Conserve spending by consolidating workloads

New HPE ProLiant DL380 Gen10 servers help organizations spend less on software licensing

Keeping a datacenter running can be costly. In addition to power, cooling, and management, your organization likely pays per socket for vital software licenses to support critical workloads. Workload consolidation allows an organization to reduce its number of servers, and thus spend less on power, cooling, and management while reducing infrastructure expenses such as VMware® vSphere® licensing.

The key to effectively consolidating workloads is to choose powerful hardware that can do the job of older servers many times over. In the Principled Technologies datacenter, we tested the new HPE ProLiant DL380 Gen10 server and three of its most recent predecessors (G6, G7, and Gen8) with a transactional Microsoft® SQL Server® 2016 workload. A new DL380 Gen10 did 4.39 times the work of a G6 server, 2.96 times the work of a G7 server, and 1.74 times the work of a Gen8 server.[1] Based on our ratios, organizations consolidating older servers and workloads to new DL380 Gen10 Servers can spend less on annual vSphere support costs and have more funds to devote to other datacenter initiatives.

As we present our results in this report, we'll explain how consolidating your workloads running on these specific older DL380 servers to the new HPE ProLiant DL380 Gen10 server can reduce OpEx for your organization.

Upgrade to HPE ProLiant DL380 Gen10 Servers and **save up to**

$594K

on virtualization software support for 100 servers **every year**

The cost of aging servers

Some datacenters contain aging HPE servers. These servers likely do a fine job of running applications in VMs, plus they're probably paid off. If your organization has these servers, it's tempting to keep them in service.

Older servers, however, can use more power and cooling resources than newer servers. They can also rack up significant OpEx in support fees for virtualization software year after year. The longer your organization keeps legacy servers around, the greater the potential risk for failure, which can introduce its own set of maintenance expenses. Replacing these older servers with new HPE rack servers using more powerful processors delivers savings in a range of areas, including dramatically reduced software support costs.

Handle more database transactions

To quantify the licensing savings that can come from upgrading older servers, PT conducted hands-on testing with a new dual-processor HPE ProLiant DL380 Gen10 and with three previous-generation dual-processor HPE ProLiant DL380 models—the G6, G7, and Gen8. We configured each of the servers in our study—in terms of amount and types of RAM and other specifications—in a way typical of the time a company would have purchased it. For details on each server, see Appendix A.

We set out to determine how many older servers each new Gen10 would realistically be able to replace. To accomplish this, we performed the same test procedure on all four servers:

- First, we used VMware vSphere to create VMs running Microsoft® Windows Server® 2016 and SQL Server 2016. We used vSphere 6.5 on the Gen8 and Gen10 Servers. We used vSphere 6.0 on the G7 Server because HPE does not officially support 6.5 for that model and used vSphere 5.5 on the G6 Server because HPE does not officially support 6.0 or 6.5 on that model. Note: VMware will stop supporting vSphere 5.5 in 2018.[1]

- Next, we ran an OLTP database benchmark that measures performance in terms of how many orders per minute (OPM) a server processes.

- Finally, we added SQL Server VMs until the processor utilization exceeded 80 percent, the point at which companies typically add compute resources.

Each VM within each server accomplished roughly the same amount of database work (measured in OPM). The Gen10 supported 16 SQL Server 2016 VMs, which did 4.39 times as much work as the G6 and 2.96 and 1.74 times as much work as the G7 and Gen8 Servers, respectively. A single HPE ProLiant DL380 Gen10 could replace as many as four older servers because it can handle that much more work.
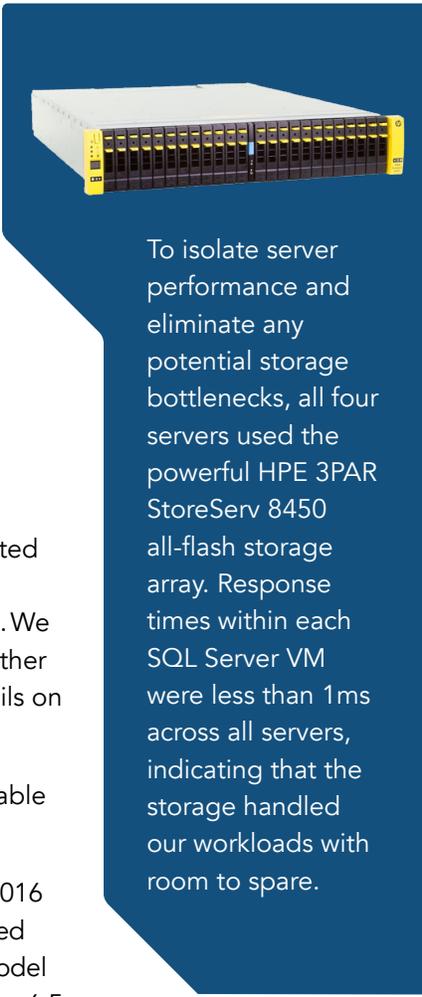
To isolate server performance and eliminate any potential storage bottlenecks, all four servers used the powerful HPE 3PAR StoreServ 8450 all-flash storage array. Response times within each SQL Server VM were less than 1ms across all servers, indicating that the storage handled our workloads with room to spare.

45,668 OPM

26,159 OPM

15,415 OPM

10,386 OPM

| VM | VM | VM | VM |

G6

G7

Gen8
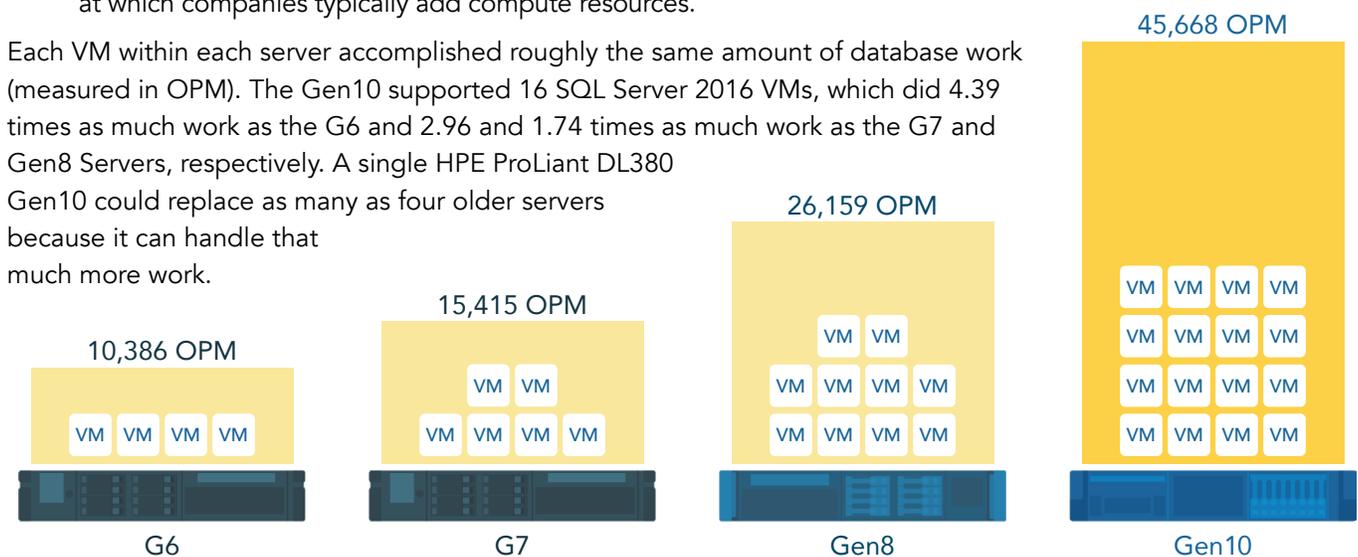
Gen10

Save money by reducing virtualization licenses

After determining how many older servers a single HPE ProLiant DL380 Gen10 could replace, we estimated the virtualization software savings this upgrade would provide.

For one dual-processor server, the upfront cost to purchase the necessary VMware vSphere Enterprise Plus licenses, including the first year of production-level support, is $8,738.[3] For subsequent years, the cost of annual support is $1,748.[4] These costs are identical whether the server is an older G6 model that runs 4 VMs or a new Gen10 that runs 16 VMs and does over four times the work—annual license and support costs are the same for vSphere 5.5, 6.0, and 6.5.

If your organization is running database workloads in vSphere VMs on many older servers, you've already bought licenses for each of them. When you consolidate your workload onto fewer HPE ProLiant DL380 Gen10 Servers, you can reuse a subset of your existing licenses. You buy no new licenses and, because you pay support for only the licenses that are in use, your annual costs decrease dramatically.

If you have 44 HPE ProLiant DL380 G6 Servers running database applications, for example, you can shift those workloads to 10 Gen10 Servers. You can take 20 of your vSphere 5.5 licenses and upgrade them to 6.5 at no charge. This would cut your annual support costs by 77 percent and retain the remaining 68 vSphere licenses for future expansion. You could quadruple your original workload before you would need to spend $8,738 to license another dual-processor server and purchase the initial year of support. In this example, we assumed the organization has a Support and Subscription (SnS) contract for each software license. While under contract, the organization would get new version upgrades free of charge. License and SnS costs for vSphere versions 5.5, 6.0, and 6.5 are the same.

$8,740	$5,244	$3,496	One Gen10 Server does the work of many older servers, lowering annual software support costs.
			$1,748
G6 (5 servers)	G7 (3 servers)	Gen8 (2 servers)	Gen10 (1 server)
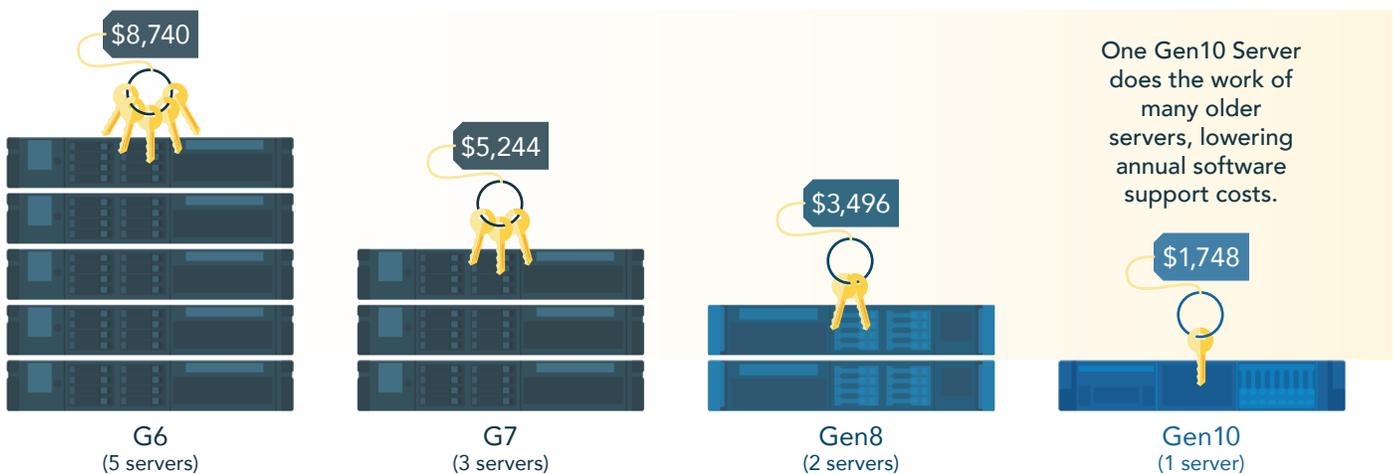
We based the figure above on the consolidation ratios we found in our analysis: 4.39 to 1 for the G6, 2.96 to 1 for the G7, and 1.74 to 1 for the Gen8. We rounded the G6 to five servers, the G7 to three servers, and the Gen8 to two servers because VMware requires a license for each server regardless of how fully utilized it is.

Annual production-level support for five G6 Servers to perform the database workload of a single HPE ProLiant DL380 Gen10 would set you back $8,740. That's five times the $1,748 you would spend for support with the Gen10, and these expenditures occur yearly. Keeping your database workloads running on older HPE servers may be more costly than you think.

Reduce datacenter sprawl while saving licensing costs

Enterprise datacenters typically use dozens if not hundreds of servers. The figures below show the number of servers and associated annual support requirements a company could replace with first 10 and then 100 HPE ProLiant DL380 Gen10 Servers. The potential for savings adds up quickly with many servers.

$76,912

$52,440

Save $59,432 on software support compared to G6 Servers

$31,464

$17,480

G6
(44 servers)

G7
(30 servers)

Gen8
(18 servers)

Gen10
(10 servers)

$769,120

$519,156

Save $594,320 on software support compared to G6 Servers

$305,900

$174,800

G6
(440 servers)

G7
(297 servers)

Gen8
(175 servers)

Gen10
(100 servers)
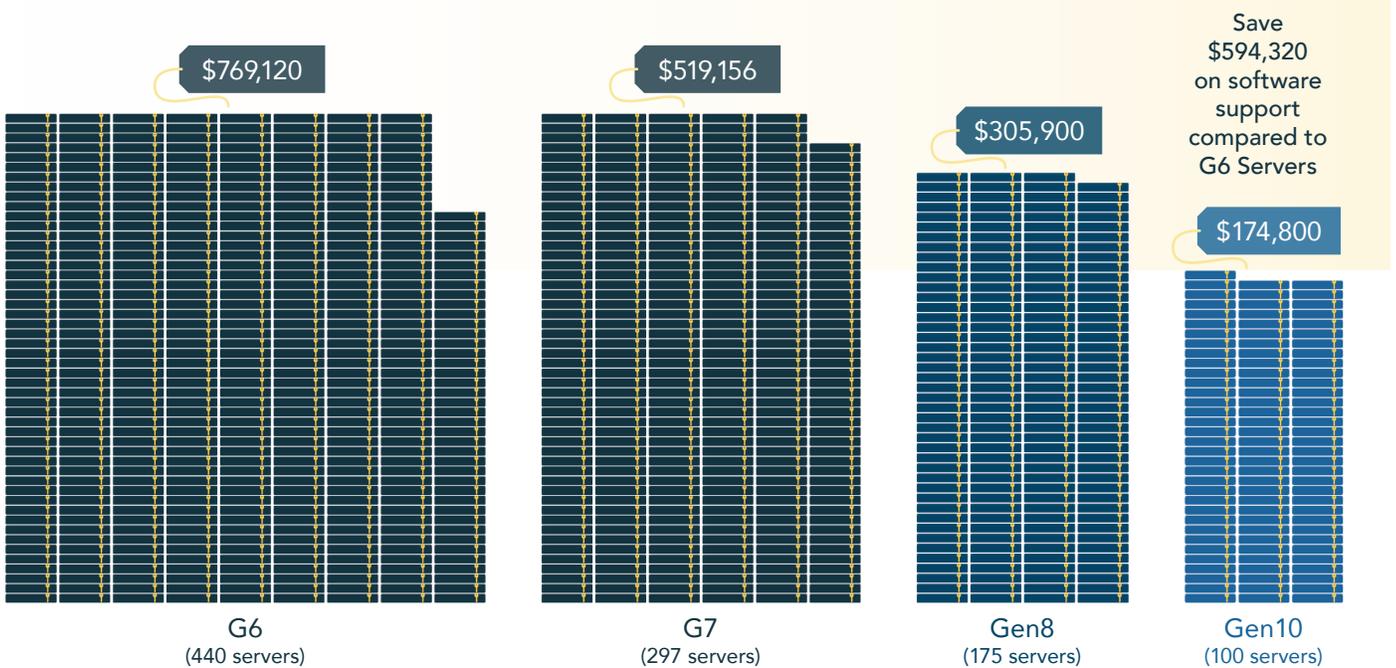
Conclusion

Keeping legacy servers in production might not be the cost-saving strategy your organization expects. Newer servers can support more workloads, which can decrease your OpEx in many key areas.

One of those areas is the cost of licensing, specifically of virtualization software and its yearly support. We showed how an organization replacing many HPE ProLiant 380 G6 rack servers with new HPE ProLiant DL380 Gen10 Servers could see a consolidation ratio of five to one. This upgrade and consolidation would allow the organization to transfer one-fifth of their vSphere licenses while retaining the remaining licenses for future growth. The organization could quintuple their workload before having to license additional servers at $8,738 (which includes one year of support).

In addition, yearly support costs for vSphere would shrink to one-fifth of what the organization would have been paying. For every five HPE DL380 G6 Servers the organization consolidates onto one Gen10, the reduction in annual support costs would equal $6,992. This is on top of potential savings on reduced power usage and IT management. A company replacing HPE ProLiant DL380 G7 or DL380p Gen8 Servers would see similar savings but on a slightly smaller scale.[5] Although this study focused on a virtualized database environment and hypervisor licensing, bare-metal applications that use per-socket or per-CPU licensing schemes could potentially benefit from similar consolidation approaches as well.

New servers do require CapEx. However, spending less every year on software support—on top of the other OpEx savings companies typically realize with server consolidation—can significantly offset the investment. After a close look at how much you're spending on virtualization software support for your older servers, you might determine that you simply can't afford not to upgrade.

Upgrade to HPE ProLiant DL380 Gen10 Servers and **save up to** **$594K** on virtualization software support for 100 servers **every year**[6]

---

1   These calculations are based on our hands-on testing. For example, we took the OPM of the Gen10 and divided it by the OPM of the G6, which came to 4.39 times as much.

2   "VMware Lifecycle Product Matrix", September 14, 2017, https://www.vmware.com/content/dam/digitalmarketing/vmware/en/pdf/support/product-lifecycle-matrix.pdf

3   "vSphere and vSphere with Operations Management"; September 1, 2017; http://store.vmware.com/store/vmware/en_US/pd/productID.284281000?src=WWW_eBIZ_productpage_vSphere_EnterprisePlus_Buy_US, http://www.vmware.com/products/vsphere.html; vSphere Enterprise Plus (1 year Production Support and Subscription) (per processor) license plus one year of production-level support

4   Ibid.

5   Smaller companies using VMware vSphere Standard edition can also save; we provide those numbers in Appendix C.

6   Based on $6,992 annual support costs for four G6 Servers vs. $1,748 annual support costs for one Gen10 server.

On August 31, 2017, we finalized the hardware and software configurations we tested. Updates for current and recently released hardware and software appear often, so unavoidably these configurations may not represent the latest versions available when this report appears. For older systems, we chose configurations representative of typical purchases of those systems. We concluded hands-on testing on September 1, 2017.

Appendix A: System configuration information

Server

Server configuration information	HPE ProLiant DL380 G6	HPE ProLiant DL380 G7	HPE ProLiant DL380p Gen8	HPE ProLiant DL380 Gen10
General				
Number of processor packages	2	2	2	2
Number of cores per processor	4	6	10	16
Number of hardware threads per core	2	2	2	2
System power management policy	Default	Default	Default	Default
CPU				
Vendor	Intel®	Intel	Intel	Intel
Name	Xeon®	Xeon	Xeon	Xeon
Model number	X5570	X5670	E5-2680 v2	Gold 6130
Socket type	FCLGA1366	FCLGA1366	FCLGA2011	FCLGA3647
Core frequency (GHz)	2.93	2.93	2.80	2.10
Bus frequency (GT/s)	6.4	6.4	8.0	10.4
L1 cache	32 KB + 32 KB (per core)	32 KB + 32 KB (per core)	32 KB + 32 KB (per core)	32 KB + 32 KB (per core)
L2 cache	256 KB	256 KB	256 KB	16 MB
L3 cache	8 MB	12 MB	25 MB	22 MB
Platform				
Vendor and model number	HPE ProLiant DL380 G6	HPE ProLiant DL380 G7	HPE ProLiant DL380p Gen8	HPE ProLiant DL380 Gen10
Motherboard model number	496069-001	599038-001	801939-001	826567-B21
BIOS version	P62	P67	P73	U30 v1.02
Integrated LOM	Broadcom® NC382i Multi Port Gigabit Server Adapter	Broadcom NC382i Gigabit Ethernet adapter	Broadcom NetXtreme® BCM5719 Gigabit Ethernet adapter	HPE Ethernet 1Gb 4-port 331i Adapter
Memory module(s)				
Total RAM in system (GB)	128	96	128	384
Vendor and model number	Samsung® M393B1K70DH0-YH9Q9	Samsung M393B1GH73BH0-YH9	Hynix® HMT42GR7MFR4C-PB	Hynix® HMA42GR7MFR4N
Type	PC3L-10600R	PC3L-10600R	PC3-12800R	PC4-2133P
Speed (MHz)	1,333	1,333	1,600	2,133

Server configuration information	HPE ProLiant DL380 G6	HPE ProLiant DL380 G7	HPE ProLiant DL380p Gen8	HPE ProLiant DL380 Gen10
Speed running in the system (MHz)	1,333	1,333	1,600	2,133
Size (GB)	8	8	16	16
Number of RAM module(s)	16	12	8	24
Chip organization	Double-sided	Double-sided	Double-sided	Double-sided
Rank	Dual	Dual	Dual	Dual
Fibre channel adapter				
Vendor and model number	Emulex LPe12000 8Gb FC adapter	Emulex LPe12000 8Gb FC adapter	Emulex LPe12000 8Gb FC adapter	Emulex LPe12000 8Gb FC adapter
Firmware				
Integrated Lights-Out firmware version	2.12	1.50	2.54	20.6.41

Storage

Storage	HPE 3PAR 8450
Storage controllers	
Controller firmware version	HPE 3PAR OS 3.3.1.215
Number of controllers	2
Number of shelves	2
Network ports	12 x 16Gb Fibre Channel
RAID configuration	RAID 5 (3+1)
Drive vendor and model number	48 x HPE DOPE1920S5xnNMRI
Drive size (GB)	1,920
Drive information (speed, interface, type)	SAS SSD

Virtual machines

Virtual machine configuration information	HPE ProLiant DL380 G6	HPE ProLiant DL380 G7	HPE ProLiant DL380p Gen8	HPE ProLiant DL380 Gen10
VMware vSphere Version	5.5.0, 5230635	6.0.0, 5572656	6.5.0, 5969303	6.5.0, 5969303
vCPU count	4	4	4	4
Memory (GB)	10	10	10	10
Virtual disk (GB)	50 (OS), 30 (DB), 20 (LOG)	50 (OS), 30 (DB), 20 (LOG)	50 (OS), 30 (DB), 20 (LOG)	50 (OS), 30 (DB), 20 (LOG)
Virtual disk controller	LSI Logic SAS	LSI Logic SAS	LSI Logic SAS	LSI Logic SAS
Virtual NIC	VMXNET 3	VMXNET 3	VMXNET 3	VMXNET 3
OS	Windows Server 2016	Windows Server 2016	Windows Server 2016	Windows Server 2016

Appendix B: How we tested

Installing VMware vSphere onto the servers

We installed VMware vSphere 5.5 on the local hard drives of the G6 server, 6.0 on the local hard drives of the G7 server, and 6.5 on the local hard drives of the Gen8 and Gen10 servers. We placed all local hard drives in RAID1 pairs.

1. Connect an external optical drive to the front of the server using the HPE KVM dongle.
2. Insert the appropriate VMware vSphere installation media into the optical drive.
3. Boot the server to the VMware vSphere installer.
4. To begin the installation wizard, press F11.
5. Select the RAID1 pair as the installation location.
6. Select US English as the keyboard type and language.
7. For the host, enter the root password.
8. To start the installation, press Enter.
9. When the installation completes, press Enter to reboot the host.
10. After the host reboots, set the management network IP address.
11. Add the host to vCenter, and enable SSH and ESXi shell.

Configuring the networking

We used a Brocade M6505 top-of-rack switch to handle Fibre Channel traffic between the servers and the HPE 3PAR storage. For all the servers, we used the 8Gb Fibre Channel adapters to directly connect to the top-of-rack switch.

Configuring the storage

We first created a Common Provisioning Group large enough to hold 32 workload VMs. We created a total of 16 LUNS (Virtual Volumes) on the HPE 3PAR all-flash storage to maximize storage concurrency. We sized eight of the LUNs to hold the OS and SQL data VMDKs for four VMs. We sized the remaining eight LUNs to hold the SQL log VMDKs for four VMs.

Creating the workload virtual machines

We created varying numbers of workload VMs for our testing depending on the generation under test. We used 4 VMs for the G6 server, 6 VMs for the G7 server, 10 VMs for the Gen8 server, and 16 VMs for the Gen10 server. Each VM had 4 vCPUs, 10 GB of memory, and a connection to our testing network. We installed Windows Server 2016 and SQL Server 2016 onto each VM. When cloning the VMs, we placed four VMs onto each HPE 3PAR Virtual Volume to maximize storage concurrency.

Creating the base VM

1. In VMware vCenter, navigate to Virtual Machines.
2. Click Create a new VM.
3. Leave Create a new virtual machine selected, and click Next.
4. Enter a name for the virtual machine, and click Next.
5. Place the VM on a host with available CPUs, and click Next.
6. Select the first HPE 3PAR data-sized Virtual Volume for the 50GB OS VMDK, and click Next.
7. Click Next.
8. Select the guest OS as Windows Server 2016, and click Next.
9. In the Customize Hardware section, make the following changes:

   - Increase the vCPUs to 4.
   - Increase the VM memory to 10,240 MB.
   - Add a 30GB VMDK for SQL data, and select the VMware Paravirtual controller and Thick Provisioned Eager Zeroed.
   - Add a 20GB VMDK for SQL logs, and select the VMware Paravirtual controller and Thick Provisioned Eager Zeroed. Place the VMDK in the first HPE 3PAR log-sized datastore.
10. Connect the VM to the test network.
11. Click Next.
12. Click Finish.

Installing Windows Server 2016 guest OS onto the VMs

1. Attach the Windows Server 2016 ISO to the VM.
2. Open the VM console, and start the VM.
3. When prompted to boot from DVD, press any key.
4. When the installation screen appears, leave language, time/currency format, and input method as default, and click Next.
5. Click Install now.
6. When the installation prompts you, enter the product key.
7. Select Windows Server 2012 Datacenter Edition (Server with a GUI), and click Next.
8. Check I accept the license terms, and click Next.
9. Click Custom: Install Windows only (advanced).
10. Select Drive 0 Unallocated Space, and click Next. This starts Windows automatically, and Windows will restart automatically after completing.
11. When the Settings page appears, enter the same password in the Password and Reenter Password fields.
12. Log in with the password you set up in the previous step.

Installing .NET Framework 3.5

1. In the VM, open Server Manager.
2. Click Manage→Add Roles and Features.
3. Select Role-based or feature-based installation, and click Next.
4. Under Server pool, select the local server, and click Next. Click Next again.
5. Under Features, select .NET Framework 3.5 Features, and click Next.
6. Click Install.
7. Upon completion, click Close.

Installing SQL Server 2016

1. Attach the installation media ISO for SQL Server 2016 to the VM.
2. Click Run SETUP.EXE. If Autoplay does not begin the installation, navigate to the SQL Server 2016 DVD, and double-click it.
3. In the left pane, click Installation.
4. Click New SQL Server stand-alone installation or add features to an existing installation.
5. Click the checkbox to accept the license terms, and click Next.
6. Click Use Microsoft Update to check for updates, and click Next.
7. To install the setup support files, click Install.
8. If no failures are displayed, click Next.
9. At the Setup Role screen, choose SQL Server Feature Installation, and click Next.
10. At the Feature Selection screen, select Database Engine Services, Full-Text and Semantic Extractions for Search, Client Tools Connectivity, Client Tools Backwards Compatibility, Management Tools – Basic, and Management Tools – Complete.
11. Click Next.
12. At the Instance configuration screen, leave the default selection of default instance, and click Next.
13. At the Database Engine Configuration screen, select the authentication method you prefer. For our testing purposes, we selected Mixed Mode.
14. Enter and confirm a password for the system administrator account.
15. Click Add Current user. This may take several seconds.
16. Click Next.
17. At the Error and usage reporting screen, click Next.
18. At the Installation Configuration Rules screen, check that there are no failures or relevant warnings, and click Next.
19. At the Ready to Install screen, click Install.
20. Close the installation window.

Enabling Lock pages in memory

1. In the VM, click Start, type `gpedit.msc` and press Enter.
2. In the Local Group Policy Editor, expand Computer Configuration→Windows Settings→Security Settings→Local Policies.
3. Select User Rights Assignment, and in the right pane, scroll down to Lock pages in memory.
4. Right-click Lock pages in memory, and click Properties.
5. Click Add User or Group, and add your SQL user account.
6. Click OK.
7. For the legacy base VM, repeat steps 1 through 6.

Configuring the DVD Store 3 benchmark

Generating the data

We generated the data using the Install.pl script included with DVD Store version 3 (DS3), providing the parameters for our 10GB database size and the Microsoft SQL Server 2016 platform. We ran the Install.pl script on a utility system running Linux.® The Install.pl script also generated the database schema.

After processing the data generation, we transferred the data files and schema creation files to a Windows-based system running SQL Server 2016. We built the 10GB database in SQL Server 2016, and then performed a full backup, storing the backup file on the C: drive for quick access. We used that backup file to restore the server between test runs.

The only modifications we made to the database schema-creation scripts were in the file sizes we specified for our database. We explicitly set the file sizes larger than necessary to ensure that no file-growth activity would affect the outputs of the test. Besides this file size modification, the database schema was created and loaded according to the DVD Store documentation. Specifically, we followed the steps below:

1. We generated the data and created the database and file structure using database schema-creation scripts in the DS2 download. We made size modifications specific to our 10GB database and changed the drive letters as appropriate.
2. We transferred the files from our Linux data generation system to a Windows system running SQL Server 2016.
3. We created database tables, stored procedures, and objects using the provided DVD Store scripts.
4. We set the database recovery model to bulk-logged to prevent excess logging.
5. We loaded the data we generated into the database. For data loading, we used the import wizard in SQL Server Management Studio. Where necessary, we retained options from the original scripts, such as Enable Identity Insert.
6. We created indices, full-text catalogs, primary keys, and foreign keys using the database-creation scripts.
7. We updated statistics on each table according to database-creation scripts, which sample 18 percent of the table data.
8. On the SQL Server instance, we created a ds2user SQL Server login using the following Transact-SQL (T-SQL) script:

```
USE [master]
GO
CREATE LOGIN [ds2user] WITH PASSWORD=N'',
      DEFAULT_DATABASE=[master],
      DEFAULT_LANGUAGE=[us_english],
      CHECK_EXPIRATION=OFF,
      CHECK_POLICY=OFF
GO
```

9. We set the database recovery model back to full.
10. We created the necessary full-text index using SQL Server Management Studio.
11. We created a database user and mapped this user to the SQL Server login.
12. We performed a full backup of the database. This backup allowed us to restore the databases to a pristine state relatively quickly between tests.

The following tables show our initial file size modifications.

Logical name	Filegroup	Initial size (MB)
Database files		
Primary	PRIMARY	4
cust1	DS_CUST_FG	3,106
cust2	DS_CUST_FG	3,106
ind1	DS_IND_FG	3,107
ind2	DS_IND_FG	3,107
ds_misc	DS_MISC_FG	200
orders1	DS_ORDERS	1,503
orders2	DS_ORDERS	1,504
Log files		
ds_log	Not applicable	147

Configuring the database workload client

For our testing, we used a virtual client for the Microsoft SQL Server client. To create this client, we installed Windows Server 2016, assigned a static IP address, and installed .NET 3.5.

Running the DVD Store tests

We created a series of batch files, SQL scripts, and shell scripts to automate the complete test cycle. DVD Store outputs an orders-per-minute metric, which is a running average calculated throughout the test. We report the last OPM reported by each client/target pair.

Each complete test cycle consisted of the following general steps:

1. Clean up prior outputs from the target system and the client driver system.
2. Drop the database from the target.
3. Restore the database on the target.
4. Shut down the target.
5. Reboot the host and client system.
6. Wait for a ping response from the server under test and the client system.
7. Let the test server idle for 10 minutes.
8. Start the DVD Store driver on the client.

We used the following DVD Store parameters for testing:

```
ds2sqlserverdriver.exe --target=<target_IP> --ramp_rate=10 --run_time=15 --n_threads=8 --db_size=10GB
--think_time=100 --detailed_view=Y --warmup_time=15 --report_rate=1 --csv_output=<drive path>
```

Appendix C – VMware vSphere Standard pricing

For our testing and analysis, we used single-instance SQL Server 2016 Enterprise VMs with CPU-based licensing.

Most companies with large numbers of servers will likely use the Enterprise Plus edition of VMware vSphere to take advantage of features exclusive to Enterprise Plus such as vDS and Storage DRS. However, some smaller companies who do not need the additional features might elect to use the Standard Edition. The table below, which uses the consolidation ratios in the body of this report along with Standard edition pricing, shows the savings such companies could expect.[1]

	HPE ProLiant DL380 G6	HPE ProLiant DL380 G7	HPE ProLiant DL380p Gen8	HPE ProLiant DL380 Gen10
Number of servers and annual software support costs to perform workloads equivalent to 1 Gen10 server				
Number of servers	5	3	2	1
Annual software support costs	$3,230.00	$1,938.00	$1,292.00	$646.00
Number of servers and annual software support costs to perform workloads equivalent to 10 Gen10 servers				
Number of servers	44	30	18	10
Annual software support costs	$28,424.00	$19,380.00	$11,628.00	$6,460.00
Number of servers and annual software support costs to perform workloads equivalent to 100 Gen10 servers				
Number of servers	440	297	175	100
Annual software support costs	$284,240.00	$191,862.00	$113,050.00	$64,600.00

Each 2-socket server costs $1,748 annually for vSphere support based on VMware vSphere Enterprise Plus 1 Year Support & Subscription cost of $874 per CPU

---

1   "vSphere and vSphere with Operations Management"; September 1, 2017; vSphere Standard (1 year Production Support and Subscription) (per processor) license plus one year of production-level support; http://www.vmware.com/products/vsphere.html; http://store.vmware.com/store/vmware/en_US/cat/categoryID.65651900?

This project was commissioned by HPE.