

Behind the Report—Testing Addendum:

# For Peak Performance, Bare Metal Wins

This document provides the system-configuration details and step-by-step procedures that Prowess Consulting used to perform benchmark testing on the following Dell Technologies™ platforms:

For the full analysis, read the [report](#).

Testing was concluded on December 2, 2022.

## Server Configurations

Configuration	Single Server RAID	Four-Server VMware vSAN™ Cluster
Server	1 x Dell™ PowerEdge™ R750	4 x Dell™ PowerEdge™ R750
Processor	Intel® Xeon® Gold 6338 processor	Intel® Xeon® Gold 6330 processor
Number of CPUs	2	2
Cores/threads per CPU	32, 64	28, 56
Cores/threads total	64, 128	56, 112
Frequency (base/SCT/MCT)	2.00 GHz	2.00 GHz
Storage controller 01	Dell™ PowerEdge RAID Controller (PERC) H755N Front NVMe Express® (NVMe®) Broadcom® LSI	Broadcom® LSI Dell™ HBA355i Front
Disk	3.2 TB KIOXIA® Dell™ NVMe® CM6 MU 7 x 1.2	1 x 480 GB Intel® SSDSC2KG480GZR TB Seagate® ST1200MM0099
Number of disks	8	8
Storage controller 02	Dell™ PERC H755N Front NVMe® Broadcom® controller	Marvell® Technology Group Ltd. Dell™ Boot Optimized Server Storage (BOSS)-S2
Disk	3.2 TB KIOXIA® Dell™ NVMe® CM6 MU (KC-M6XVUL3t20)	240 GB Micron® MTFDDAV240TDU
Number of disks	8	2
Storage controller 03	Marvell® Technology Group Ltd. Dell™ BOSS-S2	Not applicable (N/A)
Disk	480 GB Micron® MTFDDAV480TDS	N/A
Number of disks	2	N/A
Installed memory	256 GB	128 GB
Memory DIMM	Hynix® HMA82GR7DJR8N-XN 16 GB dual-rank DDR4	Hynix® HMA82GR7DJR8N-XN 16 GB dual-rank DDR4
Memory speed	3,200 megatransfers per second (MT/s)	2,933 MT/s (max 3,200 MT/s)
Number of memory DIMMs	16 x 16 GB	8 x 16 GB
Operating system (OS)	Red Hat® Enterprise Linux® 8.6 (Ootpa)	VMware ESXi™ 7.0.3
OS kernel	Linux® 4.18.0-372.26.1.el8_6.x86_64	20328353
Microsoft® SQL Server® version	Microsoft® SQL Server® Enterprise Evaluation (64-bit) 16.0.950.9 Microsoft® SQL Server® 2022 (RC1)	
BIOS version	1.6.5	1.7.5
OS performance profile	Tuned for Microsoft® SQL Server®	

## Testing Summary

Prowess engineers ran tests comparing the following two configurations:

- A single Dell™ PowerEdge™ R750 bare-metal server with two Dell™ PowerEdge RAID Controller (PERC) H755N Front controllers and eight 3.2 TB Dell™ NVMe Express® (NVMe®) CM6 drives, each running Red Hat® Enterprise Linux® 8.6 with Microsoft® SQL Server® 2022 (RC1)
- Four Dell PowerEdge R750 servers clustered with VMware vSAN™ 7.0.3 and with seven 1.2 TB Seagate® ST1200MM0099 Serial-Attached SCSI (SAS) capacity drives and one 480 GB Intel® SSDSC2KG480GZR Serial ATA (SATA®) cache drive installed in each server

On the VMware vSAN cluster, we deployed one VMmark® 3 tile and a single Red Hat Enterprise Linux 8.7 virtual machine (VM) with SQL Server 2022 (RC1).

Our testing shows that SQL Server running on a Dell PowerEdge R750 bare-metal server with NVMe RAID drives provided better performance than SQL Server running in a single VM on a VMware vSAN 7.0.3 cluster.

## Testing Procedures

We completed the following procedures to test SQL Server on a standalone Dell PowerEdge R750 server using two Dell PERC H755N Front controllers with NVMe storage and on a VM running on VMware vSAN 7.0.3.

### Configure Firmware and RAID Configurations on the Dell™ PowerEdge™ R750 Server

1. Launch the server into Integrated Dell™ Remote Access Controller (iDRAC).
2. Select **Install firmware updates**.
3. On the **Firmware update** page, select **Dell website**, and then click **Next**.
4. On the **Firmware update: Launch firmware update** page, click **Next**.
5. If prompted for **Proxy**, click **Yes**.
6. Select the **Updates** page, review the updates, and then click **Apply**.
7. Reboot the server when directed.
8. Log in to iDRAC.
9. Select **Storage > Overview**.
10. Select the first RAID controller.
11. From the **Actions** drop-down menu, select **Create Virtual Disk**.
  - a. On the **Set up virtual disk** page, select or enter the following:
    - i. **Name: Data**
    - ii. **Controller: PERC H755N Front (Embedded)**
    - iii. **Layout: RAID-5**
    - iv. **Media Type: SSD**
    - v. **Physical Disk Selection: New Group**
    - vi. **Security: Disabled**
    - vii. **Stripe Element Size: 64 KB**
    - viii. **Read Policy: No Read Ahead**
    - ix. **Write Policy: Write Through**
    - x. **Disk Cache Policy: Disabled**
  - b. Select the **Physical Disk** page, select eight disks, and then click **Next**.
  - c. On the **Virtual Disk Settings** page, click **Next**.
  - d. On the **Confirmation** page, click **Add to Pending**.
  - e. Click **Apply Now**.
  - f. On the **Information** page, click **OK**.
12. Select the second RAID controller.
13. From the **Actions** drop-down menu, select **Create Virtual Disk**.
  - a. On the **Set up virtual disk** page, select/enter the following:
    - i. **Name: Logs**

- ii. **Controller: PERC H755N Front (Embedded)**
  - iii. **Layout: RAID-10**
  - iv. **Media Type: SSD**
  - v. **Physical Disk Selection: New Group**
  - vi. **Security: Disabled**
  - vii. **Stripe Element Size: 256 KB**
  - viii. **Read Policy: No Read Ahead**
  - ix. **Write Policy: Write Through**
  - x. **Disk Cache Policy: Disabled**
- b. Complete the same steps as above to create the Data Virtual Disk RAID configuration.
14. Reboot the server, if needed, to begin the RAID creation job.
  15. From iDRAC, select the virtual remote connection to the server.
  16. Select **Virtual Media**.
  17. On the **Map CD/DVD** page, select **Map device**, in the **Location** field, select the **Red Hat Enterprise Linux ISO**, and then click **Map device**.
  18. Click **Close**.
  19. Click **Boot**, and then select **Virtual CD/DVD/ISO**.
  20. Reboot the server.
  21. When booted into the Red Hat Enterprise Linux installation media, select **Install Red Hat Enterprise Linux 8.6**.
  22. From the **Welcome to Red Hat Enterprise Linux page**, leave the default settings, and then click **Continue**.
  23. Select **Date and Time**, update to **Pacific time zone**, and then click **Done**.
  24. Select **Root password**, enter the same password twice, and then click **Done**.
  25. Select **Software selection**, select **Server**, and then click **Done**.
  26. Select **Installation destination**.
  27. Select the Dell™ Boot Optimized Server Storage (BOSS) disk location.
  28. From **Storage configuration**, click **custom**.
    - a. Click **Done**.
    - b. Under **New Red Hat Enterprise Linux 8.6 installation** click, **Click here to create them automatically** to create the mount points.
    - c. Update the mount points as follows:
      - **/home: 100 GiB**
      - **swap: 16 GiB**
      - **/root:** remaining disk space
    - d. Click **Done**.
  29. If prompted, click **Accept Changes**.
  30. Click **Network and Host name**.
    - a. In the **Host Name** field, enter a name for the server.
    - b. From the network adapter list, enable network interface controllers (NICs) that are connected, and then click **Done**.
  31. Click **Connect to Red Hat**.
  32. Enter account information to connect to Red Hat services, click **Register**, and then click **Done**.
  32. Click **Begin Installation**.
  33. When installation is complete, click **Reboot system**.
  34. Log in to the server.
  35. Run the following command to get the IP:

```
ip a
```

36. Run the following command to install updates:

```
dnf update -y && dnf upgrade -y
```

37. Run the following commands to enable additional Red Hat Enterprise Linux repository access:

```
subscription-manager repos --enable codeready-builder-for-rhel-8-$(arch)-rpms
dnf install https://dl.fedoraproject.org/pub/epel/epel-release-latest-8.noarch.rpm
dnf install -y epel-release
```

38. Run the following command to install fio:

```
dnf install fio -y
```

39. Run the following command to precondition the disks:

```
 fio --ioengine=libaio --invalidate=1 --fsync_on_close=1 --direct=1 --output=steady.tmp --norandommap --
 numjobs=8
 name=/dev/sdb --filename=/dev/sdb --rw=write --bs=4k --iodepth=32 --randrepeat=0 --size=2000G
 fio --ioengine=libaio --invalidate=1 --fsync_on_close=1 --direct=1 --output=steady.tmp --norandommap --
 numjobs=8
 name=/dev/sdc --filename=/dev/sdc --rw=write --bs=4k --iodepth=32 --randrepeat=0 --size=2000G
```

40. Run the following command to install the SQL Server Red Hat Enterprise Linux Tuned profile:

```
 yum install tuned-profiles-mssql
```

41. Run the following command to set the SQL Server Tuned profile:

```
 tuned-adm profile mssql
```

42. Run the following command to verify the SQL Server Tuned profile:

```
 tuned-adm active
```

43. Run the following command to download the SQL Server 2022 Red Hat Enterprise Linux repository config file:

```
 sudo curl -o /etc/yum.repos.d/mssql-server.repo https://packages.microsoft.com/config/rhel/8/
 mssql-server-preview.repo
```

44. Run the following command to install SQL Server 2022:

```
 yum install -y mssql-server
```

45. Run the following command to configure SQL Server 2022:

```
 /opt/mssql/bin/mssql-conf setup
```

- a. At the **Enter your edition** prompt, enter **1**, and then click **Enter**.
- b. At the **Do you accept the license terms** prompt, enter **Yes**, and then click **Enter**.
- c. At the **Enter the SQL Server system administrator password** prompt, enter a password, and then click **Enter**.
- d. At the **Confirm the SQL Server system administrator password** prompt, reenter the password, and then click **Enter**.

46. Run the following command to check the SQL Server status:

```
 systemctl status mssql-server
```

47. Run the following command to set mssql-conf into the PATH variable:

```
 echo 'export PATH="$PATH:/opt/mssql/bin"' >> ~/.bash_profile
 echo 'export PATH="$PATH:/opt/mssql/bin"' >> ~/.bashrc
 source ~/.bashrc
```

48. Run the following command to stop the SQL Server service:

```
 systemctl stop mssql-server
```

49. Run the following command to create directories for SQL Server database and log files:

```
 mkdir -p /mssql/data /mssql/logs
```

50. Run the following commands to create a file system on the two storage devices

```
 mkfs.xfs -L logs /dev/sdb -f; mkfs.xfs -L data /dev/sdc -f
```

51. Run the following command to mount the storage devices to the file directories:

```
 mount /dev/sdb /mssql/logs; mount /dev/sdc /mssql/data
```

52. Run the following commands to add additional directories to support the backup and TempDB locations:

```
 mkdir -p /mssql/data/backup /mssql/logs/tempdb
```

53. Run the following command to set permissions on the SQL Server database and log file directories:

```
 chown -R mssql:mssql /mssql
 chmod 777 -R /mssql
```

54. Run the following commands to set the directory location for the SQL Server databases:

```
 mssql-conf set filelocation.defaultdatadir /mssql/data; mssql-conf set filelocation.defaultlogdir /
 mssql/logs; mssql-conf set
 filelocation.defaultbackupdir /mssql/data/backup
```

55. Run the following commands to install SQL Server tools:

```
 sudo curl -o /etc/yum.repos.d/msprod.repo https://packages.microsoft.com/config/rhel/8/prod.repo
 sudo yum install -y mssql-tools unixODBC-devel
 echo 'export PATH="$PATH:/opt/mssql-tools/bin"' >> ~/.bash_profile
```

56. Run the following command to enter SQL commands:

```
sqlcmd -S localhost -U sa
```

57. Run the following commands to set the TempDB database location:

```
ALTER DATABASE tempdb MODIFY FILE
(NAME = tempdev, FILENAME = '/mssql/logs/tempdb/tempdb.mdf', SIZE = 1024, FILEGROWTH = 8192MB)
GO
ALTER DATABASE tempdb MODIFY FILE
(NAME = templog, FILENAME = '/mssql/logs/tempdb/templog.ldf', SIZE = 1024, FILEGROWTH = 8192MB)
GO
ALTER DATABASE tempdb
ADD FILE (NAME = tempdb2, FILENAME = '/mssql/logs/tempdb/tempdb2.ndf', SIZE = 1024, FILEGROWTH =
8192MB);
ALTER DATABASE tempdb
ADD FILE (NAME = tempdb3, FILENAME = '/mssql/logs/tempdb/tempdb3.ndf', SIZE = 1024, FILEGROWTH =
8192MB);
ALTER DATABASE tempdb
ADD FILE (NAME = tempdb4, FILENAME = '/mssql/logs/tempdb/tempdb4.ndf', SIZE = 1024, FILEGROWTH =
8192MB);
ALTER DATABASE tempdb
ADD FILE (NAME = tempdb5, FILENAME = '/mssql/logs/tempdb/tempdb5.ndf', SIZE = 1024, FILEGROWTH =
8192MB);
ALTER DATABASE tempdb
ADD FILE (NAME = tempdb6, FILENAME = '/mssql/logs/tempdb/tempdb6.ndf', SIZE = 1024, FILEGROWTH =
8192MB);
ALTER DATABASE tempdb
ADD FILE (NAME = tempdb7, FILENAME = '/mssql/logs/tempdb/tempdb7.ndf', SIZE = 1024, FILEGROWTH =
8192MB);
ALTER DATABASE tempdb
ADD FILE (NAME = tempdb8, FILENAME = '/mssql/logs/tempdb/tempdb8.ndf', SIZE = 1024, FILEGROWTH =
8192MB);
GO
```

58. Run the following command to delete the old TempDB files:

```
rm -rf /var/opt/mssql/data/temp*
```

59. From the Windows client, download and install SQL Server Management Studio.

60. From the Start menu, search for and launch the **ODBC Data Sources**:

- a. From **User Data Source**, click **Add**.
- b. From **Create New Data Sources**, scroll down, select **ODBC Driver 17 for SQL Server**, and then click **Finish**.
- c. Click **Create a New Data Source to SQL Server** page, and then, in the **Name** field, enter a name for the SQL Server; in the **Server** field, enter the IP for the SQL Server, and click **Next**.
- d. At the **How should SQL Server verify the authenticity of the login ID** page, select **With SQL Server authentication using a login ID and password entered by the user**.
- e. In the **Login ID** field, enter **SA**.
- f. In the **Password** field, enter the SA password.
- g. Click **Next**.
- h. Click **Next**.
- i. Click **Finish**.
- j. Click **Test Data Source**.

61. From the Windows client, download HammerDB 4.5 from <https://github.com/TPC-Council/HammerDB/releases/download/v4.5/HammerDB-4.5-Win.zip>.

62. From the Windows client, launch HammerDB.

63. Double-click **SQL Server**.

64. Select **TPROC-C**, and then click **OK**.

- a. Expand the **Schema** build.
  - b. Double-click **Options**, and enter the following parameters:
    - **SQL Server: <SQL Server IP>**
    - **SQL Server Authentication**
    - **SQL Server User ID: <SA>**
    - **SQL Server User Password: <SA password>**
    - **Number of Warehouses: 640**
    - **Virtual Users to Build Schema: 50**
  - c. Double-click **Build** to build the TPROC-C schema.
65. Run the following command to back up the TPROC-C database:

```
sqlcmd -S localhost -U SA -Q "BACKUP DATABASE [tpcc] TO DISK = N'/mssql/data/backuptpcc.bak' WITH NOFORMAT, NOINIT, NAME = 'tpcc-full', SKIP, NOREWIND, NOUNLOAD, STATS = 10"
```

66. Expand **Driver Script**, double-click **Options**, and use the following parameters:
- **SQL Server: <SQL Server IP>**
  - **SQL Server Authentication**
  - **SQL Server User ID: <SA>**
  - **SQL Server User Password: <SA password>**
  - **Timed Driver Script:** Selected
  - **Minutes of Rampup Time: 7**
  - **Minutes for Test Duration: 20**
  - **Use All Warehouses:** Selected
67. Click **OK**.
68. Expand **Autopilot**, double-click **Options**, and use the following parameters:
- **Autopilot Enabled:** Selected
  - **Active Virtual User Sequence: 32 64 96 128 160 192**
  - **Show Virtual User Output:** Selected
  - **Log Virtual User Output to Temp:** Selected
  - **Use Unique Log Name:** Selected
  - **Log Timestamps:** Selected
69. Click **OK**.
70. Double-click **Autopilot** to start the test.

### Configure VMware vSAN™ 7.0.3

1. Browse to iDRAC for one of the VMware ESXi™ nodes.
2. Log in with username and password.
3. Click **Virtual Console** to connect to the server.
4. Click **Get Latest Firmware**.
5. On the **Select Update Repository** page, leave the **Dell Website** default selection, and then click **Next**.
6. On the **Enter Access Details** page, click **Next**.
7. On the **Firmware Update Proxy Warning** page, click **Yes**.
8. At the **Firmware Update HTTPS** certificates warning, click **Yes**.
9. On the **Select Updates** page, select the necessary updates, and then click **Apply**.
10. Reboot when prompted.
11. From the iDRAC console control, click **Virtual Media**.
12. At the **Virtual Media** page, click **Connect Virtual Media**.
13. On the **Map CD/DVD** page, click **Choose File**, browse to and select the **VMware ESXi 7.0U3** ISO, click **Map Device**, and then click **Close**.
14. From the iDRAC console control, click **Boot**, select **Virtual CD/DVD/ISO**, and then click **Yes**.
15. From the iDRAC console control, click **Power**, select **Power Cycle System**, and then click **Yes**.
16. Press **F11** to boot, select **On-shot boot**, and then select **Virtual Optical Drive**.
17. On the **Welcome to the VMware ESXi 7.0.3 Installation** page, press **Enter**.
18. On the **End User License Agreement** page, press **F11**.

19. On the **Select a Disk to Install or Upgrade** page, select the **Dell BOSS VD** drive, and then press **Enter**.
20. On the **Confirm Disk Selection** page, click **OK**.
21. For **Please select a keyboard layout**, select **US Default**, and then press **Enter**.
22. On the **Enter a root password** page, enter a password and confirm, and then press **Enter**.
23. On the **Confirm Install** page, press **F11**.
24. On the **Installation complete** page, press **Enter**.
25. When installation is completed, the ESXi system page will show the IP to manage the system.

### Configure VMware vCenter Server®

1. Log in to the VMware Customer Connect portal to download the **Vmware-VCSA-all-7.0.3-20395099** ISO.
2. Double-click the ISO to mount.
3. Browse to the **vcsa-ui-installer** directory.
4. Browse to the **win32** directory.
5. Double-click **installer.exe** to begin the installation.
6. On the **vCenter Server 8.0 Installer** page, click **Install**.
7. On the **Introduction** page, click **Next**.
8. For the **End user license agreement**, click **I accept the terms of the license agreement**, and then click **Next**.
9. For the **vCenter Server deployment target**, fill out the following parameters:
  - **ESXi Host or vCenter Server Name:** *<ESXi host IP>*
  - **HTTPS Port:** **443**
  - **User Name:** *<ESXi user>*
  - **Password:** *<password>*
10. Click **Next**.
11. When you see the **Certificate Warning**, click **Yes**.
12. On the **Set up vCenter Server VM** page, fill out the following parameters:
  - **VM name:** **VMware vCenter Server**
  - **Set root password:** *<password>*
  - **Confirm root password:** *<password>*
13. Click **Next**.
14. For **Select deployment size**, fill out the following parameters:
  - **Deployment size:** **Medium**
  - **Storage size:** **Default**
15. On the **Select datastore** page, select **Install on a new vSAN cluster containing the target host**, and then click **Next**.
16. On the **Claim disks for vSAN** page, review the cache tier and capacity tier drives, and then click **Next**.
17. On the **Configure network settings** page, for the **Network** field, enter **VM Network**.
18. Click **Deploy**.
19. On the **Install – Stage 2** page, select **Setup vCenter Server**, and then click **Next**.
20. At the Login to **vCenter Server Appliance password** prompt, enter the root password, and then click **Login**.
21. On the **vCenter Server Configuration** page, set the following parameters:
  - **Time synchronization mode**
  - **SSH access**
22. Click **Next**.
23. On the **SSO Configuration** page, set the following parameters:
  - Create a new SSO domain
  - **Single sign-on domain name:** **vsphere.local**
  - **Single sign-on username:** **administrator**
  - **Single sign-on password:** *<password>*
  - **Confirm password:** *<password>*
24. Click **Next**.
25. On the **Configure CEIP** page, click **Next**.
26. On the **Ready to complete page**, review the settings, and then click **Finish**.
27. If prompted with a warning page, click **OK**.

28. Once deployed, click the URL to go to the vCenter Server page.
29. Click **Launch vSphere Client**.
30. Log in with previously configured **vsphere.local** credentials.

### Configure the VMware vSAN Cluster

1. Log in to vCenter Server.
2. Select the vSAN cluster.
3. Right-click the vSAN cluster, and then select **Add Hosts**.
  - a. On the **Add new and existing hosts to your cluster** page, enter the **IP address**, **Username**, and **Password** for the additional three nodes.
  - b. Click **Next**.
  - c. On the **Security Alert** page, select all three hosts, and then click **OK**.
  - d. On the **Host summary** page, click **Next**.
  - e. On the **Review** page, click **Finish**.
4. Select the vSAN cluster.
5. On the **vSAN Cluster Quickstart** page, under **2. Add hosts**, click **Re-validate**.
6. On the **vSAN Cluster Quickstart** page, under **3. Configure cluster**, click **Configure**.
  - a. On the **Distributed switches** page, next to the **100 GB vmnic**, select **Dswitch**, and then click **Next**.
  - b. On the **Storage traffic** page, select **Static IPs**, fill in the IP configuration for each server, and then click **Next**.
  - c. On the **Advanced options** page, leave the default settings and click **Next**.
  - d. On the **Claim disks** page, set the disks for **Capacity** tier and **Cache** tier, and then click **Next**.
  - e. On the **Review page**, click **Finish**.
7. From the vCenter console, wait until the drives are healthy before continuing with additional configuration.
8. From the **vSphere Client** menu, select **Content Libraries**.
9. Click **Create**.
  - a. On the **Name and location** page, enter a name in the **Name** field, and then click **Next**.
  - b. On the **Configure Content Library** page, leave the default settings, and then click **Next**.
  - c. On the **Apply security policy** page, click **Next**.
  - d. On the **Add storage** page, click **vsanDatastore**, and then click **Next**.
  - e. On the **Ready to complete** page, click **Finish**.
10. Select the content library.
11. Click **Actions**.
12. Select **Import item**.
  - a. For **Source**, select **Local file**, and then click **UPLOAD Files**.
  - b. Select the Red Hat media, and then click **Open**.
  - c. Click **Import**.

### Deploy VMmark® 3

For each server:

1. Log in to the VMware ESXi management interface.
2. Select **Virtual switches**.
3. Click **Add standard virtual switch**.
4. In the **vSwitch Name** field, enter **VMMark**.
5. For **Uplink 1**, select an enabled NIC.
6. Click **Add**.
7. Select **Port Groups**.
8. Click **Add port group**.
9. In the **Name** field, enter **VMMark**.
10. For the **Virtual switch**, select **VMMark**.
11. Click **Add**.



12. Complete the steps in the Vmmark\_Users\_Guide\_3.1.1\_2022-08-18 guide to deploy one VMmark 3 tile. Do not perform testing with the tile; complete the VM deployment only.

### Deploy Microsoft® SQL Server®

1. Log in to the vCenter Server.
2. Select the vSAN cluster.
3. Select **VMs**.
4. Select **Actions > New Virtual Machine**.
5. On the **Select a creation type** page, click **Create a new virtual machine**, and then click **Next**.
6. On the **Select a name and folder** page, enter a name for the new VM, and then click **Next**.
7. On the **Select a compute resource** page, select a node, and then click **Next**.
8. On the **Select storage** page, select **vsanDatastore**, and then click **Next**.
9. On the **Select compatibility** page, click **Next**.
10. On the **Select a guest OS** page, select the following parameters:
  - **Guest OS Family: Linux**
  - **Guest OS Version: Red Hat Enterprise Linux 8 (64-bit)**
11. Click **Next**.
12. On the **Customize hardware** page, select the following parameters:
  - a. **CPU: 64**
  - b. **Cores per Socket: 32**
  - c. **Memory: 128 GB**
  - d. **New Hard Disk: 40 GB**
  - e. Select **Add New Device**, and then select **Hard Disk**.
  - f. **New Hard Disk: 8 TB**
  - g. Select **Add New Device**, and then select **Hard Disk**.
  - h. **New Hard Disk: 8 TB**
  - i. **Select New CD/DVD Drive**, select **Content Library ISO File**, select the Red Hat ISO, and then click **OK**.
  - j. Expand **New CD/DVD drive**, and then select **Connect at Power On**.
  - k. Click **Next**.
  - l. On the **Ready to complete** page, click **Finish**.
13. Select the new VM, and then click **Power On**.
14. Click **Launch Web Console**.
15. Complete the following steps to install Red Hat Enterprise Linux:
  - a. On the **Welcome to Red Hat Enterprise Linux 8.6** page, click **Continue**.
  - b. Select **Time & Date**, select **Los Angeles**, and then click **Done**.
  - c. Select **Root Password**, enter and confirm a root password, and then click **Done**.
  - d. Select **Network & Host Name**, click **On** next to the Ethernet adapter, and then click **Done**.
  - e. Select **Connect to Red Hat**, enter a username and password, and then click **Done**.
  - f. Select **Installation Destination**, select the 16 GiB disk, and then click **Done**.
  - g. Click **Begin Installation**.
  - h. Click **Reboot System**.
  - i. Select **Licensing**, accept the license, and then click **Done**.
  - j. Click **Finish Configuration**.
16. Complete the prior SQL Server installation steps.
17. Copy the prior TPROC-C database backup from the single server to the VM.
18. Restore the TPROC-C database backup to the VM.
19. From the same Windows client, create an Open Database Connectivity (ODBC) connection to the VM.
20. Utilizing the same HammerDB parameters, complete the HammerDB testing against the VM.



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