



The science behind the report:

Reap the full potential of workload mobility within the cloud and data center by using consistent processor architecture

This document describes what we tested, how we tested, and what we found. To learn how these facts translate into real-world benefits, read the report [“Reap the full potential of workload mobility within the cloud and data center by using consistent processor architecture.”](#)

On November 14, 2018, 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 December 17, 2018.

Service disruption during VM migration

The table below presents our findings. We performed three runs to confirm repeatability. The results we cite in the report are the medians from these three runs.

	Move compute only	Move compute and storage
Between two Intel® Xeon® Platinum 8160 processor-powered servers	Run 1: No disruption Run 2: No disruption Run 3: No disruption	Run 1: No disruption Run 2: No disruption Run 3: No disruption
From a legacy server powered by Intel Xeon E5-2680 v2 processors to an Intel Xeon Platinum 8160 processor-powered server	Run 1: No disruption Run 2: No disruption Run 3: No disruption	Run 1: No disruption Run 2: No disruption Run 3: No disruption
From an Intel Xeon Platinum 8160 processor-powered server to an AMD EPYC 7601 processor-powered server	Run 1: 42 seconds Run 2: 41 seconds Run 3: 45 seconds	Run 1: 18 minutes, 51 seconds Run 2: 18 minutes, 20 seconds Run 3: 18 minutes, 31 seconds

System configuration information

The table below presents detailed information on the systems we tested.

Server configuration information	Intel R2208WFTZS	Dell EMC™ PowerEdge™ R720	Supermicro 829UAS-16
Number of nodes	2	1	1
Number of sockets	2	2	2
BIOS name and version	Intel SE5C620.86B	Dell 2.7.0	American Megatrends 1.1b
Non-default BIOS settings	Virtualization enabled	None	None
Operating system name and version/build number	VMware ESXi™ 6.7.0, 10764712	VMware ESXi 6.7.0, 10764712	VMware ESXi 6.7.0, 10764712
Date of last OS updates/patches applied	11/14/2018	11/14/2018	11/14/2018
Power management policy	Balanced	Balanced	Balanced
Mitigation variants	1,2,3,3a,4,L1TF	1,2,3,3a,4,L1TF	1,2,3,3a,4,L1TF
Testing details			
Tested by	PT	PT	PT
Test date	12/17/2018	12/17/2018	12/17/2018
Processor			
Number of processors	2	2	2
Vendor and model	Intel Xeon Platinum 8160	Intel Xeon E5-2680 v2	AMD EPYC 7601
Cores/threads (per processor)	24/48	10/20	32/64
Core frequency (GHz)	2.10	2.80	2.20
Stepping	4	4	2
Microcode	0x0200004d	0x0000042d	0x08001227
SMT	On	On	On
Clock boost	On	On	On
Memory module(s)			
Total memory in system (GB)	384	96	512
Number of memory modules	12	6	16
Vendor and model	Samsung® M393A4K40BB2-CTD	Hynix® HMT42GR7AFR4C-RD	Samsung M393A4K40BB2-CTD
Size (GB)	32	16	32
Type	PC4-21300	PC3-14900	PC4-21300
Speed (MHz)	2,667	1,866	2,667
Speed running in the server (MHz)	2,667	1,866	2,667

Server configuration information	Intel R2208WFTZS	Dell EMC™ PowerEdge™ R720	Supermicro 829UAS-16
SATA storage			
Number of drives	1	4	1
Drive vendor and model	Intel SSDSC2BA400G4	Seagate® ST9300605SS	Intel SSDSC2BA400G4
Drive size (GB)	400	300	400
Drive information (interface, type)	SATA SSD	SAS HDD	SATA SSD
Integrated network adapter			
Vendor and model	Intel X722	Intel X540-AT2	Intel X540-AT2
Number and type of ports	4x 10Gb Ethernet	2x 10Gb Ethernet	2x 10Gb Ethernet
Driver version	i40en 1.3.1-22vmw.670.1.28.10302608	ixgben 1.7.10-1OEM.670.0.0.8169922	ixgben 1.7.10-1OEM.670.0.0.8169922
10Gb network adapter			
Vendor and model	Intel 82599EB	Intel 82599EB	Intel 82599EB
Number and type of ports	2x 10Gb Ethernet	2x 10Gb Ethernet	2x 10Gb Ethernet
Driver version	ixgben 1.7.10-1OEM.670.0.0.8169922	ixgben 1.7.10-1OEM.670.0.0.8169922	ixgben 1.7.10-1OEM.670.0.0.8169922
Cooling fans			
Vendor and model	Intel FR2UFAN60HSW	Dell WCRWR	San Ace 80 FAN-0094L4
Number of cooling fans	6	6	4
Power supplies			
Vendor and model	SoluM® PSSF132202A	Dell 0CC6W	Supermicro® PWS-920P-SQ
Number of power supplies	2	2	2
Wattage of each (W)	750	1,100	920

The table below provides detailed configuration information for the network switches we used.

Network switch configuration information	Dell EMC Networking S4048-ON
Firmware revision	9.9 (0.0P9)
Number and type of ports	48 x SFP+ 10GbE, 6 x QSFP 40GbE
Number and type of ports used in test	2 x SFP+ 10GbE, 6 x QSFP 40GbE
Non-default settings used	MTU 9216

How we tested

Configuring the servers under test

We set BIOS settings to default except for enabling virtualization on the current-generation servers powered by Intel Xeon Platinum 8160 processors. Each server had a 1Gb connection to an infrastructure network for ESXi management traffic, and a 40Gb connection to a testing network for vMotion and Provisioning traffic. We installed VMware ESXi 6.7 onto the SATA SSD on the current-generation server powered by Intel Xeon Platinum 8160 processors and the server powered by AMD EPYC 7601 processors. We placed the OS onto the virtual RAID10 disk on the legacy server powered by Intel Xeon E5-2680 v2 processors.

Installing VMware ESXi 6.7

1. Boot the server to the VMware ESXi 6.7 installation media.
2. At the boot menu, press Enter.
3. Press Enter to continue.
4. To accept the license terms, press F11.
5. Select the SATA SSD or the RAID10 virtual disk, and press Enter.
6. At the keyboard layout screen, press Enter.
7. Enter a password for the root user, and press Enter.
8. At the installation confirmation screen, press Enter.
9. After the installation completes, press Enter to reboot the server.

Installing VMware vCenter 6.7

1. Mount the VMware vCenter installation media to a server or client computer running Windows.
2. Navigate to the `vcsa-ui-installer/win32` directory, and run `installer.exe`.
3. At the home page, click Install.
4. Click Next.
5. Check the I accept the terms of the license agreement checkbox, and click Next.
6. Click Next.
7. Enter the IP address or FQDN of an infrastructure server running VMware ESXi 6.7.
8. Enter the username and password for the infrastructure host.
9. Click Next.
10. Set a root password for the VCSA appliance, and click Next.
11. Click Next.
12. Provide networking details for the VCSA appliance, and click Next.
13. When the deployment completes, click Continue.
14. Click Next.
15. Click Next.
16. Enter a username and password for the SSO domain, and click Next.
17. Uncheck the Join the VMware's Customer Experience Improvement Program (CEIP) checkbox, and click Next.

Adding hosts to VMware vCenter

1. Use a web browser to navigate to the VCSA IP address and log in with the SSO domain credentials.
2. Right-click the VCSA appliance, and click New Datacenter.
3. Enter a name for the datacenter, and click OK.
4. Right-click the datacenter, and click New Host.
5. Enter the IP address of the host, and click Next.
6. Enter the root account credentials of the host, and click Next.
7. Click Next.
8. At the Assign license screen, click Next.
9. At the Lockdown mode screen, click Next.
10. Click Next.
11. Click Finish.

Creating the test VM

1. Right-click one of the hosts, and click New Virtual Machine.
2. Click Next.
3. Enter a name for the virtual machine, and click Next.
4. Select a host for the VM location, and click Next.
5. Ensure the default datastore is selected, and click Next.
6. Click Next.
7. Select Windows and Microsoft Windows Server 2016 (64-bit) for the Guest OS Family and Guest OS Version dropdown menus, and click Next.
8. Use the dropdown menus to select the following:
 - Four virtual CPUs
 - 16GB virtual memory
 - 60GB hard disk
9. From the New CD/DVD Drive drop-down menu, select Datastore ISO File.
10. Select the Microsoft Windows Server 2016 Datacenter installation ISO, and click OK.
11. Click Next.
12. Click Finish.

Installing Microsoft Windows Server 2016 Datacenter

1. Using the remote console, boot the VM to the Microsoft Windows Server 2016 Datacenter installation media.
2. Press any key to boot to the CD/DVD.
3. Click Next.
4. Click Install Now.
5. Select Windows Server 2016 Datacenter (Desktop Experience), and click Next.
6. Check the I accept the license terms checkbox, and click Next.
7. Click Custom: Install Windows only (advanced).
8. Click Next.
9. When the installation completes, enter a password for the administrator user, and click Finish.

Installing Microsoft Windows SQL Server 2016

1. Mount the Microsoft Windows SQL Server 2016 installation ISO to the Microsoft Windows Server VM.
2. Click the Autorun prompt when it appears.
3. In the left pane, click Installation.
4. Click New SQL Server stand-alone installation or add features to an existing installation.
5. Select the Specify a free edition radio button, and select Evaluation from the dropdown menu.
6. Click Next.
7. Check the I accept the license terms checkbox, and click Next.
8. Allow the Global Rules check to complete, and click Next.
9. Uncheck the Use Microsoft Update to check for updates (recommended) checkbox, and click Next.
10. Allow the Install Rules check to complete, and click Next.
11. Check the Database Engine Services, Full-Text and Semantic Extractions for Search, Client Tools Connectivity, and Client Tools Backwards Compatibility checkboxes, and click Next.
12. Allow the Feature Rules check to complete, and click Next.
13. Click Next.
14. Click Next.
15. Select the Mixed Mode (SQL Server authentication and Windows authentication) radio button, and enter a password for the SQL user.
16. Click Add Current User.
17. Click Next.
18. Click Install.

Connecting an NFS datastore

1. In the Host and Clusters view of vCenter, right-click the host, and click Storage→New Datastore.
2. Select the NFS radio button, and click Next.
3. Click Next.
4. Enter connection details for the NFS storage, and click Next.
5. Check the checkboxes to select all hosts, and click Next.
6. Click Finish.

Configuring EVC mode

1. Right-click Datacenter, and click New Cluster.
2. Enter a name for the cluster, and click OK.
3. In the left pane, click VMware EVC.
4. Click Edit.
5. Select the Enable EVC for Intel Hosts radio button.
6. Select Intel "Ivy Bridge" Generation from the dropdown menu, and click OK.
7. Drag the legacy server powered by Intel Xeon E5-2680 v2 processors and the server powered by Intel Xeon Platinum 8160 processors into the EVC cluster.

Creating a vMotion or Provisioning network

1. Select one of the hosts, and click Configure.
2. Click VMkernel adapters.
3. Click Add Networking.
4. Click Next.
5. Select the New standard switch radio button, and enter 9000 for the MTU. Click Next.
6. Click the plus sign to add an adapter.
7. Select the 10Gb adapter, and click OK.
8. Click Next.
9. Give the network a name, and check either the vMotion or Provisioning checkbox depending on the test scenario.
10. Click Next.
11. Click Next.
12. Click Finish.

Configuring the database

We used the DVD Store 2.1 (DS2) benchmarking tool to test our SQL Server connectivity during migrations.

We generated the test database using the Install.pl script included with DS2 providing the parameters for our 10GB database size and the database platform on which we ran, Microsoft SQL Server 2016. 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 2008. We built the database in SQL Server 2008, and 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 schema creation scripts were in the specified file sizes for our database. We deliberately set the file sizes higher than necessary to ensure that no file-growth activity would affect the outputs of the test. Other than this file size modification, we created and loaded the database schema according to the DS2 documentation. Specifically, we performed the following steps:

1. We generated the data and created the database and file structure using database creation scripts in the DS2 download. We made size modifications specific to our database and the appropriate changes to drive letters.
2. We transferred the files from our Linux data-generation system to a Windows system running Microsoft SQL Server.
3. Using the provided DVD Store scripts, we created database tables, stored procedures, and objects.
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.

- On the SQL Server instance, we created a ds2user SQL Server login using the following Transact SQL (TSQL) script:

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

- We set the database recovery model back to full.
- We created the necessary full text index using SQL Server Management Studio.
- We created a database user and mapped this user to the SQL Server login.

Running the migration tests

We tested the live migration scenarios by starting the DS2 workload and then migrating the VM. We ran the workload with single-second report time and ensured that each report contained database activity.

We tested the cold migration scenarios by shutting down the VM and beginning the timer. We then initiated the VM migration. As soon as the migration completed, we started the VM and our DS2 workload. We stopped the timer when the DS2 workload established a connection with the database.

Migrating the virtual machines

- In the Hosts and Clusters view of vCenter, right-click the VM, and click Migrate.
- Select the radio button for the scenario under test, and click Next.
- Select the destination host from the dropdown menu, and click Next.
- If moving storage, select the default datastore, and click Next.
- Click Finish.

Running DVD Store 2

- Using the CMD utility, navigate to the location of the ds2sqlserverdriver.exe and run the following command to start the benchmark:
`./ds2sqlserverdriver.exe -report-rate=1 -target=<IP of SQL Server VM>`

Read the report at <http://facts.pt/8zysd88> ►

This project was commissioned by Intel Corp.



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