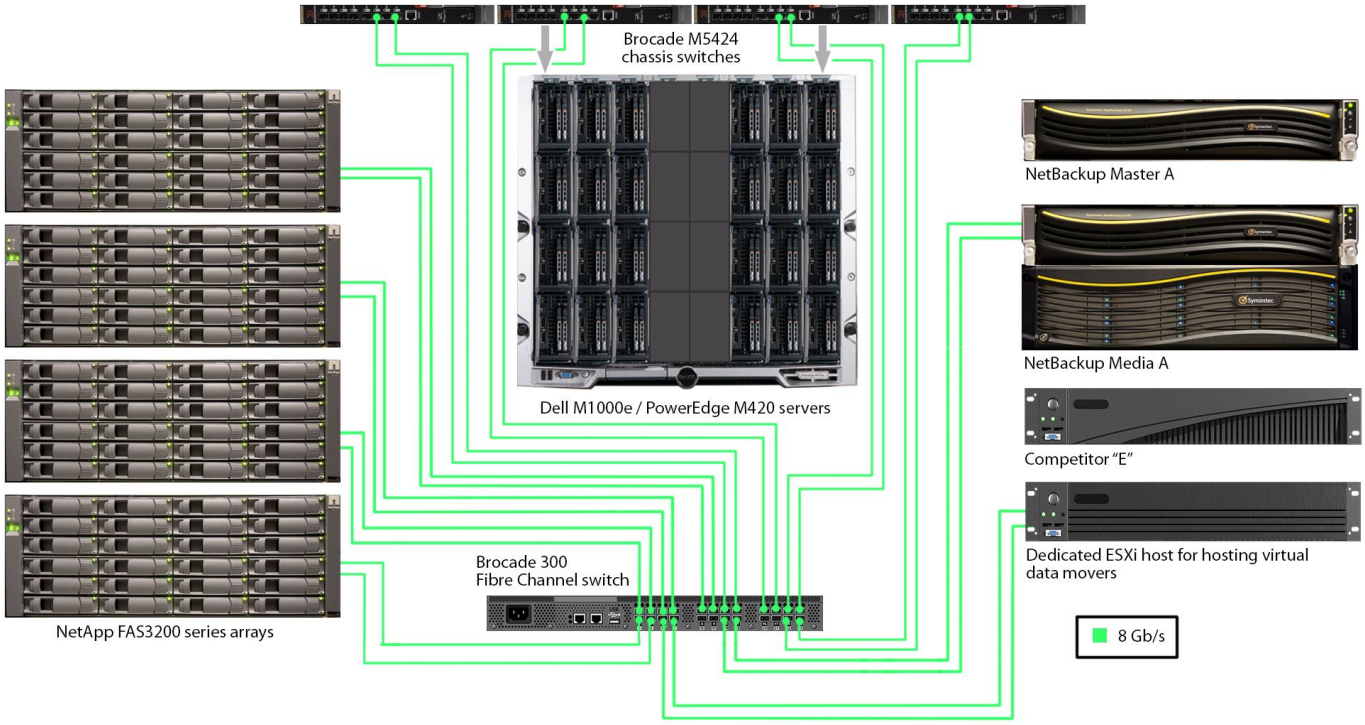


Figure 1: Detailed storage network: VADP-based backups.

We created a test environment of 1,000 Microsoft® Windows Server®-based VMs in several different configurations, depending on the test. We used Windows Server 2012 for application VMs, and Windows Server 2008 R2 Core installation for the standalone Web and idle file server VMs.

To balance the load across the ESXi hosts and storage, we created a matrix to ensure that equal load was distributed across all four NetApp filers (four volumes for the NAS testing, 40 LUNs/datastores for SAN testing) and the 20 ESXi hosts. This prevented overutilization of individual system components while others were idle, optimizing the performance of the multi-threaded backup procedures. For VADP backup testing, we used Veritas NetBackup's resources limits capability to eliminate the possibility of resource contention.

When we completed our NetBackup testing, we removed the NetBackup appliance, added Competitor "E" hardware, and retested on exactly the same test bed. Competitor "E" does not support SAN Transport for VADP backups. SAN transport allows

the backup solution to leverage the FC storage network for moving backup data, which reduces the impact on your production network.

Instead, Competitor "E" leverages virtual machines that act as data movers to move data across a data network. As shown in Figure 2, the data mover VMs utilize the "hot-add" method for VADP backups. The hot-add method provides virtual machines access to the same LUNs their virtualization host can access. This in turn enables the data mover virtual machines to read the snapshot files housed on the virtual machine datastores, and then transmit the data to the Competitor "E" backup appliance via the data network.

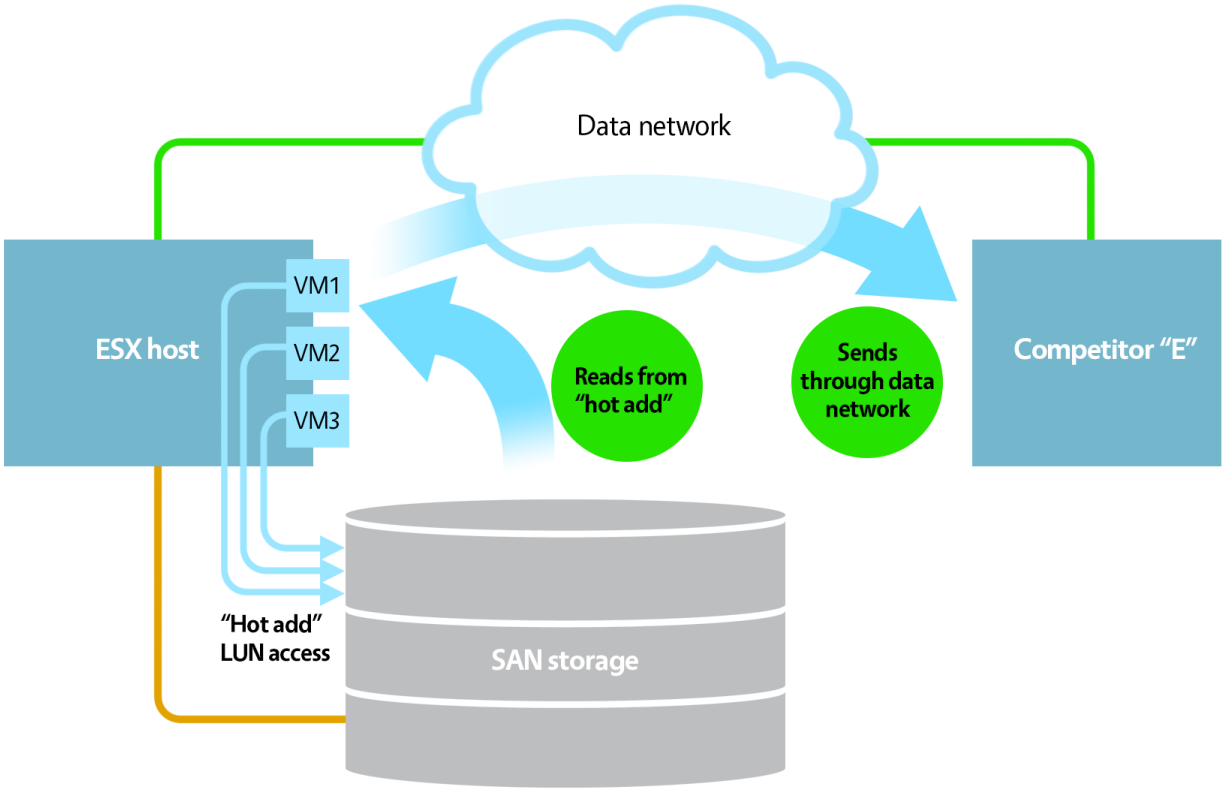


Figure 2: The "hot add" method provides a data mover VM access to the same datastores as its host.

To utilize this method, the data movers must reside on virtualization hosts in your environment. In order to make our comparisons as "apples-to-apples" as possible, we added additional hardware similar to the Veritas NetBackup Integrated Appliance so that the overall solution is functionally similar in terms of Fiber Channel connectivity. We utilized this hardware as a dedicated ESXi host to act as the SAN connection point for the virtual data movers, rather than distribute the Competitor "E" data movers among the active test hosts.

Our host was able to house three virtual data movers without any resource contention, each with eight available instances for a total of 24 potential streams. We did this to maximize the 24 processor threads available on the dual socket Intel Xeon E5-2620 processor-based server. To reduce the chance of over-utilizing any datastore, we assigned our target datastores to each of the data mover instances in round-robin fashion, allowing each datastore to be accessed by no more than two instances simultaneously. This allowed us to manage potential resource contention.

For this first scenario, on SAN transport, we created 200 Windows Server 2012 application VMs running Microsoft SQL Server®, Microsoft Exchange, or Microsoft SharePoint® (10 tiles of 20 VMs each), and up to 800 idle Windows Server 2012 VMs. Figure 3 represents the grouping of VMs included in each backup job.

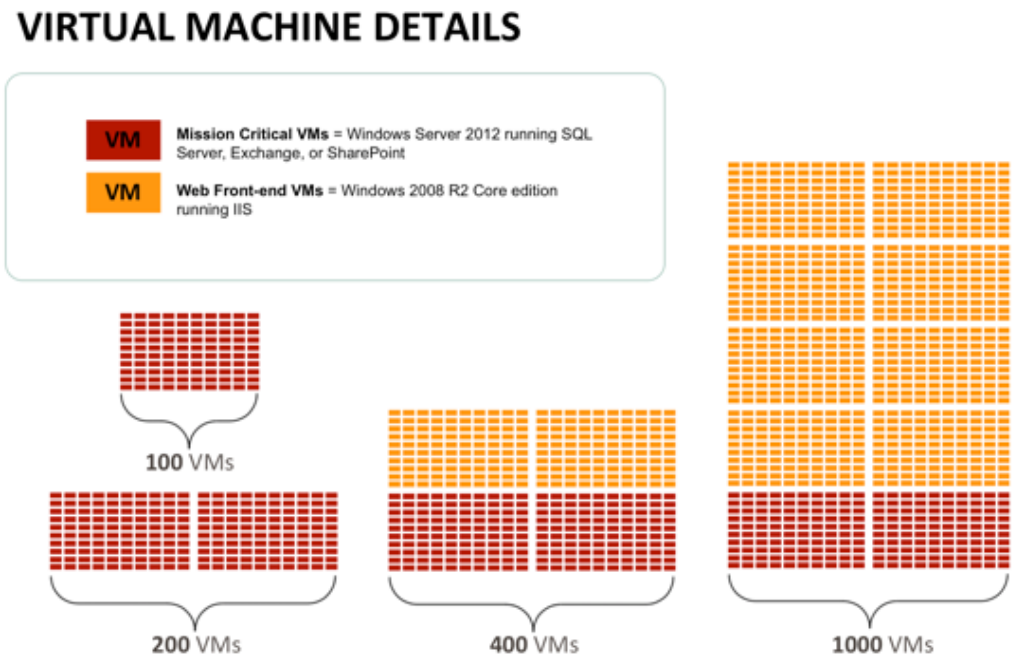


Figure 3: Backup via VADP-based transport VM grouping.

Figure 4 provides the details for the sub-categories of VMs we used in this phase of testing.

Server VM type	Disk size (in GB)	VM count			
		100	200	400	1,000
Active Directory® server	55	5	10	10	10
Exchange Server	50	25	50	50	50
SharePoint Web server	55	15	30	30	30
SharePoint SQL server	160	5	10	10	10
Web application SQL server	50	50	100	100	100
Idle Web server	22			200	800

Figure 4: Production VMs on SAN storage. Color-coding corresponds with Figure 3.

WHAT WE FOUND

SAN testing vs. Competitor "E"

Backup with virtual application protection via VADP

We used the Competitor "E" appliance as the backup target and the Competitor "E" enterprise backup software and consulted published documentation to perform various backups.[2] As we did so, we timed how long it took to complete an application-consistent backup of a group of VMs using SAN transport.

For this scenario, we created policies or groups containing the client VMs we wished to target, and from the GUI, instructed the orchestration server of each product to perform backups of the entire group. The NetBackup solution backed up 1,000 VMs in 66.8 percent less time than the Competitor "E" solution. In other words, the NetBackup solution completed the backup of 1,000 VMs three times faster than Competitor "E" did. Figure 5 shows the total time to complete the SAN backup for both solutions at every level of VM count we tested.

The Competitor "E" solution has the capability for hot-add transport, which is not ideal for true off-host backups, and is limited to eight streams per data mover. To create an equitable comparison, we had to give ESXi resources to work around these architectural limitations. The goal in doing so was to assist the Competitor "E" solution by creating a workaround that could extract more hardware resources from the physical host.

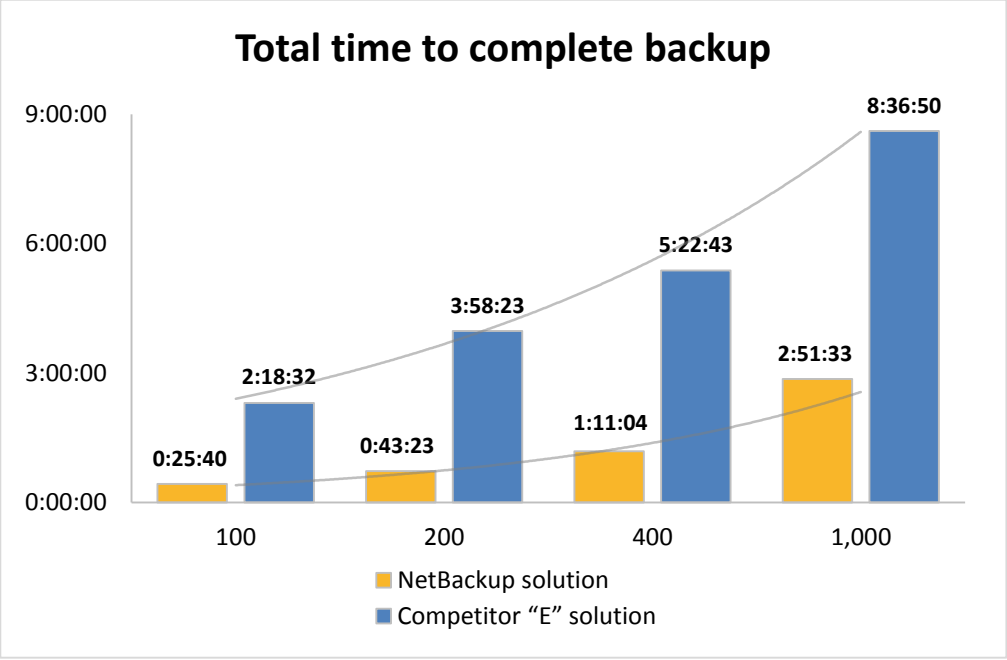


Figure 5: The total time each system took to complete VADP-based SAN backup in hours:minutes:seconds. Lower numbers are better.

[2] This configuration fell within the recommendations of Competitor "E."

Analysis of the data captured during backup runs suggested the maximum CPU utilization on the host dedicated to the virtual data movers was in excess of 85 percent (see Figure 16 in Appendix C). While there were additional CPU resources left available on the data mover host, the addition of another virtual data mover would have overtaxed the CPUs, creating resource contention.

The average CPU utilization on the Competitor "E" virtual data mover host remained relatively high throughout the entire backup job – approximately 75 percent. Without available dedicated hardware to host virtual data movers, the ESXI hosts running your production environment would be directly impacted by the load, which means reduced hosting capacity on any host running a virtual data mover. See Appendix C for more details on virtual data mover server CPU utilization.

Additionally, as shown in Figures 6 and 7 below, the % disk utilization – the percentage of time the disks are in use – for the filers was relatively low for both solutions, which indicates the filers had additional resources available. The figures also highlight the differences in the length of the backup jobs for each solution.

The NetBackup solution was able to perform backups well within an allotted 8-hour backup window, while Competitor "E" exceeded the window. In a production environment, this can mean backups occur during normal business hours, which can affect user experience.

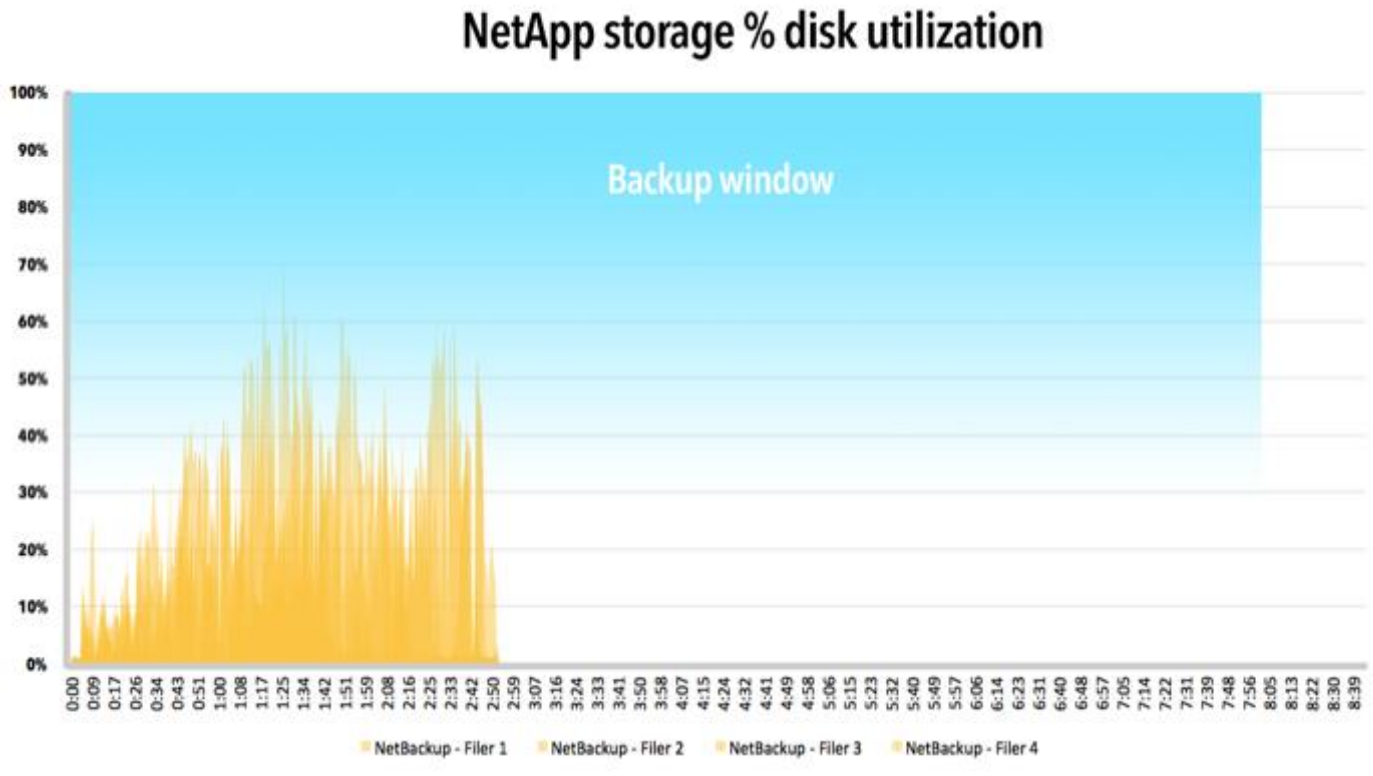


Figure 6: Average disk activity across the four NetApp filers, as reported by sysstat, for Veritas NetBackup.

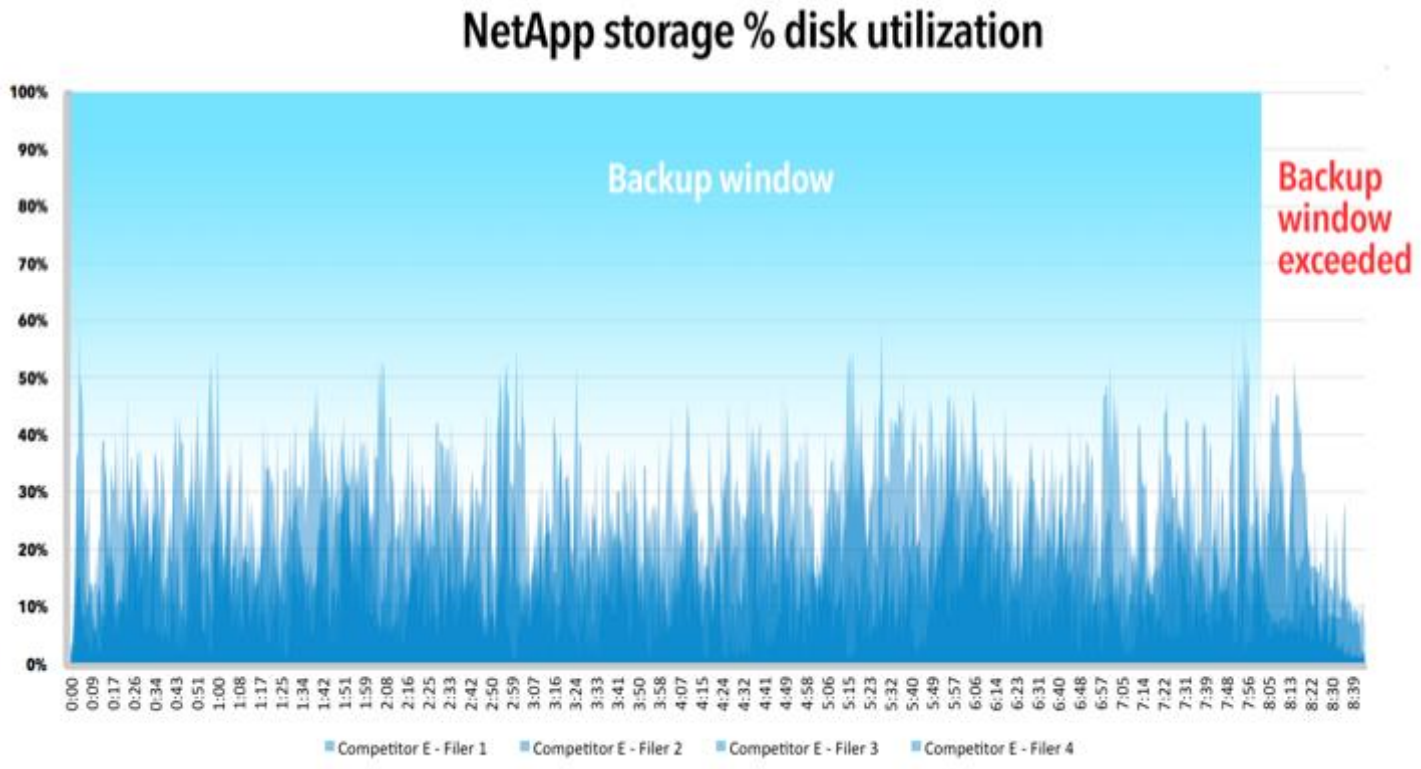


Figure 7: Average disk activity across the four NetApp filers, as reported by sysstat, for Competitor "E."

The value of granular recovery and the required protection window to ensure it

In the case of file corruption or VM deletion, a system administrator can run a recovery job to recreate a VM from a previously captured backup image stored on the media server or media server equivalent. There are times, however, that recovering an entire VM is very inefficient—for example, when all that really needs recovery is an individual application file or database object. In the case of a SQL database application, an administrator may only need to recover an individual database.

In addition to the backup job used to protect a virtual machine, Competitor "E" requires an in-guest agent to stream data for enabling granular recovery of application data. VM protection for Competitor "E" requires use of VADP hot-add-based image level backups while NetBackup provides granular recovery-enabled, application-consistent, single-pass backups for applications using any supported VADP transport.

During the virtual machine backup job, the NetBackup client installed on the application VM captures the application metadata in a manner that allows recovery of either an entire VM or only application-specific data, so no additional backup jobs are necessary. As Figure 8 shows, in our testing the Veritas NetBackup solution needed just 4 minutes and 46 seconds to create a backup image that supports granular restore. Competitor "E" required 8 minutes and 30 seconds and required three additional steps

to protect the same data. Veritas NetBackup's strategy results in a 43.9 percent reduction in time required for complete protection of a single application VM.

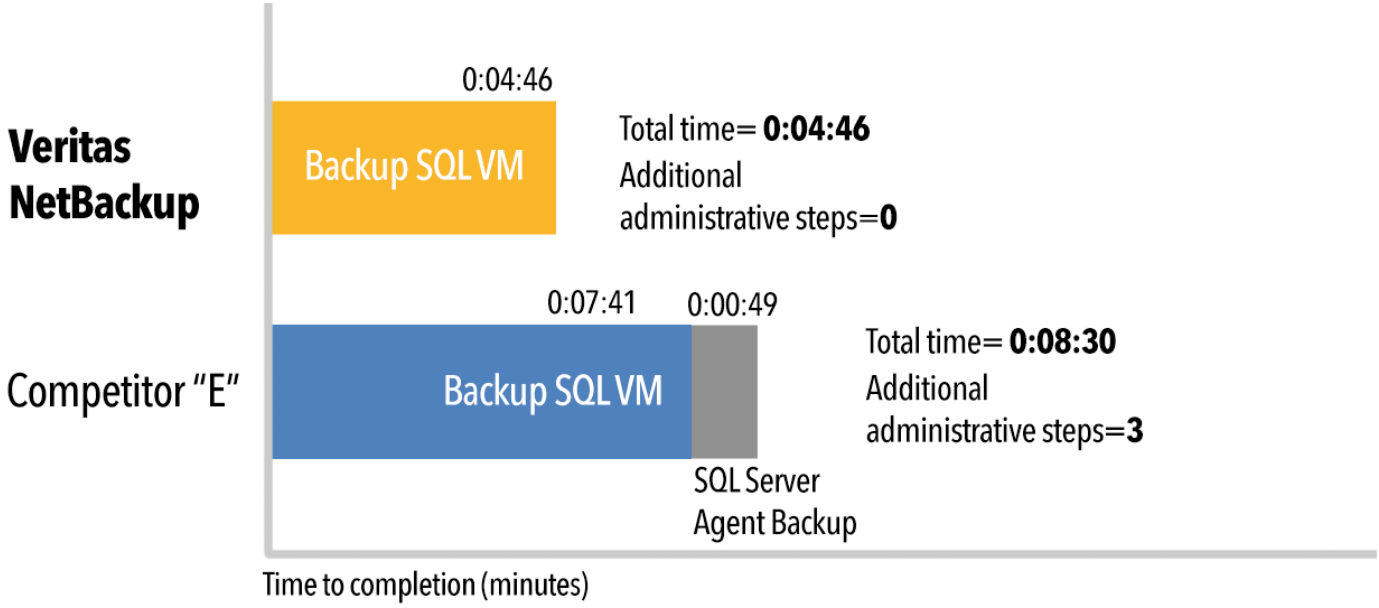


Figure 8: The additional time and steps needed to create the backup necessary to enable granular recovery.

Recovery at scale

When multiple servers need recovering at the same time, in the case of an off-site disaster recovery operation for example, the ability to recover servers quickly means a faster return to service and potentially a smaller impact on your bottom line. In our labs at Principled Technologies, we compared the time it took to recover a single application VM, and concurrently, 8-, 16-, and 24-application VMs with Veritas NetBackup 7.6 and the Competitor "E" solution.

As seen in Figure 9 below, Veritas NetBackup 7.6 offered better performance at every concurrent recovery level with performance improving at scale, completing 24 application VMs about a half hour faster than Competitor "E". That's over 37 percent faster recovery time at each of the scale levels.

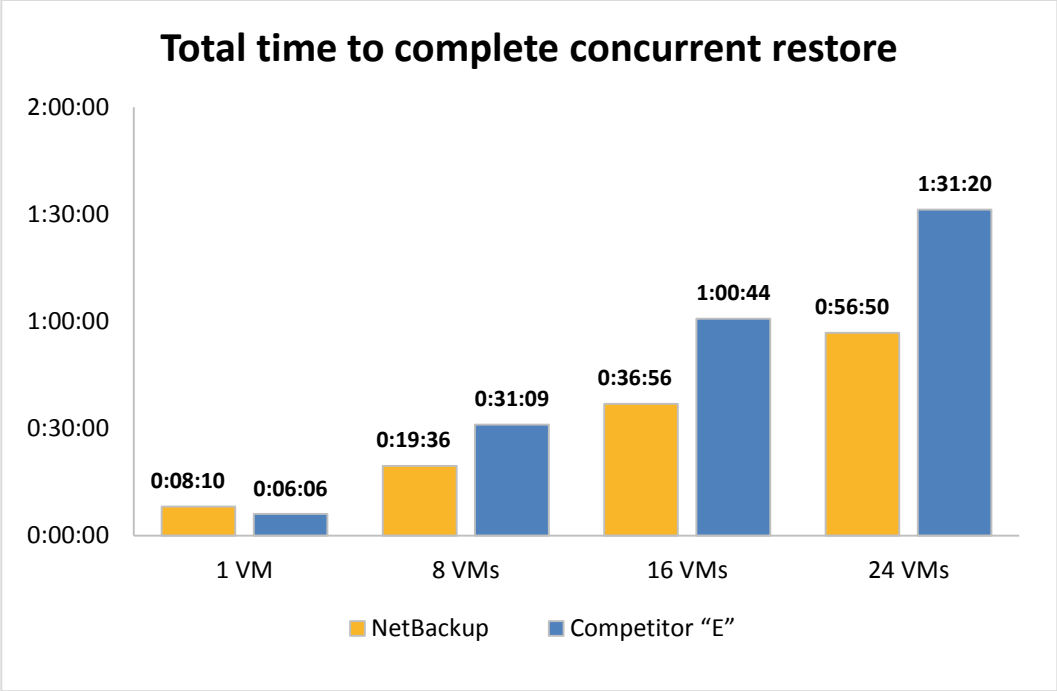


Figure 9: The total time each system took to complete concurrent restores in hours:minutes:seconds. Lower numbers are better.

CONCLUSION

The footprint of a VM can grow quickly in an enterprise environment and large-scale VM deployments in the thousands are common. As this number of deployed systems grows, so does the risk of failure. Critical failures can become unavoidable and offering data protection from a backup solution promotes business continuity. Elongated protection windows requiring multiple jobs of different types can create resource contention with production environments and may require valuable IT admin time, so a finite window for system backups can have plenty of importance.

In our hands-on SAN backup testing, the Veritas NetBackup Integrated Appliance running NetBackup 7.6 offered application protection to 1,000 VMs in 66.8 percent less time than Competitor "E" did. In addition, the Veritas NetBackup Integrated Appliance with NetBackup 7.6 created backup images that offered granular recovery without additional steps. These time and effort savings can scale as your VM footprint grows, allowing you to execute both system protection and user-friendly, simplified recovery.

APPENDIX A – SYSTEM CONFIGURATION INFORMATION

Figure 10 lists the information for the server from the NetBackup solution.

System	Dell PowerEdge M420 blade server (vSphere host)
Power supplies (in the Dell PowerEdge M1000e Blade Enclosure)	
Total number	6
Vendor and model number	Dell A236P-00
Wattage of each (W)	2,360
Cooling fans (in the Dell PowerEdge M1000e Blade Enclosure)	
Total number	9
Vendor and model number	Dell YK776 Rev. X50
Dimensions (h x w) of each	3.1” x 3.5”
Volts	12
Amps	7
General	
Number of processor packages	2
Number of cores per processor	8
Number of hardware threads per core	2
System power management policy	Performance
CPU	
Vendor	Intel
Name	Xeon
Model number	E5-2420
Stepping	2S
Socket type	FCLGA1356
Core frequency (GHz)	1.9
Bus frequency	7.2
L1 cache	32 KB + 32 KB (per core)
L2 cache	256 KB (per core)
L3 cache	15 MB
Platform	
Vendor and model number	Dell PowerEdge M420
Motherboard model number	0MN3VC
BIOS name and version	1.2.4
BIOS settings	Default, Performance profile
Memory module(s)	
Total RAM in system (GB)	96
Vendor and model number	Samsung® M393B2G70BH0-YH9
Type	PC3L-10600R
Speed (MHz)	1,333
Speed running in the system (MHz)	1,333
Timing/Latency (tCL-tRCD-tRP-tRASmin)	9-9-9-36
Size (GB)	16

System	Dell PowerEdge M420 blade server (vSphere host)
Number of RAM module(s)	6
Chip organization	Double-sided
Rank	Dual
Operating system	
Name	VMware vSphere 5.5.0
Build number	1209974
File system	VMFS
Kernel	VMkernel 5.5.0
Language	English
Graphics	
Vendor and model number	Matrox® G200eR
Graphics memory (MB)	16
RAID controller	
Vendor and model number	Dell PERC H310 Embedded
Firmware version	20.10.1-0084
Driver version	5.1.112.64 (6/12/2011)
Cache size (MB)	0 MB
Hard drive	
Vendor and model number	Dell SG9XCS1
Number of disks in system	2
Size (GB)	50
Buffer size (MB)	N/A
RPM	N/A
Type	SSD
Ethernet adapters	
Vendor and model number	2 x Broadcom® BCM57810 NetXtreme® II 10 GigE
Type	LOM
USB ports	
Number	2 External
Type	2.0

Figure 10: Detailed information for the server we tested from the NetBackup solution.

Figure 11 lists the information for the NetApp storage from the NetBackup solution.

System	NetApp FAS3240
Platform	
Vendor and model number	4 x NetApp FAS3240
OS name and version	NetApp Release 8.1.3 (7-Mode)
Hard drives	
Number of drives	24
Size (GB)	560
RPM	15K
Type	SAS

System	NetApp FAS3240
Network adapters	
Vendor and model number	2 x 10Gbps
Type	Integrated
Fiber adapters	
Vendor and model number	2 x 8Gbps
Type	PCI-E

Figure 11: System configuration information for the NetApp storage array.

Figure 12 details the configuration of the NetBackup integrated appliance and the Competitor "E" media server.

System	NetBackup 5230 integrated appliance	Competitor "E" appliance	Virtual Data Movers Host (Competitor "E")
General			
Number of processor packages	2	1	2
Number of cores per processor	6	4	6
Number of hardware threads per core	2	1	2
System power management policy	Default	Default	Default
CPU			
Vendor	Intel	Intel	Intel
Name	Xeon E5-2620	Xeon E5-2603	Xeon E5-2620
Model number	E5-2620	E5-2603	E5-2620
Socket type	FCLGA2011	FCLGA2011	FCLGA2011
Core frequency (GHz)	2 GHz	1.8 GHz	2 GHz
Bus frequency	7.2 GT/s	6.4 GT/s	7.2 GT/s
L1 cache	32 KB + 32 KB per core	32 KB + 32 KB per core	32 KB + 32 KB per core
L2 cache	1.5 MB (256 KB per core)	1 MB (256 KB per core)	1.5 MB (256 KB per core)
L3 cache	15 MB	10 MB	15 MB
Platform			
Vendor and model number	Veritas NetBackup 5230 Integrated Appliance	N/A	N/A
Memory module(s)			
Total RAM in system (GB)	64	32	64
Vendor and model number	Ventura Tech® D3-60MM104SV-999	Micron MT36JSF1G72PZ-1G6K1HF	Ventura Tech D3-60MM104SV-999
Type	PC3-10600	PC3-12800R	PC3-10600
Speed (MHz)	1,333	1600	1,333
Timing/Latency (tCL-tRCD-tRP-tRASmin)	9-9-9-27	11-11-11-34	9-9-9-27
Size (GB)	8	8	8

System	NetBackup 5230 integrated appliance	Competitor "E" appliance	Virtual Data Movers Host (Competitor "E")
Number of RAM module(s)	8	4	8
Chip organization	Double-sided	Double-sided	Double-sided
Rank	Dual rank	Dual rank	Dual rank
Operating system			
Name	NetBackup Appliance 2.6.0.2	Suse Linux 11	VMware vSphere 5.5.0
Build number	2.6.32.59-0.7-default-fsl	2.6.32.59-0.71.5736.1.PTF	1209974
RAID controller			
Vendor and model number	Intel RMS25CB080	Intel RMS25CB080	Intel RMS25CB080
Firmware version	23.9.0-0025	23.12.0-0013	23.9.0-0025
Cache size (MB)	1024	1024	1024
Hard drives			
Vendor and model number	Seagate® Constellation® ES ST1000NM0001	HGST E182115	Seagate Constellation ES ST1000NM0001
Number of drives	10	12	10
Size (GB)	1,000	2,000	1,000
RPM	7.2K	7.2k	7.2K
Type	SAS	SATA	SAS
Ethernet adapters			
Vendor and model number	Intel X520 10Gbps dual-port Ethernet adapter	Intel I350 Quad-Port Gigabit Controller	Intel X520 10Gbps dual-port Ethernet adapter
Type	PCI-E	Integrated	PCI-E

Figure 12: Detailed information on the media server from each solution.

Figure 13 shows how we configured our data network. We used this configuration universally on SAN testing.

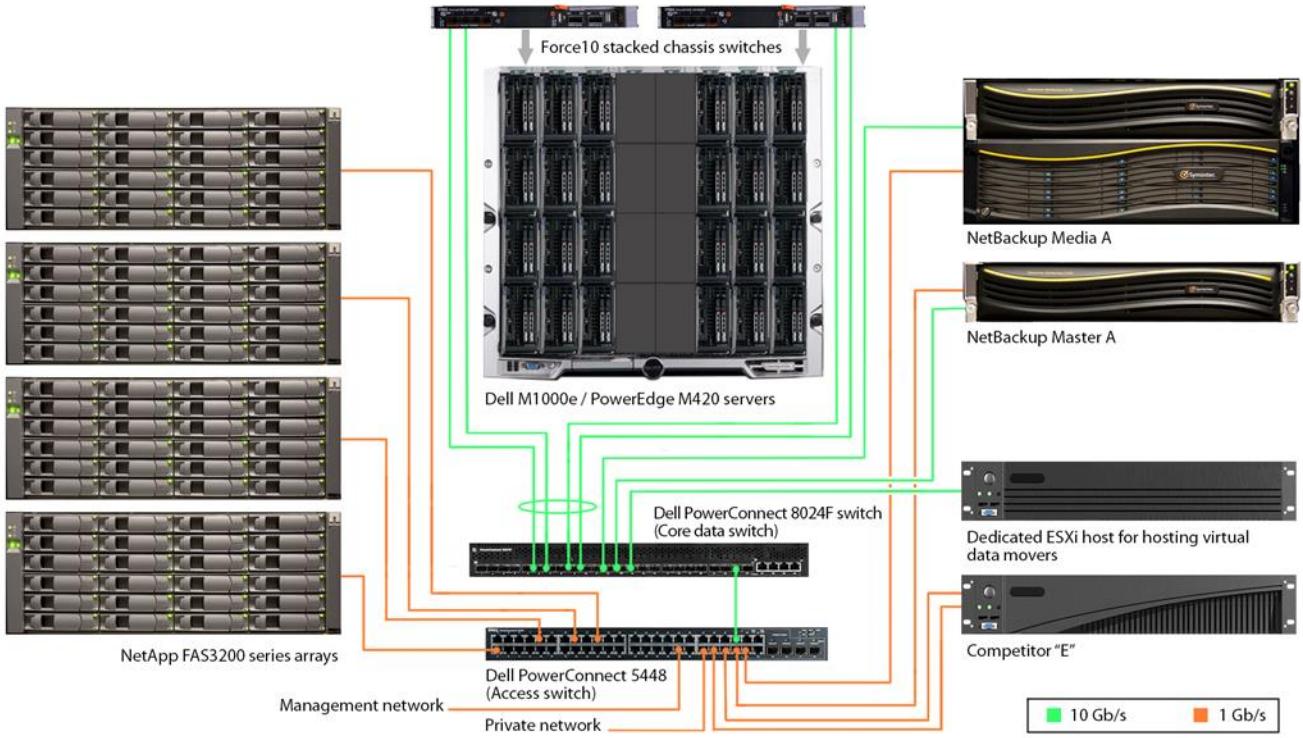


Figure 13: Detailed test bed layout: data network.

APPENDIX B – HOW WE TESTED

We set up hardware and software for Competitor "E" according to administrative best practices.

Creating a storage lifecycle policy with NetBackup 7.6

1. Open a connection to the NetBackup machine.
2. If the Veritas NetBackup Activity Monitor is not open, open it.
3. Log into nbu-master-a with administration credentials.
4. Go to Storage→Storage Lifecycle Policies.
5. Right-click in the right pane, and select New Storage Lifecycle Policy.
6. Enter a name for your SLP.
7. Click Add.
8. In the New Operation window, change the operation to Snapshot, and select primary-snap as your destination storage.
9. Click OK.

Creating a policy with NetBackup 7.6

1. Open a connection to the NetBackup machine.
2. If the Veritas NetBackup Activity Monitor is not open, open it.
3. Log into nbu-master-a with administration credentials.
4. Go to Policies.
5. Right-click the All Policies area, and select New Policy.
6. Under Add a New Policy, enter your policy name, and click OK.
7. Change Policy type to VMware.
8. Click the Policy storage drop-down menu, and select the policy you created earlier.
9. Check Use Replication Director, and click Options.
10. In the Replication Director options, change Maximum Snapshots to 1,000, and make sure that Application Consistent Snapshot is Enabled.
11. Click the Schedules tab.
12. In the Schedules tab, select New.
13. In the Attributes window, enter a name for your scheduled backup, click Calendar, and click the Calendar Schedule tab.
14. In the Calendar Schedule tab, select a date as far away as you deem reasonable, and click OK.
15. Click the Clients tab.
16. Click Select automatically through query. If a warning window appears, click Yes.
17. Choose the VMs you wish to backup through queries (for example, if you want to back up all VMs on a drive, choose Datastore in the Field category, and enter the drive you want to pull all VMs from in quotes in the Values field.

Running a test with NetBackup 7.6

1. Open a connection to the NetBackup machine.
2. If the Veritas NetBackup Activity Monitor is not open, open it.
3. Log into nbu-master-a with administration credentials.
4. Go to Policies.
5. Right-click the policy you wish to run, and select Manual Backup.
6. Click OK.

Note: In the case of the NAS backups, we had two separate policies as each one targets the opposite VMs. Make sure to run the even and odd backup.

Backing up VM hosts in NetBackup 7.6

1. Select Policies.
2. Under All Policies, right-click and select New Policy.
3. Provide a policy name and click OK.
4. On the Attributes tab, use the pull-down menu for Policy type and select VMware.
5. For Destination, use the pull-down menu and select your target storage. We selected media-msdp.
6. Check the box for Disable client-side deduplication.
7. Check the box for Use Accelerator.
8. On the Schedules tab, create a backup schedule based on the desired parameters.
9. On the Clients tab, choose Select automatically through query.
10. Select the master server as the NetBackup host to perform automatic virtual machine selection.
11. Build a query to select the correct VMs required for the backup job.
12. Click Test Query to ensure the correct VMs are properly selected.
13. Start the backup.

NetBackup 7.6 Exchange Instant Recovery

1. Start LoadGen test load.
2. Force-power-down all VMs once 50 LoadGen operations complete.
3. Initiate the Exchange infrastructure restore job/start timer.
    a. Establish a connection to the master server via SSH.
    b. Log in with administrator credentials.
    c. Type `support` and press Enter.
    d. Type `maintenance` and press Enter.
    e. Enter the administrator credentials.
    f. Type `elevate` and press Enter.
    g. Type the following:

    nbrestorevm -vmw -ir_activate -C *client_DNS_name* -temp_location t*emporary_restore_LUN* -vmproxy *restore_host_FQDN* –vmpo

    This will restore, activate, and power-on the VM.
    h. Repeat Step g for each of the four VMs to restore.
    i. Stop the LoadGen test run.
4. When restores complete, restart the LoadGen test.
5. Once 100 LoadGen operations complete successfully, stop the timer.

NetBackup 7.6 Exchange restore via command line

Initiate Exchange infrastructure restore job

1. Establish a connection to the master server via SSH.
2. Log in with administrator credentials.
3. Type `support` and press Enter
4. Type `maintenance` and press Enter.
5. Enter the administrator credentials
6. Type `elevate` and press Enter.
7. Type the following:

    nbrestorevm -vmw -ir_activate -C *client_DNS_name* -temp_location t*emporary_restore_LUN* -vmproxy *restore_host_FQDN* –vmpo

This will restore, activate, and power-on the VM.

8. Repeat step 7 for each of the four VMs to restore.

NetBackup 7.6 Exchange Instant Recovery

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    b. Log in with administrator credentials.
    c. Type `support` and press Enter.
    d. Type `maintenance` and press Enter.
    e. Enter the administrator credentials.
    f. Type `elevate` and press Enter.
    g. Type the following:

        nbrestorevm -vmw -ir_activate -C *client_DNS_name* -temp_location t*emporary_restore_LUN* -vmproxy *restore_host_FQDN* –vmpo

        This will restore, activate, and power-on the VM.
    h. Repeat step g for each of the four VMs to restore.
    i. Stop the LoadGen test run.
4. When restores complete, restart the LoadGen test.
5. Once 100 LoadGen operations complete successfully, stop the timer.

Launching collectors and compiling data for NetBackup 7.6

The following two tasks (Launch the collectors & Compile the data) should be executed from the domain\administrator login on INFRA-SQL.

Launching the collectors

Note: If this is a first run collection, skip to step 2.

1. Double-click the collector job (located in C:\Scripts) associated with the number of VMs you want to collect.
2. In the PuTTY session launched for the media server collection, enter the following sequence:

```
Support
Maintenance
(P@ssw0rd)
iostat –d 30
```

3. RDP into the Backup-Test server.
4. On the NetBackup Console, expand nbu-master-a→NetBackup Management→Policies.
1. Right click the Policy you want to start, and select Manual Backup.
5. To start the job, click OK.
6. Open the Activity Monitor on the NetBackup Administration Console.
7. The Backup job will execute and spawn four different kinds of jobs for each target VM:
    a. Application State Check
    b. VM Snapshot
    c. Backup
    d. Image Cleanup

Compile the data

In the following steps, ### represents the number of VMs you're testing, and # represents the test number.

1. At job completion, double-click the StopCollection.bat file (located in C:\Scripts).

2. Capture screenshots of the Main Backup Job (both Tabs) and sub jobs for a SQL server, an Exchange Server, and a SharePoint server.
    a. Save each screenshot in:
    E:\Veritas Test Results\01 Backup Test\### VM Results Repository\Test #\
    b. If this is a first run, return to step 1 above.
3. On the menu at the top of the NetBackup Console, select File→Export.
4. Select All Rows, and export to *<Test#.xls>.* Click Save.
5. Manually select all the rows in the activity monitor and delete them.
6. Open WinSCP.
7. Select My Workspace on the left panel and click Login. This will open a connection and automatically log into each of the ESXI servers undergoing data collection.
    a. In the left panel, browse for the correct job folder:
    \### VM Results Repository\Test #\esxtop\
    b. In the right panel, select the esxout file (which may be of considerable size) and drag it into the esxtop directory.
    c. Once the file transfer is complete, delete the esxtop from the server (right panel).
    d. Repeat steps a-c for each of the esx servers.
8. Close WinSCP.
9. On the INFRA-SQL server, open E:\Putty Output.
10. In a separate window, open:
    E:\Veritas Test Results\01 Backup Test\### VM Results Repository\Test #\sysstats.
11. Move all the files from E:\Putty Output to the Test folder you selected in the previous step.
12. Close all Explorer windows.
13. Return to step 1 above.

General concurrent restore procedure

1. Delete restore target VM(s) from disk in vCenter.
2. Launch the data collector script.
3. Execute a restore job using one of the following methods:
    a. For NetBackup:
        i. Open a PuTTY session to the NBU master server (172.16.100.100).
            1. Log in as admin/P@ssw0rd
            2. Type `support` and press Enter.
            3. Type `maintenance` and press Enter.
            4. Enter the maintenance password `P@ssw0rd`
            5. Type `elevate` and press Enter.
        ii. Copy the commands to be executed from a text file and paste them into the command line interface on the NetBackup master server.
4. Determine the time by determining the difference between the time the first job begins and the end-time of the last job to complete.
5. Export the NBU job log to disk and copy it to the results folder.
6. Stop the collection script.
7. Transfer the relevant data collector output into the test folder.

APPENDIX C – CPU UTILIZATION

Figure 14 shows the CPU utilization for the NetBackup solution.

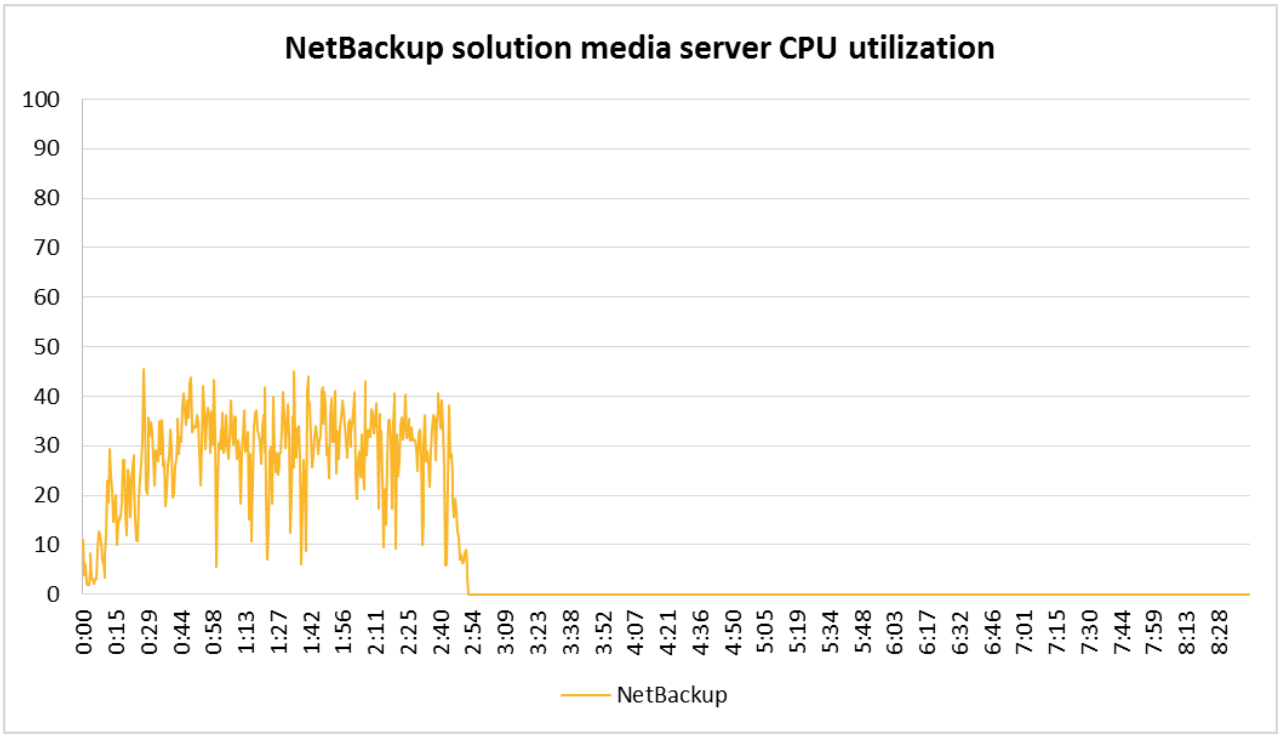

Figure 14: CPU utilization for the NetBackup solution using the NetApp media server.

Figure 15 shows the CPU utilization for the Competitor “E” solution.

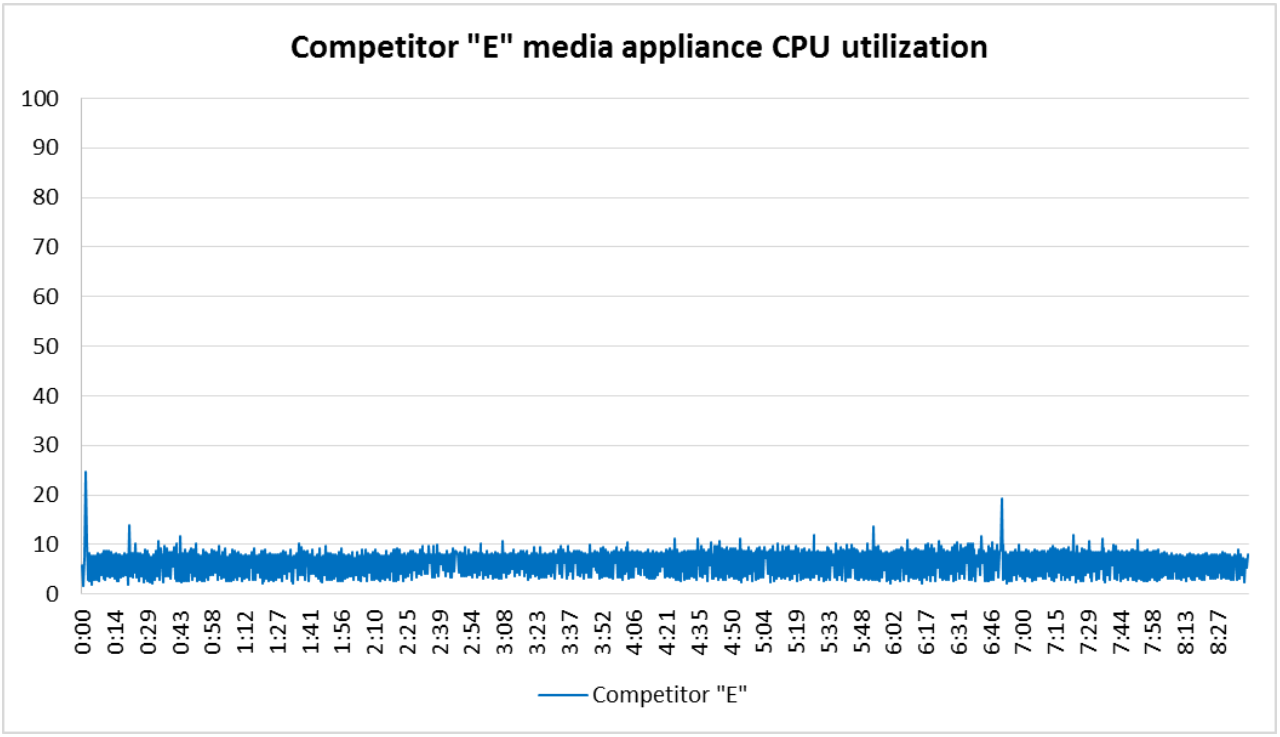

Figure 15: CPU utilization for the Competitor “E” media appliance solution.

Figure 16 shows the CPU utilization for the Competitor “E” virtual data movers host.

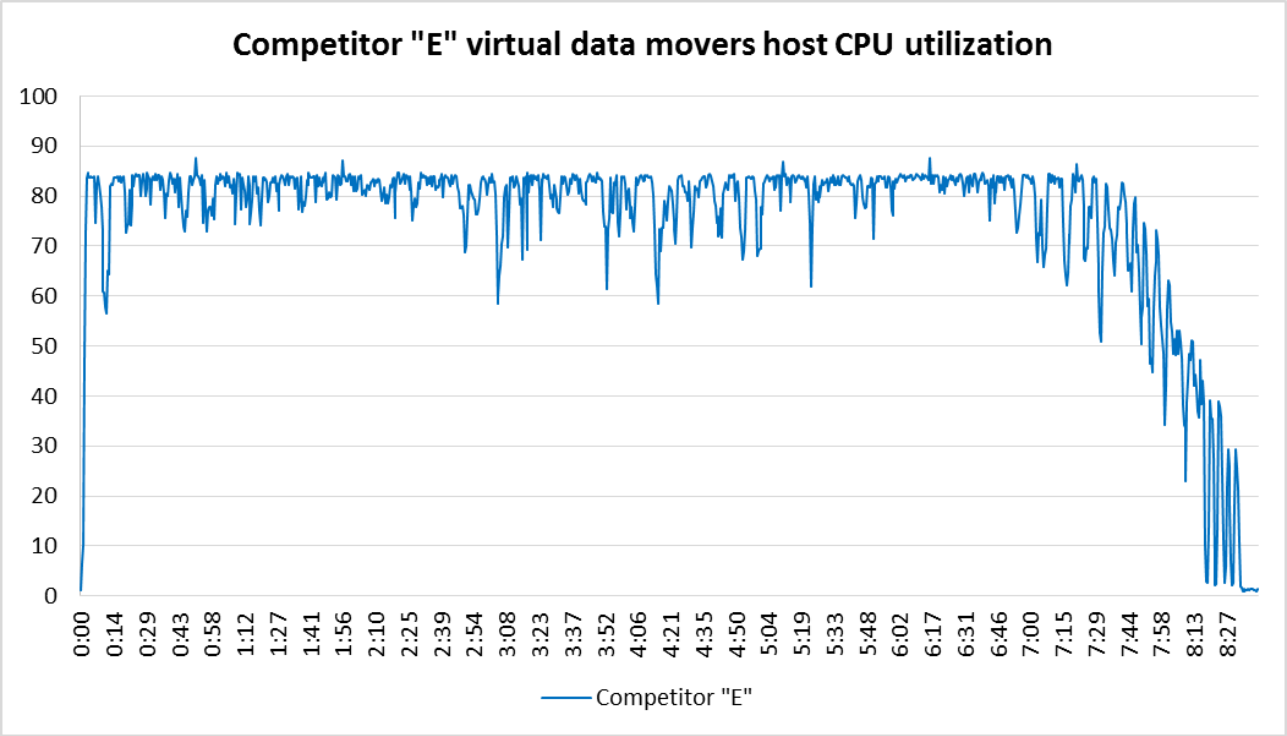

Figure 16: CPU utilization for the virtual data movers host used with the Competitor “E” solution.

ABOUT PRINCIPLED TECHNOLOGIES

Principled Technologies, Inc.
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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.

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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.