



The science behind the report:

Handle more Oracle transactions and support more VMs with the Dell PowerEdge R7625 featuring the PowerEdge RAID Controller 12 Series (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 [Handle more Oracle transactions and improve response times with the Dell PowerEdge R7625 featuring the PowerEdge RAID Controller 12 Series \(PERC 12\)](#).

We concluded our hands-on testing on January 31, 2022. 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 21, 2022 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 testing. Source: Principled Technologies.

	Dell™ PowerEdge™ R7625	HPE ProLiant DL380 Gen9
Relative NOPM	6.3	1
Relative number of VMs	2.5	1

System configuration information

Table 2: Detailed information on the systems we tested. Source: Principled Technologies.

System configuration information	Dell PowerEdge R7625	HPE ProLiant DL380 Gen9
Tested by	Principled Technologies	Principled Technologies
Test date	1/31/2023	1/31/2023
Workload and version	HammerDB TPROC-C 4.6	HammerDB TPROC-C 4.6
Workload-specific parameters	100 / 300 warehouses, 8 virtual users, all_warehouse=true / false	100 / 300 warehouses, 8 virtual users, all_warehouse=true / false
Iterations and result choice	3 runs, median	3 runs, median
Server platform	Dell PowerEdge R7625	HPE ProLiant DL380 Gen9
BIOS name and version	Dell 1.0.2	P89 v2.8
Operating system name and version/ build number	VMware® vSphere® 8.0.0 RHEL 8.7 4.18.0-425.3.1.el8.x86_64	VMware vSphere 7.0.2 RHEL 8.7 4.18.0-425.3.1.el8.x86_64
Date of last OS updates/patches applied	1/21/2023	1/21/2023
Processor		
Number of processors	2	2
Vendor and model	AMD EPYC™ 9354 @ 3.25 GHz	Intel® Xeon® E5-2650 v4 @ 2.20 GHz
Core count (per processor)	32	12
Core frequency (GHz)	3.25	2.20
Family, model, stepping	25,17,1	6,79,1
SMT	Yes	Yes
Turbo	Yes (3.8 GHz)	Yes (2.9 GHz)
Memory module(s)		
Total memory in system (GB)	192	192
NVMe memory present?	No	No
Total memory (DDR+NVMe RAM)	192	192
General hardware		
Storage: NW or Direct Att / Controller	Direct Att PERC H965i	Direct Att SmartArray P440ar
OS		
Number of drives	2	2
Drive size (GB)	960	960
Drive information (speed, interface, type)	8 GT/s NVMe M.2 SSD	12 Gbps SAS SSD
Data drive		
Number of drives	6	6
Drive size	3 TB	960 GB
Drive information (speed, interface, type)	16 GT/s NVMe SSD	12 Gbps SAS SSD

How we tested

In our tests, we compared the following dual-socket solutions:

- Dell PowerEdge R7625 with AMD EPYC 9354 32-core processors and 192GB DDR4 memory
 - PERC 12 storage controller (PERC H965i)
- HPE ProLiant DL380 Gen9 with Intel Xeon E5-2650v4 12-core processors and 192GB DDR4 memory
 - HPE P440ar storage controller

Both servers used six SSDs in a RAID10 configuration to host the Oracle Database data and logs. We used VMware vSphere 8.0 as our hypervisor. We created 10 VMs on each server, each with 10 vCPU and 18 GB of memory. We installed Red Hat Enterprise Linux 8.7 and Oracle Database 19c. We ran the HammerDB 4.6 TPROC-C workload and measured the new orders per minute (NOPM) that each VM achieved.

Installing VMware vSphere 8

1. Boot to the VMware vSphere 8 installation media.
2. To continue, press Enter.
3. To accept the license agreement, press F11.
4. Select the BOSS M-2 installation location.
5. Select a language, and create the root password.
6. To install, press F11.

Creating the base VM

1. Use a web browser to connect and log into the vSphere instance.
2. Right-click the host, and click New VM.
3. Assign the VM the following properties:
 - 10 virtual CPU
 - 18 GB of memory
 - 60GB VMDK on SCSI controller 0 (for operating system)
 - 100GB VMDK on SCSI controller 1 (for Oracle data)
 - VMware Paravirtual controller
 - Thick-provisioned eager-zeroed
 - 30GB VMDK on SCSI controller 2 (for Oracle logs)
 - VMware Paravirtual controller
 - Thick-provisioned eager-zeroed
4. Click Finish.

Installing Red Hat Enterprise Linux 8.7

1. Boot the VM to the Red Hat Enterprise Linux 8.7 installation media.
2. Select Install or upgrade an existing system.
3. Choose English, and click Continue.
4. Under Installation Destination, select the OS VMDK to install the OS.
5. Click Done.
6. Click Accept Changes.
7. Select Kdump.
8. Uncheck Enable kdump, and click Done.
9. Select Network & Hostname.
10. Enter the desired hostname for the system.
11. Turn on the desired network ports, and click Configure.
12. On the General tab, select Automatically connect to this network when it is available.
13. On the IPv4 Settings tab, choose the Method drop-down named menu, and select Manual.
14. Under Addresses, click Add, and enter the desired static IP information for the server.
15. Enter the desired DNS information.
16. Click Save, and click Done.

17. Select Date & Time, and ensure the correct date, time, and time zone are set.
18. To add your NTP server, click the cog next to the Network Time On/Off switch.
19. Add the IP address of your NTP server, and click +.
20. Uncheck all other NTP servers.
21. Click OK.
22. Click Done.
23. Click Software Selection.
24. Choose the Base Environment of Minimal Install.
25. Click Done.
26. Click Begin Installation.
27. Select Root Password.
28. Enter the desired root password, and click Done.
29. When the installation completes, select Reboot to restart the server.

Configuring Red Hat Enterprise Linux 8.7 for Oracle Database

1. Log onto the server as root.
2. Disable the firewall:

```
systemctl stop firewalld
systemctl disable firewalld
```

3. Disable SELinux:

```
vi /etc/selinux/config
SELINUX=disabled
```

4. Register your RHEL subscription:

```
subscription-manager register --username <RHEL_USERNAME> --password <RHEL_PASSWORD> --auto-attach
```

5. Install wget, sysstat, and gdisk:

```
yum install -y sysstat wget gdisk
```

6. Update RHEL 8.7:

```
yum update -y
```

7. Disable auditd:

```
systemctl disable auditd
```

8. Disable transparent hugepages persistently by adding "transparent_hugepage=never" to the end of the GRUB_CMDLINE_LINUX option in /etc/default/grub and running the following command to rebuild the grub.cfg file:

```
grub2-mkconfig -o /boot/efi/EFI/redhat/grub.cfg
```

9. Reboot.
10. On a separate computer, in a web browser, download the preinstall rpm for 19c, and copy the file to the RHEL system.
11. Download the compat-libstdc++-33-3.2.3-72.el7.x86_64.rpm:

```
wget http://mirror.centos.org/centos/7/os/x86_64/Packages/compat-libstdc++-33-3.2.3-72.el7.x86_64.rpm
```

12. Install compat-libstdc++-33:

```
yum localinstall -y compat-libstdc++-33-3.2.3-72.el7.x86_64.rpm
```

13. Install the Oracle preinstall:

```
yum localinstall -y oracle-database-preinstall-19c-1.0-2.el8.x86_64.rpm
```

14. Create groups for ASM by running these shell commands:

```
groupadd -g 54327 asmdba  
groupadd -g 54328 asmoper  
groupadd -g 54329 asmadmin
```

15. Modify the oracle user to add the ASM groups:

```
usermod -G asmdba,asmoper,asmadmin -a oracle
```

16. Create passwords for the oracle account with passwd.

```
passwd oracle
```

17. On a separate computer, navigate to the RHEL Labs page for the RHEL Tuner for Oracle (<https://access.redhat.com/labs/rheltfo/>), and fill out the proper details for your system (we put the SGA as 13.5 GB). Click the button to generate the script for your server.

- Red Hat Enterprise Linux Version: Red Hat Enterprise Linux 8
- Oracle Group Name/ID: 54321
- System Global Area (SGA): 13500 MB
- Maximum number of open file descriptors: 65536 (Default)

18. Copy the RHEL Tuner script to your server.

19. Change the permissions of the RHEL Tuner to make it executable:

```
chmod +x rhel-config-for-oracle.sh
```

20. On your server, accept all changes, and execute the RHEL Tuner:

```
./rhel-config-for-oracle.sh
```

21. Create the following directories, and assign the following permissions:

```
mkdir -p /u01/app/19.0.0.0/grid  
mkdir -p /u01/app/oracle/product/19.0.0.0/dbhome_1  
chown -R oracle:oinstall /u01  
chmod -R 775 /u01/
```

22. Append the following to the /etc/security/limits.conf:

```
oracle - nofile 65536  
oracle - nproc 16384  
oracle - stack 32768  
oracle - memlock 4500000  
soft memlock unlimited  
hard memlock unlimited
```

23. Log into the oracle user:

```
su - oracle
```

24. Add the following lines to the `.bash_profile`:

```
export TMP=/tmp
export TMPDIR=$TMP
export ORACLE_HOSTNAME=<HOSTNAME>
export ORACLE_UNQNAME=orcl
export ORACLE_BASE=/u01/app/oracle
export GRID_HOME=/u01/app/19.3.0.0/grid
export DB_HOME=$ORACLE_BASE/product/19.3.0.0/dbhome_1
export ORACLE_HOME=$DB_HOME
export ORACLE_SID=orcl
export ORACLE_TERM=xterm
export BASE_PATH=/usr/sbin:$PATH
export PATH=$ORACLE_HOME/bin:$BASE_PATH
export LD_LIBRARY_PATH=$ORACLE_HOME/lib:/lib:/usr/lib
export CLASSPATH=$ORACLE_HOME/JRE:$ORACLE_HOME/jlib:$ORACLE_HOME/rdbms/jlib
alias grid_env='. /home/oracle/grid_env'
alias db_env='. /home/oracle/db_env'
```

25. Create the following files in the oracle user's home folder:

```
>>>grid_env<<<
export ORACLE_SID=+ASM
export ORACLE_HOME=$GRID_HOME
export PATH=$ORACLE_HOME/bin:$BASE_PATH
export LD_LIBRARY_PATH=$ORACLE_HOME/lib:/lib:/usr/lib
export CLASSPATH=$ORACLE_HOME/JRE:$ORACLE_HOME/jlib:$ORACLE_HOME/rdbms/jlib
>>>db_env<<<
export ORACLE_SID=orcl
export ORACLE_HOME=$DB_HOME
export PATH=$ORACLE_HOME/bin:$BASE_PATH
export LD_LIBRARY_PATH=$ORACLE_HOME/lib:/lib:/usr/lib
export CLASSPATH=$ORACLE_HOME/JRE:$ORACLE_HOME/jlib:$ORACLE_HOME/rdbms/jlib
```

26. As the root user, install the ASMLib kernel module package:

```
yum install -y kmod-redhat-oracleasm-2.0.8-12.2.el8.x86_64.rpmDownload the OracleASM support and lib packages from here: https://access.redhat.com/solutions/5396481
```

27. Copy the packages to your RHEL server.
28. From the directory you copied the packages to, install the Oracle ASM lib and support packages:

```
yum localinstall -y oracleasm*
```

29. Edit `/etc/sysconfig/oracleasm` to contain the following:

```
# ORACLEASM_ENABLED: 'true' means to load the driver on boot.
ORACLEASM_ENABLED=true
# ORACLEASM_UID: Default UID owning the /dev/oracleasm mount point.
ORACLEASM_UID=oracle
# ORACLEASM_GID: Default GID owning the /dev/oracleasm mount point.
ORACLEASM_GID=oinstall
# ORACLEASM_SCANBOOT: 'true' means fix disk perms on boot
ORACLEASM_SCANBOOT=true
# ORACLEASM_USE_LOGICAL_BLOCK_SIZE: 'true' means use the logical block
# size reported by the underlying disk instead of the physical. The
# default is 'false' ORACLEASM_USE_LOGICAL_BLOCK_SIZE=false
```

30. Run the following command to initialize Oracle ASM:

```
oracleasm init
```

31. Create a partition on all disks using gdisk.
32. Run the following commands to configure the disks for Oracle ASM:

```
oracleasm createdisk DATA /dev/<DISK1>
oracleasm createdisk LOG /dev/<DISK2>
```

Installing Oracle Grid Infrastructure 19c

1. Log in as the oracle user.
2. To set the Oracle grid environment, type grid_env.
3. Change directories to the grid home directory:

```
cd $ORACLE_HOME
```

4. Unzip linuxx64_193000_grid_home.zip.

```
unzip -q <grid_zip_location>/LINUX.X64_193000_grid_home.zip
```

5. To start the installer, type ./gridSetup.sh
6. In the Select Installation Option screen, select Install and Configure Grid Infrastructure for a Standalone Server, and click Next.
7. Choose the language, and click Next.
8. In the Create ASM Disk Group screen, choose the Disk Group Name (DATA), and change redundancy to External.
9. Change the path to /dev/oracleasm/disks, and select the DATA disk.
10. In the Specify ASM Password screen, choose Use same password for these accounts, write the passwords for the ASM users, and click Next.
11. At the Management Options screen, click Next.
12. Leave the default Operating System Groups, and click Next.
13. Leave the default installation, and click Next.
14. Leave the default inventory location, and click Next.
15. Under Root script execution, leave the defaults, and click Next.
16. In the Prerequisite Checks screen, make sure that there are no errors.
17. In the Summary screen, verify that everything is correct, and click Finish to install Oracle Grid Infrastructure.
18. At one point during the installation, the installation prompts you to execute a configuration script as root. Follow the instructions to run the scripts.
19. At the Finish screen, click Close.
20. To run the ASM Configuration Assistant, type asmca.
21. In the ASM Configuration Assistant, click Create.
22. In the Create Disk Group window, name the new disk group LOG, choose redundancy External Redundancy, and select the LOG disk.
23. Click Advanced Options.
24. Set the database compatibility level to 19.0.0.0.0, and click OK.
25. Exit the ASM Configuration Assistant.

Installing Oracle Database 19c

1. To set the Oracle database environment, type db_env Change directories to the database home directory:

```
cd $ORACLE_HOME
```

2. Unzip LINUX.X64_193000_db_home.zip.

```
unzip -q <database_zip_location>/LINUX.X64_193000_db_home.zip
```

3. Run ./runInstaller.
4. Wait for the GUI installer to load.
5. On the Select Configuration screen, choose Set Up Software Only, and click Next.
6. On the Select Database Installation screen, select Single instance database installation, and click Next.

7. For Select Database Edition, select Enterprise Edition, and click Next.
8. For Specify Installation Location, leave the default Oracle base, and click Next.
9. On the Privileged Operating System groups screen, keep the defaults, and click Next.
10. On the Perform Prerequisite Checks screen, wait for the verification results and fix all errors, and click Next.
11. On the Summary screen, review, and click Install.
12. Once the Execute Configuration scripts prompt appears, ssh into the server as root, and run the following command:

```
/u01/app/oracle/product/19.3.0.0/dbhome_1/root.sh
```

13. Return to the prompt, and click OK.
14. Once the installer completes, click Close.

Creating and configuring the database

1. Using SSH, log into the host.
2. To switch to the first database environment, type `db_envTo` to open the Database configuration assistant, type `dbca` and press Enter.
3. At the Database Operation screen, select Create Database, and click Next.
4. Under Creation Mode, select Advanced configuration, and click Next.
5. At the Database Deployment Type screen, select Data Warehouse. Click Next.
6. Enter a Global database name and an appropriate SID, and uncheck Create as Container database. Click Next.
7. At the storage option screen, select Use following for the database storage attributes.
8. In the drop-down menu, select Automatic Storage Management (ASM), select +DATA for the file location, and click Next.
9. At the Fast Recovery Option screen, check the box for Specify Fast Recovery Area.
10. In the drop-down menu, select ASM, select +DATA for the Fast Recovery Area, and enter 15GB for the size.
11. At the Specify Network Configuration Details, select the listener, and click Next.
12. At the Specify Oracle Data Vault Config Option screen, leave the default options, and click Next.
13. At the Specify Configuration Options screen, leave the memory selections to defaults, and click Next.
14. At the Specify Management Options screen select Configure Enterprise Manager (EM) Database Express, and click Next.
15. At the User Credentials screen, select Use the same administrative password for all accounts, enter and confirm the desired password, and click Next.
16. At the Creation Options, select Create Database, and click Next.
17. At the summary screen, click Finish.
18. Close the Database Configuration Assistant.

Configuring Oracle tablespaces and redo log

Alter the tablespaces on both systems as shown below. Type `sqlplus / as sysdba` to enter SQL prompt.

```
ALTER DATABASE ADD LOGFILE GROUP 11 ( '/tmp/templ.log' ) SIZE 50M;
ALTER DATABASE ADD LOGFILE GROUP 12 ( '/tmp/temp2.log' ) SIZE 50M;

ALTER SYSTEM SWITCH LOGFILE;
ALTER SYSTEM SWITCH LOGFILE;
ALTER SYSTEM CHECKPOINT;

ALTER DATABASE DROP LOGFILE GROUP 1;
ALTER DATABASE DROP LOGFILE GROUP 2;
ALTER DATABASE DROP LOGFILE GROUP 3;

ALTER SYSTEM SWITCH LOGFILE;
ALTER SYSTEM SWITCH LOGFILE;
ALTER SYSTEM CHECKPOINT;

alter system set "_disk_sector_size_override"=TRUE scope=both;

ALTER DATABASE ADD LOGFILE GROUP 1 ( '+LOG/redo01.log' ) SIZE 10G
BLOCKSIZE 4K;
ALTER DATABASE ADD LOGFILE GROUP 2 ( '+LOG/redo02.log' ) SIZE 10G
BLOCKSIZE 4K;

ALTER SYSTEM SWITCH LOGFILE;
ALTER SYSTEM SWITCH LOGFILE;
ALTER SYSTEM CHECKPOINT;
```

```

ALTER DATABASE DROP LOGFILE GROUP 11;
ALTER DATABASE DROP LOGFILE GROUP 12;

SHUTDOWN

STARTUP

HOST rm -f /tmp/temp*.log

CREATE BIGFILE TABLESPACE "TPCC"
DATAFILE '+DATA/ORCL/DATAFILE/tpcc.dbf' SIZE 40G AUTOEXTEND ON NEXT 1G
BLOCKSIZE 8K
EXTENT MANAGEMENT LOCAL AUTOALLOCATE
SEGMENT SPACE MANAGEMENT AUTO;
alter system set db_16k_cache_size = 1125M;
CREATE BIGFILE TABLESPACE "TPCC_OL"
DATAFILE '+DATA/ORCL/DATAFILE/tpcc_ol.dbf' SIZE 20G AUTOEXTEND ON NEXT 1G
BLOCKSIZE 16K
EXTENT MANAGEMENT LOCAL AUTOALLOCATE
SEGMENT SPACE MANAGEMENT AUTO;

ALTER DATABASE DATAFILE '+DATA/ORCL/DATAFILE/<UNDO FILE>' RESIZE 3276M;
ALTER TABLESPACE UNDOTBS1 ADD DATAFILE '+DATA/ORCL/DATAFILE/undo2.dbf' SIZE 3276M AUTOEXTEND ON
MAXSIZE UNLIMITED;
ALTER TABLESPACE UNDOTBS1 ADD DATAFILE '+DATA/ORCL/DATAFILE/undo3.dbf' SIZE 3276M AUTOEXTEND ON
MAXSIZE UNLIMITED;
ALTER TABLESPACE UNDOTBS1 ADD DATAFILE '+DATA/ORCL/DATAFILE/undo4.dbf' SIZE 3276M AUTOEXTEND ON
MAXSIZE UNLIMITED;

```

Installing HammerDB

1. Log on to the server as root.
2. Install sysstat, gcc, gcc-c++:

```
yum install -y sysstat gcc gcc-c++
```

3. Download the tarball of the latest version of HammerDB.
4. Install HammerDB:

```
tar -xvf HammerDB-4.6-Linux.tar.gz
```

Building the TPC-C schema

1. Log onto the HammerDB client as the Oracle user.
2. Change directories into the HammerDB directory:

```
cd HammerDB-4.6
```

3. Switch to the HammerDB command line interface:

```
./hammerdbcli
```

4. Change the following settings in the build script:

```

dbset db ora
dbset bm tpc-c
diset connection system_password <Password>
diset connection instance ORCL
diset tpcc count_ware 100 / 300
diset tpcc num_vu 8
diset tpcc tpcc_def_tab tpcc
diset tpcc tpcc_ol_tab tpcc_ol
diset tpcc partition true
diset tpcc hash_clusters true

```

- Build the schema:

```
buildschema
```

- After the build is finished, destroy the virtual users:

```
vudestroy
```

Running the TPC-C test

- Log onto the HammerDB client as the root user.
- Change directories into the HammerDB directory:

```
cd HammerDB-4.6
```

- Switch to the HammerDB command line interface:

```
./hammerdbcli
```

- Change the following settings in the load script:

```
dbset db ora
dbset bm tpc-c
diset connection system_password <Password>
diset connection instance ORCL
diset tpcc count_ware 100 / 300
diset tpcc tpcc_def_tab tpcc
diset tpcc tpcc_ol_tab tpcc_ol
diset tpcc partition true
diset tpcc total_iterations 100000000
diset tpcc rampup 2
diset tpcc duration 5
diset tpcc ora_driver timed
diset tpcc use_allwarehouse true / false
loadscript
```

- Create the virtual users:

```
vuset vu 8
vuset showoutput 1
vuset logtotemp 1
vuset unique 1
vucreate
```

- Run the test:

```
vurun
```

- When the test is complete, record the NOPM, and delete the virtual users:

```
vudestroy
```

- Repeat steps 1 through 7 two more times for a total of three runs.

Read the report at <https://facts.pt/R12W0hd>



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