The science behind the report:

Analyze data from Cassandra databases more quickly: Select Dell PowerEdge C6620 servers with Dell PowerEdge RAID controllers (PERC 12)

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 Analyze data from Cassandra databases more quickly: Select Dell PowerEdge C6620 servers with Dell PowerEdge RAID controllers (PERC 12).

We concluded our hands-on testing on January 9, 2023. 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 3, 2023 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: Results of our YCSB testing.

	Dell™ PowerEdge™ C6520	Dell PowerEdge C6620
Throughput (operations per second)	198,161.3	249,210.0
Read latency (milliseconds)	2.310	1.828
Update latency (milliseconds)	1.868	1.298

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System configuration information

Table 2: Detailed information on the systems we tested.

System configuration information	Dell PowerEdge C6520	Dell PowerEdge C6620
BIOS name and version	1.3.8	0.2.32
Operating system name and version/build number	VMware® ESXi™ 8.0.0, 20513097	VMware ESXi 8.0.0, 20513097
Date of last OS updates/patches applied	December 16, 2022	December 16, 2022
Power management policy	Performance	Performance
BMC firmware version	iDRAC 5.00.10.20	iDRAC 6.10.05.00
Processor		
Number of processors	2	2
Vendor and model	Intel® Xeon® Gold 6330	Intel Xeon Platinum 8452Y
Core count (per processor)	28	36
Core frequency (GHz)	2	2
Stepping	6	6
Memory module(s)		
Total memory in system (GB)	512	512
Number of memory modules	16	16
Vendor and model	Hynix HMAA4GR7AJR8N-XN	Hynix HMCG88AEBRA107N
Size (GB)	32	32
Type	DIMM DDR4	DIMM DDR5
Speed (MHz)	2,933	4,800
Speed running in the server (MHz)	2,933	4,800
Storage controller		
Vendor and model	PERC H750 Adapter	PERC H965i Adapter
Cache size (GB)	8	8
Firmware version	52.16.1-4074	8.0.0.0.18-74
Local storage		
Number of drives	6	2
Drive vendor and model	Toshiba PX05SVB096Y	Dell Enterprise NVMe v2 AGN RI U.2 3.84TB
Drive size	960 GB	3.84 TB
Drive information (speed, interface, type)	12Gb SAS, SSD	NVMe, SSD

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System configuration information	Dell PowerEdge C6520	Dell PowerEdge C6620
Network adapter 1		
Vendor and model	Broadcom® Gigabit Ethernet BCM5720	Broadcom Gigabit Ethernet BCM5720
Number and type of ports	1 x 1GbE	1 x 1GbE
Network adapter 2		
Vendor and model	Intel Ethernet 25G 2P E810-XXV OCP	Intel Ethernet 25G 2P E810-XXV OCP
Number and type of ports	2 x 25GbE	2 x 25GbE
Power supplies		
Vendor and model	Dell 0J1CC3A01	Dell 008PMKA00
Number of power supplies	2	2
Wattage of each (W)	2,400	2,800
Power Management Controller firmware	0.2c.2c	00.07.08

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How we tested

For our testing, we installed vSphere 8 on the systems under test. We configured a separate infrastructure server with ESXi and vCenter to manage the systems under test and to host client VMs. To perform our testing, we used YCSB to create a 100GB database across six Cassandra VMs, then ran workload B for 30 minutes and recorded the results.

Installing ESXi on the servers

1. Open the BMC for the system you're installing on, and log in.
2. Open the remote console for the system.
3. Mount the ESXi 8 install ISO to the remote console.
4. Boot the server, and boot into the ESXi installation.
5. Once you are in the ESXi installation menu, press Enter to continue.
6. At the license agreement, press F11 to accept and continue.
7. Select the drive you wish to install ESXi on, and press Enter.
8. In keyboard selection, choose your preferred keyboard, and press Enter.
9. In the final review and confirmation screen, press F11 to begin the installation.
10. Repeat steps 1 through 9 for the remaining systems, including the infrastructure host.

Installing vCenter

1. Mount the vCenter installation ISO on the system you are using to install to the remote hosts.
2. Open your system's file browser, navigate to the installer executable in the ISO, and run the installer.
3. When the installer opens, select Install.
4. On the Introduction screen, click Next.
5. On the End user license agreement screen, accept the terms, and click Next.
6. On the vCenter Server deployment target screen, enter the IP address, username, and password of the ESXi infrastructure host you installed previously, and click Next.
7. If you are presented with a certificate warning, to accept and continue, click Next.
8. On the Set up vCenter Server VM screen, enter a VM name and password, and click Next.
9. For Select deployment size, select Tiny, and click Next.
10. For Select datastore, select the appropriate datastore, make sure Enable Thin Disk Mode is enabled, and click Next.
11. On the Configure network settings screen, enter the networking information for your vCenter, and click Next.
12. Click Finish to begin the vCenter installation.
13. When the You have successfully deployed the vCenter Server notification appears, click Continue.
14. On the Introduction screen, click Next.
15. On the vCenter Server Configuration screen, turn on NTP, and click Next.
16. For SSO Configuration, create your SSO domain name and password, and click Next.
17. In Configure CEIP, accept defaults, and click Next.
18. On the Ready to Complete screen, click Finish.
19. On the Install - Stage 2: Complete screen, click the address of the vCenter to open the vCenter management webpage.

Configuring vCenter and adding hosts

1. Log into the vCenter.
2. In the left pane, right-click the vCenter, and select New Datacenter.
3. In the New Datacenter window, enter your datacenter name, and click OK.
4. Right-click your new datacenter, and click Add Host.
5. For Name and location, enter your host IP, and click Next.
6. In Connection settings, enter the username and password for your host, and click Next.
7. In Host summary, review the host information, and click Next.
8. In Assign license, leave defaults, and click Next.
9. In Lockdown mode, make sure Disabled is selected, and click Next.
10. In VM location, leave defaults, and click Next.
11. On the Ready to complete screen, review your settings, and click Finish.
12. Repeat steps 1 through 11 for any remaining hosts.

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Creating the gold VM

1. Right-click the infrastructure host, and select Create new Virtual Machine.
2. In Select a creation type, choose Create a new virtual machine, and click Next.
3. In Select a name and folder, name the virtual machine (we chose gold), and click Next.
4. In Select a compute resource, choose the infrastructure host, and click Next.
5. In Select storage, choose the appropriate storage, and click Next.
6. In Select compatibility, leave defaults, and click Next.
7. In Select a guest OS, choose Linux and Ubuntu Linux (64-bit), and click Next.
8. In Customize hardware, make the following changes to the default configuration:

   - CPU: 8
   - Memory: 8 GB
   - New Hard disk: 32 GB
   - Add a new Network device attached to the 10 or 25GbE network as appropriate

9. Click Next.
10. On the Ready to complete screen, verify your choices, and click Finish.
11. When the VM has finished creation, start it and mount the Ubuntu 22.04 LTS ISO to the VM.
12. When choosing your Ubuntu installation, choose to install Ubuntu without a GUI and with SSH enabled.
13. Once the VM has finished installation, log in as the user you created.
14. Edit the sudoers file by typing the following:

```
sudo visudo /etc/sudoers
```

15. Edit the sudoers file by modifying the line starting with %sudo to the following:

```
%sudo    ALL=(ALL:ALL) NOPASSWD:ALL
```

16. Press Ctrl+x to exit.
17. When prompted, choose to save the changes.
18. Update the operating system:

```
sudo apt-get update
sudo apt-get upgrade -y
```

19. Disable the firewall:

```
sudo ufw disable
```

20. Create an SSH key, and add it to your authorized keys:

```
ssh-keygen -t rsa -b 4096
cat ~/.ssh/id_rsa.pub >> ~/.ssh/authorized_keys
```

21. Remove the machine ID of your Ubuntu VM:

```
sudo rm /etc/machine-id
sudo rm /var/lib/dbus/machine-id
```

22. Shut down your Ubuntu VM:

```
sudo shutdown now
```

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Modifying the gold VM for the Cassandra installation

1. Clone the gold VM. Name the new VM to make clear it is for Cassandra.
2. Right-click the Cassandra gold VM, and select Edit Settings.
3. In the Virtual Hardware screen, change the CPU to [12 for the Dell PowerEdge C6520 Cassandra VMs, 16 for the Dell PowerEdge C6620 Cassandra VMs], the memory to 96GB, add a new 128 GB disk to the VM, and click OK.
4. Power on the Cassandra gold VM.
5. Once the Cassandra gold VM has finished booting, log into the OS.
6. Create a filesystem on the new drive you added to the VM (in this example, the drive is sdb. Make sure it is sdb for your setup) by typing the following:

```
sudo mkfs.xfs /dev/sdb
```

7. Make a directory for your Cassandra database and mount the new drive to that directory:

```
sudo mkdir /data
sudo mount /dev/sdb /data
```

8. Edit the filesystem table to include the entry for the newly formatted drive, making sure that it mounts to the appropriate directory.
9. Shut down your Cassandra VM:

```
sudo shutdown now
```

Cloning the VMs

1. Right-click the appropriate gold VM, and select Clone → Clone to Virtual Machine.
2. In Select a name and folder, name the VM (we chose client-01 for the client VMs and cassandra-01 for the Cassandra VMs), and click Next.
3. In Select a compute resource, choose the appropriate host as the compute resource for the VM, and click Next.
4. In Select storage, choose the appropriate storage for the VM, and click Next.
5. In Select clone options, leave defaults, and click Next.
6. On the Ready to complete screen, review your choices, and click Finish.
7. Repeat steps 1 through 6 until you have six client VMs and six Cassandra VMs cloning.
8. Once the VMs have finished cloning, power them on.
9. Generate a new system ID on each VM by typing the following command:

```
sudo systemd-machine-id-setup
```

10. Change the IP addresses of the public facing and faster internal NICs and note down the IP addresses, as you will use them for the Cassandra installation and later testing.

Installing and configuring Cassandra

1. Add the Cassandra repo to your Cassandra VMs:

```
sudo echo "deb http://www.apache.org/dist/cassandra/debian 40x main" > /etc/apt/sources.list.d/
cassandra.sources.list
sudo curl https://downloads.apache.org/cassandra/KEYS > /etc/apt/cassandra.key
sudo apt-key add /etc/apt/cassandra.key
```

2. Install Cassandra:

```
sudo apt-get install cassandra cassandra-tools
```

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3. Create the Cassandra database and log directories:

```
mkdir -p /data/log
mkdir -p /data/db
chown -R cassandra:cassandra /data/
chmod -R 755 /data/
```

4. Modify the Cassandra configuration file (located in `/etc/cassandra/cassandra.yaml`) with the following changes, starting with the first Cassandra VM:

```
data_file_directories:
  - /data/db
commitlog_directory: /data/log
listen_address: [your Cassandra VM's internal IP]
broadcast_address: [your Cassandra VM's external IP]
rpc_address: [your Cassandra VM's internal IP]
broadcast_rpc_address: [your Cassandra VM's external IP]
listen_on_broadcast_address: true
listen_interface_prefer_ipv6: false
rpc_interface_prefer_ipv6: false
storage_port: 7000
native_transport_port: 9042
seed_provider:
  - class_name:
    parameters:
      - seeds: "[your first Cassandra VM's external IP]"
```

5. Restart the Cassandra service to enable the changes:

```
sudo service cassandra restart
```

Installing YCSB on the YCSB clients

1. On each of the YCSB clients, install the prerequisites for YCSB by typing the following commands:

```
sudo apt_install openjdk-11-jdk curl net-tools nmon python2.7 && \
( [ -x /usr/bin/python ] || ln -s /usr/bin/python2.7 /usr/bin/python )
sudo apt_install git htop wget build-essential
```

2. On each of the YCSB clients, download YCSB and extract it to the /opt directory.
3. Make sure that the YCSB file is executable:

```
chmod +x /opt/ycsb-0.17.0/ycsb-0.17.0/bin/ycsb*
```

Running the tests

1. Reboot all Cassandra VMs.
2. If this is after a previous run, drop the YCSB table and keyspace by logging into Cassandra and typing the following commands:

```
USE ycsb;
drop table usertable;
drop keyspace YCSB;
```

3. If necessary, in each Cassandra VM run the following command to delete any database backups:

```
sudo rm -rf /data/db/ycsb/usertable-*/snapshots/
```

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4. Create a new YCSB database by logging into Cassandra and typing the following commands:

```
create keyspace YCSB WITH REPLICATION = {'class': 'SimpleStrategy', 'replication_factor': 3 };
USE ycsb:
create table usertable (
y_id varchar primary key,
field0 varchar,
field1 varchar,
field2 varchar,
field3 varchar,
field4 varchar,
field5 varchar,
field6 varchar,
field7 varchar,
field8 varchar,
field9 varchar);
```

5. Use YCSB to populate the new database:

```
/opt/ycsb-0.17.0/ycsb-0.17.0/bin/ycsb load cassandra-cql \
-p hosts="[the first Cassandra VM's IP address]" \
-threads "25" \
-p core_workload_insertion_retry_limit=3 \
-p fieldcount="10" \
-p recordcount="100000000" \
-p requestdistribution="zipfian" \
-P "/opt/ycsb-0.17.0/ycsb-0.17.0/workloads/workloadb"
```

6. On each client, run the following command simultaneously to kick off a new YCSB test (make sure each YCSB client is targeting a different Cassandra VM):

```
/opt/ycsb-0.17.0/ycsb-0.17.0/bin/ycsb run cassandra-cql \
-p hosts="[the appropriate Cassandra VM IP address]" \
-threads "[60 for the C6520, 90 for the C6620]" \
-p maxexecutiontime="1800" \
-p fieldcount="10" \
-p recordcount="100000000" \
-p requestdistribution="zipfian" \
-p operationcount="400000000"
-P "/opt/ycsb-0.17.0/ycsb-0.17.0/workloads/workloadb"
```

Read the report at https://facts.pt/Qvw27zvl ▶

This project was commissioned by Dell Technologies.

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