The science behind the report:

With Dell PowerEdge R7625 servers powered by 4th Gen AMD EPYC 9274F processors, enable security features with no impact to OLTP performance

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 With Dell PowerEdge R7625 servers powered by 4th Gen AMD EPYC 9274F processors, enable security features with no impact to OLTP performance.

We concluded our hands-on testing on April 30, 2024. During testing, we determined the appropriate hardware and software configurations and applied updates as they became available. The results in this report reflect configurations that we finalized on April 15, 2024 or earlier. Unavoidably, these configurations may not represent the latest versions available when this report appears.

Our results

To learn more about how we have calculated the wins in this report, go to http://facts.pt/calculating-and-highlighting-wins. Unless we state otherwise, we have followed the rules and principles we outline in that document.

Table 1: Total operations per minute that each configuration of the Dell™ PowerEdge™ R7625 server powered by 4th Gen AMD EPYC™ 9274F processors handled and the average CPU utilization during testing. For operations per minute, higher is better, and for CPU utilization, lower is better. Source: Principled Technologies.

	AMD Secure Memory Encryption (SME) and AMD Secure Encrypted Virtualization Encrypted State (SEV-ES)	
	Disabled	Enabled
Operations per minute	62,577	63,609
Percentage CPU utilization	75.48%	76.67%

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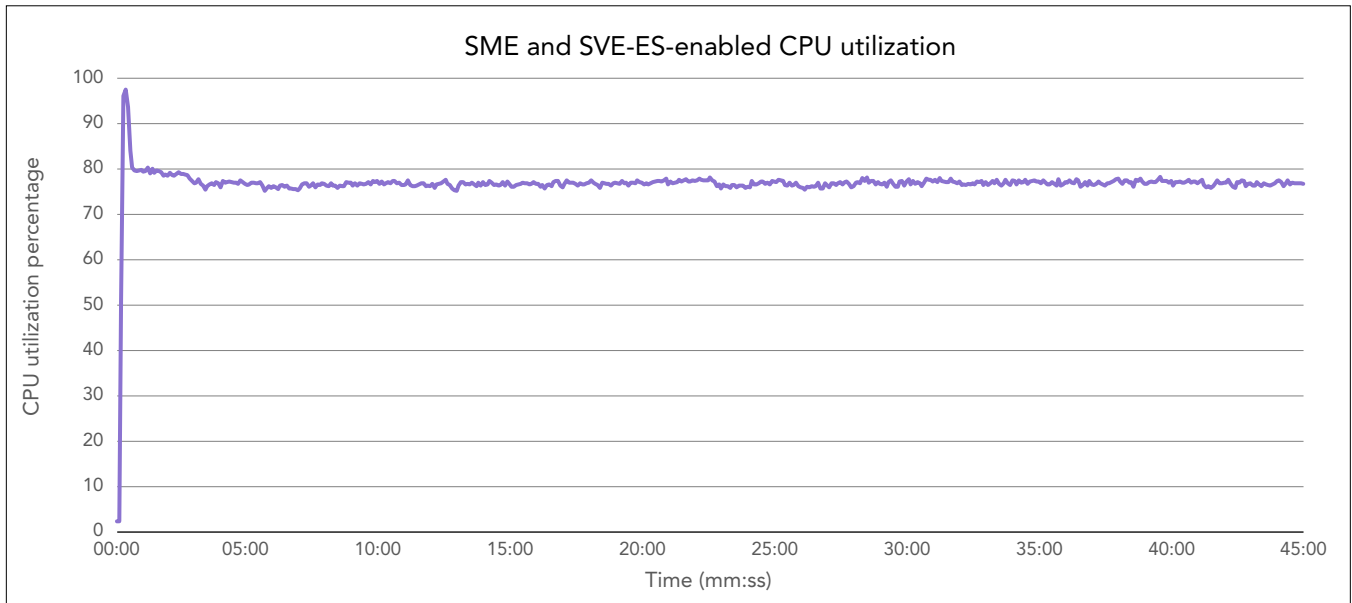
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CPU utilization

Figure 1: CPU utilization percentage during our median test of the SME and SEV-ES-enabled configuration. Source: Principled Technologies.
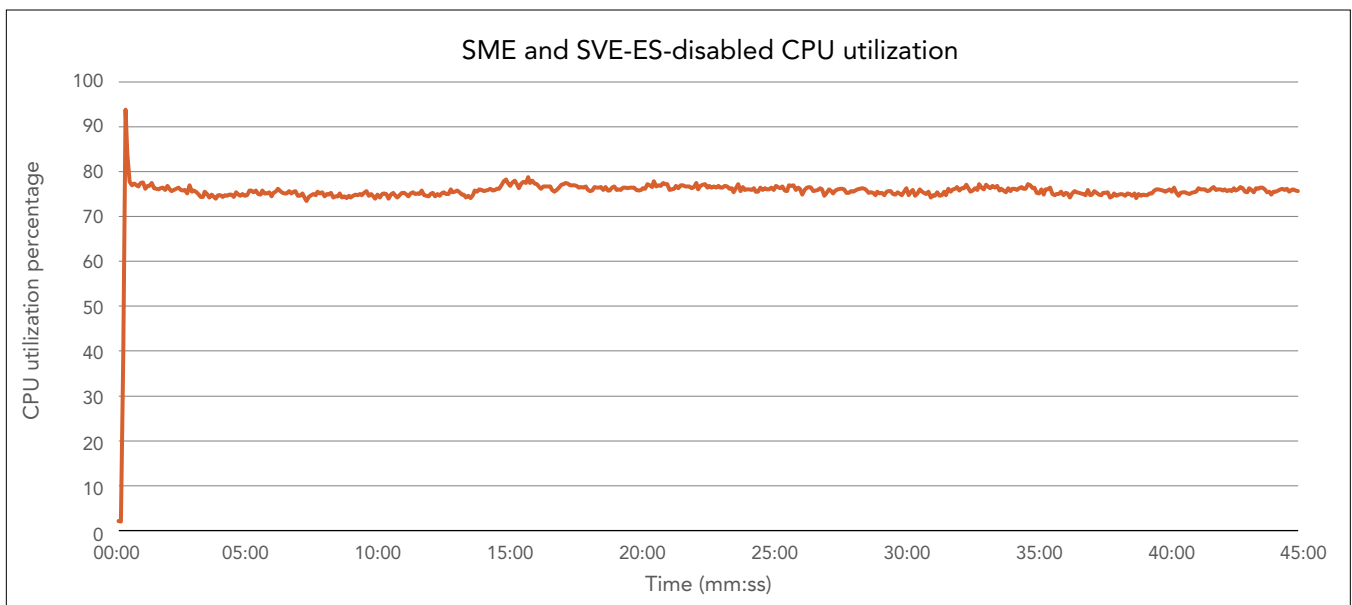

Figure 2: CPU utilization percentage during our median test of the SME and SEV-ES-disabled configuration. Source: Principled Technologies.

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System configuration information

Table 2: Detailed information on the systems we tested.

System configuration information	Dell PowerEdge R7625
BIOS name and version	Dell 1.7.2
Non-default BIOS settings	SME enabled; TSME enabled; ASID limit 13
Operating system name and version/build number	VMware® ESXi 8.0.2 Build 22380479
Date of last OS updates/patches applied	04/15/2024
Power management policy	Maximum Performance
Processor	
Number of processors	2
Vendor and model	AMD EPYC 9274F
Core count (per processor)	24
Core frequency (GHz)	4.05
Stepping	1
Memory module(s)	
Total memory in system (GB)	768
Number of memory modules	24
Vendor and model	Hynix® HMCG88AEBRA115N
Size (GB)	32
Type	DDR-5
Speed (MHz)	4,800
Speed running in the server (MHz)	4,800
Storage controller	
Vendor and model	Boss-N1
Cache size	N/A
Firmware version	2.1.13.2025
Local storage (type A)	
Number of drives	1
Drive vendor and model	Dell NVMe® PE8010 RI M.2
Drive size (GB)	480
Drive information (speed, interface, type)	M.2 NVMe SSD

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System configuration information	Dell PowerEdge R7625
Local storage (type B)	
Number of drives	2
Drive vendor and model	Dell NVMe PM1743 RI E3.S
Drive size (TB)	7.68
Drive information (speed, interface, type)	PCIe® 5.0 SSD
Network adapter	
Vendor and model	Broadcom® BCM57508
Number and type of ports	2 x 100 QSFP
Firmware version	21.85.21.91
Cooling fans	
Vendor and model	Dell Gold
Number of cooling fans	6
Power supplies	
Vendor and model	Dell 0CYHHJA05
Number of power supplies	2
Wattage of each (W)	1,400

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How we tested

Our hands-on testing compared the performance of a dual-socket Dell PowerEdge R6525 server powered by dual AMD EPYC 9274F processors with and without two AMD security features enabled: AMD Secure Memory Encryption (SME) and AMD Secure Encrypted Virtualization-Encrypted State (SEV-ES).

We loaded the system with 768 GB of RAM, a single NVMe SSD for the OS and two PCIe SSDs in RAID 0 for storage. We installed VMware ESXi 8.0.2 on the server and connected it to a VMware vCenter 8.0 appliance. We created and configured a gold VM with Red Hat Enterprise Linux 8.9 and Microsoft SQL Server 2022. We used the built-in scripts provided by DVD Store 3 (DS3) to generate CSV files to build and load our 40GB database.

Once we created and configured the VM and database, we cloned out the gold VM to yield the full set of 12 test VMs. Because DS3 is a CPU-intensive workload, we configured the VMs to have enough vCPUs to allocate all of the host's cores. Our 12 test VMs had 8 vCPUs and 16GB of RAM each. We used external client VMs running Windows Server 2022 over a 100Gb network to target our database VMs and run the DS3 driver. To monitor the performance of the host, we ran esxtop in batch mode and output the data to CSV.

We conducted our testing with SME and SEV-ES enabled in the host BIOS, vSphere 8, and RHEL 8 guest OSes. Afterward, we ran DS3 again with both features disabled.

Running DVD Store 3 on Red Hat Enterprise Linux 8.9 with SQL Server 2022

Installing VMware ESXi 8.0U2

1. Attach the installation media.
2. Boot the server.
3. At the VMware Installer screen, press Enter.
4. At the EULA screen, to Accept and Continue, press F11.
5. Under Storage Devices, select the appropriate virtual disk, and press Enter.
6. As the keyboard layout, select US, and press Enter.
7. Enter the root password twice, and press Enter.
8. To start installation, press F11.
9. After the server reboots, press F2, and enter root credentials.
10. Select Configure Management Network, and press Enter.
11. Select the appropriate network adapter, and select OK.
12. Select IPv4 settings, and enter the desired IP address, subnet mask, and gateway for the server.
13. Select OK, and restart the management network.

Deploying the VMware vCenter Server Appliance 8.0

1. On a Windows server or VM, locate the VMware-VCSA installer image.
2. Mount the image, navigate to the vcsa-ui-installer folder, and double-click win32.
3. Double-click installer.exe.
4. Click Install.
5. Click Next.
6. Accept the terms of the license agreement, and click Next.
7. Leave "vCenter Server with an Embedded Platform Services Controller" selected, and click Next.
8. Enter the FQDN or IP address of the host onto which you will deploy the vCenter Server Appliance.
9. Provide the server's username and password, and click Next.
10. To accept the certificate of the host to which you chose to connect , click Yes.
11. Provide a name and password for the vCenter Appliance, and click Next.
12. Set an appropriate Appliance Size, and click Next.
13. Select the appropriate datastore, and click Next.
14. At the Configure Network Settings page, configure the network settings as appropriate for your environment, and click Next.
15. Review your settings, and click Finish.
16. When the deployment completes, click Next.
17. At the Introduction page, click Next
18. At the Appliance configuration page, select the time synchronization mode and SSH access settings, click Next
19. Select Create a new SSO domain.
20. Provide a password, and confirm it.
21. Provide an SSO Domain name and SSO Site name, and click Next.

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22. At the CEIP page, click Next.
23. At the Ready to complete page, click Finish.
24. When installation completes, click Close.
25. Using the VMware vSphere web client, log into the vCenter server using the credentials you previously provided.

Adding the ESXi host to the vCenter appliance

1. Log into vCenter, and navigate to Hosts and Clusters.
2. Select the vCenter you deployed above.
3. Right-click the vCenter object, and select New Datacenter…
4. Enter a name for the new data center, and click OK.
5. Right-click the new data center object, and click Add Host…
6. Enter the host's IP address, and click Next.
7. Enter the host's root username and password, and click Next.
8. Click Next four more times, and click Finish.

Creating the RHEL 8.9 VM

1. Log into vCenter, and click Hosts and Clusters.
2. Right-click the host to which you wish to deploy, and click New Virtual Machine.
3. Click Next.
4. Enter a name for the virtual machine, and click Next.
5. Ensure the desired host is selected as the compute resource, and click Next.
6. Select the appropriate datastore to host the VM, and click Next.
7. Ensure compatibility is set to ESXi 8.0 and later, and click Next.
8. Set Guest OS Family to Linux, and set Guest OS Version to RHEL 9.0 and later. Click Next.
9. In the Customize Hardware section, use the following settings:

    • Set CPU to 8.
    • Set Memory to 16GB and Reservation to 16GB.
    • Add 1 x 120GB Hard Disk for OS / Backup.
    • Add 1 x 150GB Hard Disk for database files.
    • Add 1 x 50GB Hard Disk for database logs.
    • Set the OS Hard Disk to thin provisioning, and set the other disks to thick provision eager zeroed.

10. Create two additional VMware Paravirtual SCSI controllers, and assign the database and log disks to the new controllers.
11. Under VM Options → Boot Options, set Firmware to EFI, and disable Secure Boot.
12. Attach the RHEL installer ISO to the CD/DVD drive.
13. Click Next.
14. Click Finish.

Installing and configuring RHEL 8.9

1. Start the VM, and open its remote console in vCenter.
2. Wait for the installer to finish updating itself.
3. Select Red Hat Enterprise Linux 8.9, and click Next.
4. Select I agree to the license terms, and click Next.
5. Register the system with RHEL.
6. When prompted to enable update repositories, click Next.
7. Check Development Tools Module, and click Next.
8. Click Next four times.
9. Enter a username and password, select Use this password for system administrator, and click Next.
10. Click Kdump, select Disable Kdump, and click OK.
11. Click Install, and click Install again to confirm.

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Enabling SEV-ES in the guest OS

1. Log into vCenter, and navigate to the RHEL VM.
2. Right-click the VM, and click Edit Settings.
3. Select the VM Options tab.
4. Under the Encryption section, check the box to enable AMD SEV-ES.
5. Click Ok.

Installing and configuring SQL Server 2022

1. Use SSH to connect to the VM as root.
2. Add the MS-SQL Server 2022 repository:

```
curl -o /etc/yum.repos.d/mssql-server.repo https://packages.microsoft.com/config/rhel/8/mssql-
server-2022.repo
```

3. Install SQL Server 2022:

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

4. Set up SQL Server 2022. When prompted, enter the license type and desired password:

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

5. Install full text search:

```
yum install mssql-server-fts
```

6. Install SQL Server Tools, and add to PATH:

```
sudo curl https://packages.microsoft.com/config/rhel/8/prod.repo | sudo tee /etc/yum.repos.d/
mssql-release.repo
sudo yum install mssql-tools18 unixODBC-devel
echo 'export PATH="$PATH:/opt/mssql-tools18/bin"' >> ~/.bash_profile
```

7. Create a filesystem for the data and log files:

```
mkfs.xfs /dev/sdb
mkfs.xfs /dev/sdc
```

8. Create a mount path for SQL Server and mount the data and log files:

```
mkdir -p /mssql/data
mkdir -p /mssql/logs
mount /dev/sdb /mssql/data
mount /dev/sdc /mssql/logs
```

9. Change ownership of the SQL server directory:

```
chown -R mssql:mssql /mssql
```

10. Set the default database and log location for SQL to the directories you created and restart the SQL service.

```
/opt/mssql/bin/mssql-conf set filelocation.defaultdatadir /mssql/data
/opt/mssql/bin/mssql-conf set filelocation.defaultlogdir /mssql/logs
systemctl restart mssql-server
```

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Configuring and running the DVD Store 3 benchmark

Data generation overview

We generated the data using the Install.pl script included with DVD Store version 3 (DS3), providing the parameters for our 40GB database size and the database platform we used. We ran the Install.pl script on a utility system running Linux® to generate 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 2014. We built the 40GB database in Microsoft SQL Server and performed a full backup, storing the backup file remotely for quick access. We used that backup file to restore the database when necessary.

The only modification we made to the schema creation scripts was to change the specified file sizes for our database. We explicitly 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 in accordance with the DVD Store documentation. Specifically, we followed these steps:

1. Generate the data. Using the database creation scripts from the DS3 download, create the database and file structure. Make size modifications specific to our 40GB database, and make the appropriate changes to drive letters.
2. Transfer the files from the Linux data generation system to a Windows system running SQL Server.
3. Using the provided DS3 scripts, create the database tables, stored procedures, and objects.
4. To prevent excess logging, set the database recovery model to bulk-logged.
5. Load the data you generated into the database. For data loading, use the import wizard in SQL Server Management Studio. Where necessary, retain options from the original scripts, such as Enable Identity Insert.
6. Using the database-creation scripts, create indices, full-text catalogs, primary keys, and foreign keys.
7. Update statistics on each table according to database-creation scripts, which sample 18 percent of the table data.
8. On the SQL Server instance, create 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

EXEC master..sp_addsrvrolemember @loginame = N'ds2user',
@rolename = N'sysadmin'

USE [DS3]
CREATE USER [ds3DS3user] FOR LOGIN [ds2user]
EXEC sp_addrolemember N'db_owner', N'ds3DS3user'

USE [master]
CREATE USER [ds3masteruser] FOR LOGIN [ds2user]
EXEC sp_addrolemember N'db_owner', N'ds3masteruser'
```

9. Set the database recovery model back to Full.
10. Using SQL Server Management Studio, create the necessary full-text index.
11. Create a database user, and map this user to the SQL Server login.
12. To restore the databases to a pristine state, perform a full backup of the database.

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Cloning additional SQL Server VMs

Once you have generated the database, created the ds2user login, and stored the backup on the Master SQL VM, you can clone the rest of the VMs from the Master. For our testing, we created 12 SQL Server VMs.

1. From a web browser, log into vCenter.
2. Right-click the Master SQL VM and select Clone → Clone to Virtual Machine.
3. Select a name for the VM and a datastore location to store it, and click Next.
4. Select the compute resource on which the VM will reside, and click Next.
5. Set "Select virtual disk format" to "Same format as source."
6. Set "VM Storage Policy" to "Keep existing VM storage policies."
7. Select the appropriate datastore, and click Next.
8. Deselect all clone options, and click Next.
9. Review your settings, and click Next.

Running the DVD Store 3 tests

We created a series of batch files, SQL scripts, and shell scripts to automate the complete test cycle. DVD Store 3 outputs an orders-per-minute metric, which is a running average it calculates throughout the test. In this report, we report the last OPM that each target reported.

Each complete test cycle consisted of the following general steps:

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

We used the following DVD Store 3 parameters for testing:

```
ds3sqlserverdriver.exe --target=<target _ IP> --ramp_rate=10 --run_time=30 --n_threads=16 --db_size=40GB
--think_time=0.1 --detailed_view=Y --warmup_time=15 --report_rate=1 --pct_newcustomers=20 --csv_
output=<drivepath>
```

Read the report at https://facts.pt/2Y7qaTG ▶

This project was commissioned by Dell.

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