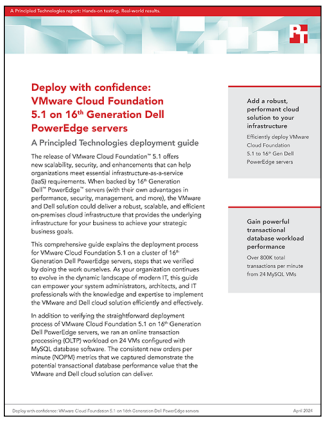

The science behind the report:

Deploy with confidence: VMware Cloud Foundation 5.1 on 16th Generation Dell PowerEdge servers

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 Deploy with confidence: VMware Cloud Foundation 5.1 on 16th Generation Dell PowerEdge servers.

We concluded our hands-on testing on February 23, 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 January 16, 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 2: Results of our testing. Bold indicates the median of the three runs.

	TPROC-C run 1	TPROC-C run 2	TPROC-C run 3
Total new orders per minute (NOPM)	342,850	**344,889**	345,961
Total transactions per minute (TPM)	796,817	**801,329**	803,411

System configuration information

Table 3: Detailed information on the systems we tested.

System configuration information	Dell™ PowerEdge™ R750xs	Dell PowerEdge R760
BIOS name and version	Dell 1.12.1	Dell 1.6.6
Operating system name and version/build number	ESXi 8.0 Update 2 Build-22380479 (Dell customized)	ESXi 8.0 Update 2 Build-22380479 (Dell customized)
Date of last OS updates/patches applied	01/16/24	01/16/24
Power management policy	Performance	Performance
Processor		
Number of processors	2	2
Vendor and model	Intel® Xeon® Gold 6336Y	Intel Xeon Gold 6430
Core count (per processor)	24	32
Core frequency (GHz)	2.40	2.10
Stepping	6	8
Memory module(s)		
Total memory in system (GB)	256	512
Number of memory modules	16	16
Vendor and model	Hynix® HMA82GR7CJR8N-WM	Hynix HMCG88AEBRA115N
Size (GB)	16	32
Type	PC4-23400	PC5-38400
Speed (MHz)	2,933	4,800
Speed running in the server (MHz)	2,933	4,800
Storage controller		
Vendor and model	Dell PERC H755	Dell PERC H755
Cache size (GB)	8 GB	8 GB
Firmware version	52.26.0-5179	52.26.0-5179
Local storage (type A)		
Number of drives	8	20
Drive vendor and model	Seagate® XS3840LE70134	Toshiba® KRM6VVUG1T92
Drive size (GB)	3,840	1,920
Drive information (speed, interface, type)	12Gb SAS SSD	12Gb SAS SSD
Local storage (type B)		
Number of drives	N/A	4
Drive vendor and model	N/A	Dell 6FJDT

System configuration information	Dell™ PowerEdge™ R750xs	Dell PowerEdge R760
Drive size (GB)	N/A	1600
Drive information (speed, interface, type)	N/A	NVMe® PCIe SSD
Network adapter		
Vendor and model	Broadcom® BCM5720	Broadcom BCM57404
Number and type of ports	2x 25GbE	2x 25GbE
Firmware version	22.71.11.13	22.61.10.77
Cooling fans		
Vendor and model	Dell	Dell
Number of cooling fans	5	12
Power supplies		
Vendor and model	Dell 07DWXYA01	Dell 0P56GHA00
Number of power supplies	2	2
Wattage of each (W)	1,400	2,800

How we tested

We deployed the VMware Cloud Foundation management domain on the four Dell PowerEdge R750xs servers. Each R750xs server had two BOSS drives for VMware ESXi 8.0.2 and eight SAS SSDs for VMware vSAN storage. We deployed a VI workload domain on the three Dell PowerEdge R760 servers. Each Dell PowerEdge R760 server had two BOSS drives for ESXi 8.0.2, and four NVMe drives and 20 SAS SSDs for vSAN storage. All the Dell PowerEdge servers in our testbed had two 25Gb Ethernet connections to a Dell S5248F switch. We also used a Dell PowerEdge R6625 server as an infrastructure server where we deployed the AD/DNS server, the Certificate Authority server, a jumpbox VM, and pfsense routers to manage the VLANs on the Dell S5248F switch.

We used the TPROC-C benchmark from the HammerDB suite to simulate a real-world online transaction processing (OLTP) database workload. We created a MySQL VM on the workload domain cluster with 16 vCPUs, 64 GB of memory, and 2 TB of storage from the VSAN datastore. We installed Ubuntu 22.04 and MySQL 8.0 on the MySQL VM. We then scaled up to 8 VMs on each Dell PowerEdge R760 server. We ran the HammerDB 4.9 TPROC-C workload with 500 warehouses and measured the new orders per minute and transactions per minute metrics.

Switch and Networking Configuration

We created and configured the following VLANs for the VCF management domain on the Dell S5248F switch. We deployed a pfsense gateway on VLAN 1 and VLAN 200. The pfsense gateway also provided NAT and inter-VLAN routing for these two VLANs.

VLAN ID	Gateway	MTU	Description
1	N/A	9,000	Management and VM network
20	192.168.20.1	9,000	vSAN network
40	192.168.40.1	9,000	vMotion Network
50	192.168.50.1	9,000	NSX Host Overlay network
60	192.168.60.1	9,000	NSX Edge TEP network
70	192.168.70.1	9,000	NSX Edge Tier-0 uplink network
80	192.168.80.1	9,000	NSX Edge 2nd Tier-0 uplink network
100	192.168.100.1	9,000	NSX Management RegionA network
200	N/A	9,000	NSX Management xRegion network

We created and configured the following VLANs for the VCF VI workload domain on the Dell S5248F switch. We deployed a pfsense gateway for VLAN 150 which provided DHCP service for the NSX Host Overlay network.

VLAN ID	Gateway	MTU	Description
1	N/A	9,000	Management and VM network
120	192.168.120.1	9,000	vSAN network
140	192.168.140.1	9,000	vMotion network
150	N/A	9,000	NSX Host Overlay network
160	192.168.160.1	9,000	NSX Edge TEP network
170	192.168.170.1	9,000	NSX Edge Tier-0 uplink network
180	192.168.180.1	9,000	NSX Edge 2nd Tier-0 uplink network

Deploying VCF management domain and workload domain

We followed the procedure that we discussed in the report to deploy the management domain, VMware Aria Operations, and VI workload domain on the Dell PowerEdge servers.

Deploying OLTP database workload

After we deployed the VI workload domain, we installed and configured MySQL 8.0 VMs on the workload domain cluster. We also Installed and configured client HammerDB VMs on an infrastructure server.

Creating the base Ubuntu 22.04 VM

1. Use a web browser and connect and log into the vCenter in the Workload Domain.
2. Right-click the Workload Domain cluster, and click New VM.
3. Assign the VM the following properties:
   - 16 vCPUs
   - 64 GB memory
   - 2 TB storage from the vSAN datastore
   - One network connection from the VM network portgroup
4. Click Finish.
5. Download and attach the Ubuntu 22.04 iso image to the base VM.
6. Power on the VM, and follow the on-screen instructions to install Ubuntu 22.04.

Installing MySQL 8.0 on the base VM

1. Log into the Ubuntu 22.04 VM via ssh.
2. Update and upgrade Ubuntu 22.04:

```
sudo apt update
sudo apt upgrade
```

3. Install MySQL server:

```
sudo apt install mysql-server
```

4. Change the bind address to 0.0.0.0 in /etc/mysql/mysql.conf.d/mysqld.cnf, and restart MySQL server:

```
sudo systemctl restart mysql.service
```

5. Set a password for the 'root' user:

```
sudo mysql
mysql> ALTER USER 'root'@'localhost' IDENTIFIED WITH mysql_native_password BY '<password>';
mysql> exit
```

6. Run the MySQL secure installation script, and follow the prompts to finish the installation:

```
sudo mysql_secure_installation
```

7. Create a tpcc user, and grant privileges:

```
mysql -u root -p
Enter password: <password>
mysql> create user '<tpcc user>'@'%' identified by '<password>';
mysql> create database tpcc;
```

```
mysql> grant all on *.* to '<tpcc user>'@'%';
mysql> exit
```

Creating and configuring the client VM

We created the client VMs on a separate infrastructure server and connected them to the same VM network on the 25Gb switch. We used ESXi 8.0.2 for the infrastructure hypervisor and Ubuntu 22.04 for the Guest operation system.

1. Log into the client VM via ssh.
2. Install the MySQL client library:

```
sudo apt-get install python3-dev default-libmysqlclient-dev build-essential pkg-config
sudo apt install python3-pip
pip install mysqlclient
sudo apt install mysql-client-core-8.0
```

3. Download and extract HammerDB 4.9:

```
wget https://github.com/TPC-Council/HammerDB/releases/download/v4.9/HammerDB-4.9-Linux.tar.gz
tar -xzvf HammerDB-4.9-Linux.tar.gz
```

Creating the TPROC-C database schema

1. Use SSH to connect to the Ubuntu client VM, and navigate to the Hammerdb directory.
2. Create a mysql_tpcc_buildschema.tcl script file:

```
#!/bin/tclsh
puts "SETTING CONFIGURATION"
dbset db mysql
dbset bm TPC-C
diset connection mysql_host <mysql server IP>
diset connection mysql_port 3306
diset connection mysql_socket /tmp/mysql.sock
set vu 16
set warehouse 500
diset tpcc mysql_count_ware $warehouse
diset tpcc mysql_num_vu $vu
diset tpcc mysql_user <tpcc username>
diset tpcc mysql_pass <tpcc user password>
diset tpcc mysql_dbase tpcc
diset tpcc mysql_storage_engine innodb
diset tpcc mysql_partition true
puts "SCHEMA BUILD STARTED"
buildschema
puts "SCHEMA BUILD COMPLETED"
```

3. Build a TPCC database schema:

```
./hammerdbcli auto mysql_tpcc_buildschema.tcl
```

Running the HammerDB/OLTP tests

1. Use SSH to connect to the Ubuntu client VM, and navigate to the hammerdb folder.
2. Create a mysql_tpcc_run.tcl file:

```
dbset db mysql
dbset bm TPC-C

diset connection mysql_host <mysql server IP>
diset connection mysql_port 3306
diset connection mysql_socket /tmp/mysql.sock

diset tpcc mysql_driver timed
diset tpcc mysql_rampup 5
diset tpcc mysql_duration 10
diset tpcc mysql_count_ware 500
diset tpcc mysql_user <tpcc username>
diset tpcc mysql_pass <tpcc user password>
diset tpcc tpcc_allwarehouse false
diset tpcc mysql_timeprofile true

loadscript
puts "TEST STARTED"
vuset vu 64
vuset logtotemp 1
vucreate
tcstart
tcstatus
set jobid [ vurun ]
vudestroy
tcstop
puts "TEST COMPLETE"
```

3. Run the test with 5 minutes warmup time and 10 minutes run time:

```
./hammerdb_cli auto mysql_tpcc_run.tcl
```

4. Repeat step 3 twice for a total of three runs, and identify the median results.

Read the report at https://facts.pt/JTZhO4Z ▶

This project was commissioned by Dell Technologies.