The science behind the report:

Save up to $2.8M per new server over five years by consolidating with new Supermicro H14 Hyper Dual Processor servers powered by AMD EPYC™ 9475F processors

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 Save up to $2.8M per new server over five years by consolidating with new Supermicro H14 Hyper Dual Processor servers powered by AMD EPYC™ 9475F processors.

We concluded our hands-on testing on February 17, 2025. 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, 2025 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 TCO and database performance comparison.

	Legacy Supermicro Ultra DP AS -2124US-TNRP servers with AMD EPYC™ 7532 processors	Supermicro H14 Hyper DP AS -2126HS-TN server with AMD EPYC 9475F processors
5-year TCO for equivalent performance		
Number of systems required for equivalent performance	4	1
Purchase price	$0 (existing)	$30,000.00
Licensing	$4,641,004.00	$1,740,376.50
Power	$11,955.61	$6,319.49
Data center space	$1,904.76	$476.19
Maintenance	$26,073.78	$6,518.44
5-year TCO	$4,680,938.16	$1,783,690.62

	Legacy Supermicro Ultra DP AS -2124US-TNRP servers with AMD EPYC™ 7532 processors	Supermicro H14 Hyper DP AS -2126HS-TN server with AMD EPYC 9475F processors
Transactional database performance		
New orders per minute (NOPM) (higher is better)	1,915,613	7,260,166
Consolidation ratio: number of servers required to do the same work		
Number of servers (lower is better)	4	1
Power efficiency		
NOPM per watt (higher is better)	3,738.25	6,172.65
Power consumption (single server)		
Watts (lower is better)	512	1,176
Power consumption (equivalent performance solutions)		
Watts (lower is better)	2,048	1,176

TCO summary

Table 3: Database performance comparison and the total number of systems required for equivalent performance for the two solutions.

Total systems required for equivalent performance	Legacy Supermicro Ultra DP servers with AMD EPYC 7532 processors	Supermicro H14 Hyper DP server with AMD EPYC 9475F processors	Notes
Servers			
Number of VMs per server	14	23	
Total new orders per minute (NOPM) on single server	1,915,613	7,260,166	
Number of systems required for equivalent performance	3.79	1	
Total number of systems required	4	1	Rounded up to whole number because this represents the total number of older servers required to get equivalent performance to a single H14 Hyper DP server.

Table 4: Licensing cost comparison for the two solutions.

Licensing costs	Legacy Supermicro Ultra DP servers with AMD EPYC 7532 processors	Supermicro H14 Hyper DP server with AMD EPYC 9475F processors	Notes
Licensing costs - SQL Server 2022 Enterprise			
Total cores per system to be licensed	64	96	
Required 2-core license packs for system physical cores	32	48	
Annual cost per 2-core license pack	$15,123.00	$15,123.00	Source (MS pricing page from Nov 2024): https://www.microsoft.com/en-us/sql-server/sql-server-2022-pricing
Annual cost for Software Assurance (SA) per license pack	$3,780.75	$3,780.75	SA costs an additional 25% of annual licensing cost.
Total annual cost for SQL 2022 Enterprise licenses	$483,936.00	$725,904.00	
Total annual cost for SA	$120,984.00	$181,476.00	
First year cost for 1 system (core licenses + SA)	$604,920.00	$907,380.00	
Total cost for 4 additional years of SA	$483,936.00	$725,904.00	
Total 5y cost for 1 system	$1,088,856.00	$1,633,284.00	
Total 5y cost for all required systems	$4,355,424.00	$1,633,284.00	

Licensing costs	Legacy Supermicro Ultra DP servers with AMD EPYC 7532 processors	Supermicro H14 Hyper DP server with AMD EPYC 9475F processors	Notes
Licensing costs - Windows Server 2022 Datacenter			
Total cores per system to be licensed	64	96	
Required 16-core license packs for system physical cores	4	6	
Annual cost per 16-core license pack	$6,155.00	$6,155.00	Source (MS pricing page from Nov 2024): https://web.archive.org/web/20241002044436/https://www.microsoft.com/en-us/windows-server/pricing
Annual cost for Software Assurance (SA) per license pack	$1,538.75	$1,538.75	SA costs an additional 25% of annual licensing cost.
Total annual cost for WS2022 Datacenter licenses	$24,620.00	$ 36,930.00	
Total annual cost for SA	$6,155.00	$9,232.50	
First year cost for 1 system (core licenses + SA)	$30,775.00	$46,162.50	
Total cost for 4 additional years of SA	$24,620.00	$36,930.00	
Total 5y cost for 1 system	$55,395.00	$83,092.50	
Total 5y cost for all required systems	$221,580.00	$83,092.50	
Licensing costs - VMware® vSphere® Standard			
Total cores per system to be licensed	64	96	
vSphere Standard subscription annual cost per core	$50.00	$50.00	Source: PT confirmed this pricing with a Broadcom reseller in December 2024.
Total annual cost for system physical cores	$3,200.00	$4,800.00	
Total 5y cost for 1 system	$16,000.00	$24,000.00	
Total 5y cost for all required systems	$64,000.00	$24,000.00	

Table 5: Power and cooling cost comparison for the two solutions.

Power and cooling costs	Legacy Supermicro Ultra DP servers with AMD EPYC 7532 processors	Supermicro H14 Hyper DP server with AMD EPYC 9475F processors	Notes
Cost per kWh	0.1701	0.1701	Avg price of electricity Nov 2024 https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=table_es1a
Hours in year	8,760	8,760	

Power and cooling costs	Legacy Supermicro Ultra DP servers with AMD EPYC 7532 processors	Supermicro H14 Hyper DP server with AMD EPYC 9475F processors	Notes
Percentage time under load/ active (remainder idle)	0.50	0.50	Assume 50% active (12 hours per day)
Power usage per server (watts-active)	512	1,176	
Power usage per server (watts-idle)	290	520	
Typical watts	401.175	848.21	Calculation: (% time active * Watts-active) + (% time idle * Watts-idle)
Annual kWh per server	3514.29	7430.32	
Total annual energy cost per server	$597.78	$1,263.90	
Total 5y energy cost per server	$2,988.90	$6,319.49	
Total 5y cost for all required systems	$11,955.61	$6,319.49	

Table 6: Data center space cost comparison for the two solutions.

Data center space costs	Legacy Supermicro Ultra DP servers with AMD EPYC 7532 processors	Supermicro H14 Hyper DP server with AMD EPYC 9475F processors	Notes
Rack units per server (U)	2	2	
Annual data center costs per rack (42U)	$2,000.00	$2,000.00	Estimate assuming $2,000, but could be anywhere from $1,000-$3,000+ depending on location, bandwidth, infrastructure, and other factors. See https://cyfuture.cloud/kb/colocation/how-much-does-renting-rack-space-cost-key-factors-to-consider
Annual data center costs per rack unit (1U)	$47.62	$47.62	
Rack units (U) required for all systems	8	2	
Annual cost for all required systems	$380.95	$95.24	
Total 5y cost for all required systems	$1,904.76	$476.19	

Table 7: Maintenance and administration cost comparison for the two solutions.

Maintenance/ administration costs	Legacy Supermicro Ultra DP servers with AMD EPYC 7532 processors	Supermicro H14 Hyper DP server with AMD EPYC 9475F processors	Notes
Number of servers per IT admin	100	100	PT estimate. Can vary based on management/infrastructure factors.
Number admins needed for all required systems	0.04	0.01	Total required systems divided by number of servers per IT admin.
Average salary of an administrator	$100,580.00	$100,580.00	Average for network and computer systems administrator, BLS May 2023 https://www.bls.gov/oes/current/oes_nat.htm
Burden rate	0.2962	0.2962	Burden rate for private industry workers, BLS Sept 2024 https://www.bls.gov/news.release/ecec.nr0.htm
Average burdened salary	$130,368.90	$130,368.90	Average salary * (1 + burden rate)
Annual administration cost	$5,214.76	$1,303.69	
Total 5y administration cost	$26,073.78	$6,518.44	

Table 8: CAPEX costs comparison for the two solutions.

Total system costs	Legacy Supermicro Ultra DP servers with AMD EPYC 7532 processors	Supermicro H14 Hyper DP server with AMD EPYC 9475F processors	Notes
New cost of systems required	$0	$30,000	No purchase required for legacy systems. H14 Hyper DP server cost estimates from a Supermicro quote in February 2025. Price subject to change.

Table 9: Five-year TCO comparison for the two solutions.

Total 5-year TCO	Legacy Supermicro Ultra DP servers with AMD EPYC 7532 processors	Supermicro H14 Hyper DP server with AMD EPYC 9475F processors	Notes
Number of systems required	4	1	
Total system cost	$0	$30,000.00	
Total 5y licensing cost	$4,641,004.00	$1,740,376.50	SQL + WS + vSphere
Total 5y power cost	$11,955.61	$6,319.49	
Total 5y data center space cost	$1,904.76	$476.19	
Total 5y maintenance cost	$26,073.78	$6,518.44	
Total 5y costs	$4,680,938.16	$1,783,690.62	

System configuration information

Table 10: Detailed information on the systems we tested.

System configuration information	Supermicro Ultra DP (AS -2124US-TNRP)	Supermicro H14 Hyper DP (AS -2126HS-TN)
BIOS name and version		
BIOS name and version	American Megatrends 3.0	American Megatrends 1.1
Non-default BIOS settings	N/A	N/A
Operating system name and version/build number	VMware ESXi™ v8.0 Update 3 build 24414501	VMware ESXi v8.0 Update 3 build 24414501
Date of last OS updates/patches applied	01/21/2025	01/21/2025
Processor		
Number of processors	2	2
Vendor and model	AMD EPYC 7532	AMD EPYC 9475F
Core count (per processor)	32	48
Core frequency (GHz)	2.4	3.65
Stepping	B0	1
Memory module(s)		
Total memory in system (GB)	512	2,304
Number of memory modules	32	24
Vendor and model	Micron MEM-DR416L-CL06-ER32	Micron MEM-DR596L-CL01-ER56
Size (GB)	16	96
Type	PC4-25600	PC5-44800
Speed (MHz)	3,200	5,600
Speed running in the server (MHz)	2,933	
Storage controller		
Vendor and model	Supermicro AOC-S3808L-L8IT-O	Direct-attached
Firmware version	29.00.00.00	
Driver version	17.00.13.00-3vmw	
Local storage (type A)		
Number of drives	8	14
Drive vendor and model	Micron HDS-M2T-MTFDDAK3T8TGA1BC	Kioxia HDS-TUN-KCD8XPUG3T84
Drive size	3.84TB	960GB
Drive information (speed, interface, type)	6Gbps, SATA, SSD	NVMe PCIe Gen4

System configuration information	Supermicro Ultra DP (AS -2124US-TNRP)	Supermicro H14 Hyper DP (AS -2126HS-TN)
Local storage (type B)		
Number of drives	2	N/A
Drive vendor and model	HDS-TUN-KCD6FLUL1T92	N/A
Drive size	1.92TB	N/A
Drive information (speed, interface, type)	NVMe SSD Gen4	N/A
Network adapter		
Vendor and model	Supermicro AOC-2UR68G4-i4XTS	Supermicro AOC-S25G-B2S-O
Number and type of ports	4 x 10GbE	2 x 25GbE
Driver version	1.7.1.44-1vmw	226.0.21.0-31vmw
Cooling fans		
Vendor and model	Supermicro	Supermicro
Number of cooling fans	4	6
Power supplies		
Vendor and model	Supermicro PWS-1K62A-1R	Supermicro PWS-2K63A-1R
Number of power supplies	2	2
Wattage of each (W)	1,600	2,600

How we tested

We used the HammerDB TPROC-C benchmark to compare online transaction processing (OLTP) database performance on both systems under test, a 5-year-old Supermicro Ultra DP system with two AMD EPYC 7532 (Rome) processors and a new Supermicro H14 Hyper DP with two AMD EPYC 9475F (Turin) processors. We installed ESXi 8.0.3 on both systems and set up additional servers to host our vCenter, pfSense, and other test infrastructure including the HammerDB client VMs. Both servers and all client systems utilized 10Gb/s networking configured with an MTU of 9000. To maximize performance on the legacy system and minimize disk latency, we placed all HammerDB SQL database VMs OSes on a single SATA-based datastore, all log drives on NVMe storage, and spread out database drives evenly across the rest of the SATA storage. For the new H14 Hyper DP system, we spread out the OS, logs, and database across the available NVMe drives as evenly as possible. Our HammerDB database VMs used Windows Server 2022 Datacenter Edition (build 20348) and SQL Server 2022 Enterprise (version 16.0.1000.6).

Setting up the SQL Server and HammerDB client VMs

We performed the following steps in a fully updated VMware vSphere® environment.

Installing and configuring the base VM image

We first created a base VM that we later customized for our client and SQL Server VMs.

1. Log into the vCenter console.
2. Right-click the system under test, and select New Virtual Machine.
3. In Select a creation type, select Create a new virtual machine, and click Next.
4. In Select a name and folder, name the VM `gold-sql`, and click Next.
5. In Select a compute resource, click Next to accept defaults.
6. In Select storage, choose the storage you set up for your client VMs, and click Next.
7. In Select compatibility, click Next to accept defaults.
8. In Select a guest OS, choose Windows → Microsoft Windows Server 2022 (64-bit), and click Next.
9. Choose the following options for the new VM:
    - CPU: 8
    - RAM: 35 GB
    - Storage
        - Hard disk 1: 100 GB
        - Hard disk 2: 120 GB
        - Hard disk 3: 200 GB
    - Network
        - Network connection 1: Your network connection for the internet (optional if your test network has a pre-configured gateway)
        - Network connection 2: Your 10G test network connection
10. Verify that you chose the correct options, and click Next.
11. In Ready to complete, verify that you've applied the correct details, and click Finish.
12. Right-click your new VM, and select Power → Power On.
13. Open a console to the new VM.
14. Attach a Windows Server 2022 ISO to the VM, and press any key to boot from the ISO when prompted.
15. Leave language, time and currency format, and input method as default, and click Next.
16. Click Install Now.
17. Select Windows Server 2022 Datacenter Evaluation (Desktop Experience), and click Next.
18. Accept the license terms, and click Next.
19. Select Custom: Install Microsoft Server Operating System only (advanced).
20. Select Drive 0 (the 100GB hard disk), and click Next.
21. After WS2022 installation completes and the guest OS automatically reboots, enter and confirm the desired administrator password, and click Finish.
22. Log in with the password specified in the previous step, and open Server Manager.
23. Click Local server, and make the following configuration changes:
    a. Disable Microsoft Defender firewall on the public, private, and domain networks.
    b. Disable IE Enhanced Security Configuration.
    c. Ensure the time zone is set correctly.
    d. Change the hostname to something descriptive (we chose gold-sql), and click Restart Now when prompted.

24. After the server reboots, log back in, and reopen Server Manager.
25. Click Local Server, and click the Windows Update link.
26. Click Check for Updates.
27. Run updates, rebooting as prompted, until Windows Updates shows that it is fully up to date.
28. Return to vCenter, select the VM, and install VMware Tools by clicking Actions → Install VMware Tools.
29. Click Mount.
30. Return to the VM, navigate to the mounted VMware Tools installer, and run it.
31. Click Next, select Complete, and click Next.
32. Click Install.
33. Click Finish.
34. Download and install the Microsoft ODBC Driver 18 for SQL Server from https://learn.microsoft.com/en-us/sql/connect/odbc/download-odbc-driver-for-sql-server?view=sql-server-ver16.
35. Click the Start menu, and select Settings.
36. Click Apps.
37. Click Optional features.
38. Click Add a feature, and search for and install OpenSSH Server.
39. Open an elevated PowerShell prompt, and enter the following commands to set the OpenSSH Server service to run automatically on startup:

```
Start-Service sshd
Set-Service -Name sshd -StartupType 'Automatic'
```

40. Reboot and confirm that the sshd OpenSSH Server service starts automatically by opening an elevated PowerShell prompt and running the following command:

```
Get-Service -Name sshd
```

Installing and configuring the SQL Server 2022 gold VM

We used the baseline WS2022 image we created previously to configure the SQL Server 2022 database gold VM.

1. Log into the vCenter console.
2. Shut down the gold-sql VM and clone it by right-clicking the gold-sql VM and clicking Clone→Clone to Virtual Machine.
3. Enter a name for the SQL Server gold VM (we chose gold-sql), and click Next.
4. Select the SUT, and click Next.
5. Select the appropriate storage, and click Next.
6. Select Power on virtual machine after creation, and click Next.
7. Click Finish.
8. Once the VM has finished cloning and booted up, open a remote console to it.
9. Log in with the administrator password specified earlier.
10. Open the start menu, type `diskmgmt.msc`, and click Create and format hard disk partitions.
11. Right-click the previously added 1200GB and 200GB disks, and click Online.
12. Right-click either of the disks from the previous step, click Initialize, ensure both are selected, and click OK.
13. Right-click the 200GB disk volume, and click New Simple Volume.
14. Click Next.
15. Click Next.
16. Click Next.
17. Enter logs as the volume label, and click Next.
18. Click Finish.
19. Repeat steps 13 through 18 for the 120GB disk, but enter data as the volume label.
20. Close Disk Management.
21. Download or copy the SQL Server 2022 ISO to the VM, and mount it.
22. Double-click the Setup application.
23. Click Installation → New SQL Server standalone installation or add features to an existing installation.
24. Select the Evaluation version, and click Next.
25. Check the I accept the license terms and Privacy Statement box, and click Next.

26. Check the Use Microsoft Update to check for updates (recommended) box, and click Next.
27. On the Feature Selection page, check the boxes for Database Engine Services and Full-Text and Semantic Extractions for Search, and click Next.
28. Leave the default instance selected, and click Next.
29. Leave the default service accounts, and click Next.
30. On the Server Configuration tab, select Mixed Mode (SQL Server authentication and Windows authentication) and enter and confirm a password for the SQL Server system administrator (sa) account.
31. Click Add Current User under Specify SQL Server administrators.
32. Click Next.
33. Click Install.
34. After the installation is complete, return to the SQL Server Installation Center and click Install SQL Server Management Tools.
35. Download the SMSS installer, and install with defaults.
36. After SMSS installation completes, open Server Manager, and click Local Server.
37. Run Windows Update again to ensure SQL Server 2022 is fully up to date, rebooting if prompted.
38. Once Windows Update is fully up to date, open the Services list by clicking Start and typing `Services`.
39. Right-click the Windows Update service, and select Properties.
40. Change the Startup type to Disabled, and click Stop to stop the service.
41. Click OK.
42. Click the Start menu, type `Local Security Policy`, and open it.
43. Expand Local Policies, and click User Rights Assignment.
44. In the right pane, double-click Lock pages in memory.
45. Click Add User or Group, type `NT Service\MSSQLSERVER`, and click OK.
46. Close the Local Security Policy window.
47. Launch SQL Server Management Studio.
48. Check the Trust server certificate box, and click Connect.
49. Right-click the SQL instance, and click Properties.
50. Click Advanced, and change the value for Max Degree of Parallelism to 0.
51. Click OK.
52. Open the SQL instance properties again, and click Memory.
53. Set the maximum server memory (in MB) to 90% of the VM's total memory. In our case, with 35GB of memory, we entered 31500MB.
54. Click OK.
55. Right-click the SQL instance, and restart the service. When prompted, click Yes.

Installing and configuring the HammerDB client gold VM

We used the same baseline WS2022 image we created previously to configure the HammerDB client gold VM.

1. Log into the vCenter console.
2. Shut down the gold-sql VM, and clone it by right-clicking the gold-sql VM and clicking Clone→Clone to Virtual Machine.
3. Enter a name for the client gold VM (we chose gold-client), and click Next.
4. Select the infrastructure host, and click Next.
5. Select the appropriate storage, and click Next.
6. Click Next, and click Finish.
7. Once the VM has successfully cloned, right-click the gold-client VM, and click Edit Settings.
8. Change the settings to reflect the following:
    a. 8 CPUs
    b. 8GB memory
    c. 60GB hard disk (delete the other two hard disks and their data)
9. Click OK, power on the VM, and open a remote console to it.
10. Log in, and click Start.
11. Type `CMD`, and open an elevated command prompt.
12. Type `diskmgmt.msc`, and open Disk Management.

13. Enter the following commands to delete the recovery partition and extend the OS hard disk, ensuring the selected disks and partitions correspond to the OS disk and recovery partition in your setup:

```
reagentc /disable
diskpart
list disk
select disk 0
list partition
select partition 4
delete partition override
```

14. Close CMD.
15. Click Start, type `diskmgmt.msc`, and open Disk Management.
16. Right-click the OS partition, and click Extend Volume.
17. Click Next.
18. Click Next.
19. Click Finish. Your C drive should now be just under 60GB in size.
20. Open a browser, and download the Windows HammerDB 4.12 installer from https://hammerdb.com/download.html.
21. Double-click the downloaded executable.
22. Click Next.
23. Accept the license agreement, and click Next.
24. Click Next, and click Next again to install.
25. Click Finish.

Initializing the HammerDB TPROC-C database and backing up the database

We used a combination of Microsoft SQL Server Management Studio (SMSS) and the Red Hat® Enterprise Linux® command line to perform the following steps.

1. Open SMSS, and connect to the SQL Server installation.
2. In SMSS, right-click Databases, and select New Database.
3. In the New Database window, name your database tpcc, and give the database four database files and one log file. Ensure the database files are in E:\db\, and the log file is in F:\log\.
4. In the Options tab, change the Recovery mode to Simple, and click OK.
5. Log into the client VM via SSH, and navigate to the HammerDB directory:

```
cd HammerDB-4.12
```

6. Open the HammerDB cli:

```
./hammerdbcli
```

7. Inside the HammerDB cli, set the benchmark to Microsoft SQL and TPROC-C:

```
dbset db mssqls
dbset bm TPROC-C
```

8. Configure the connection details for the SQL server:

```
diset connection mssqls_server 192.168.30.31
diset connection mssqls_uid sa
diset connection mssqls_pass Password1
diset connection mssqls_trust_server_cert true
```

9. Configure the size of the database and the number of users to create the database:

```
diset tpcc mssqls_count_ware 350
diset tpcc mssqls_num_vu 4
```

10. Change the HammerDB client so it doesn't use locally cached data when initializing (Note: this is for compatibility purposes with our setup. If you have configured your setup to use locally cached data, you can leave this at defaults):

```
diset tpcc mssqls_use_bcp false
```

11. Start the database creation:

```
buildschema
```

12. While the database is initializing, create a TPROC-C automation file for HammerDB:

```
vi tproc-c.tcl
```

13. Inside the tproc-c.tcl, add the following lines:

```
dbset db mssqls
dbset bm TPC-C

diset connection mssqls_server 192.168.30.31
diset connection mssqls_authent sql
diset connection mssqls_uid sa
diset connection mssqls_pass Password1

diset tpcc mssqls_count_ware 350
diset tpcc mssqls_use_bcp false
diset tpcc mssqls_total_iterations 1000000000
diset tpcc mssqls_driver timed
diset tpcc mssqls_rampup 10
diset tpcc mssqls_duration 20
diset tpcc mssqls_allwarehouse false

loadscript
puts "TEST STARTED"
vuset vu 16
vuset logtotemp 1
vucreate
tcstart
tcstatus
set jobid [ vurun ]
vudestroy
tcstop
puts "TEST COMPLETE"
```

14. After you create the database, use SSMS to log into the SQL server.
15. Right-click the tpcc database, and select Properties.
16. In the Files tab of Database Properties, click the log file, and expand it to 50GB.
17. In the Options tab of Database Properties, change Recovery model to full, and click OK.
18. Right-click the tpcc database, and select Tasks → Back Up.
19. In the Back Up Database window, change the destination to /data/backup/backup.bak.
20. In the Backup Options tab of the Back Up Database window, set backup compression to Compress backup, and click OK.
21. After a few minutes, the database backup will complete.
22. Shut down the HammerDB client, and SQL VMs.

Cloning VMs to prepare for testing

Cloning and configuring the HammerDB client VMs

1. Right-click the gold client VM, and select Clone → Clone to Virtual Machine.
2. In Select a name and folder, enter the name for the first HammerDB client, and click Next.
3. In Select a compute resource, select your infrastructure host, and click Next.
4. In Select storage, select your client VM storage, and click Next.
5. In Select clone options, accept defaults, and click Next.
6. In Ready to complete, verify your options, and click Finish.
7. When the VM has finished cloning, log into it, and make the IP address of the VM unique.
8. In Server Manager, change the VM hostname.
9. Edit the HammerDB automation file to target the correct SQL server.
10. Complete steps 1 through 9 for all remaining clients.

Cloning and configuring the SQL Server host VMs

The following steps should only be performed after the HammerDB clients have initialized the SQL database on the gold VM, as described in Initializing the SQL database section.

1. Right-click the gold SQL VM, and select Clone → Clone to Virtual Machine.
2. In Select a name and folder, enter the name for the first SQL Server VM, and click Next.
3. In Select a compute resource, select your system under test host, and click Next.
4. In Select storage, select Configure per Disk.
5. Clone the configuration file, operating system, and log disks to one drive, and clone the database disk to a second drive. Keep track of which drives you used—when cloning new VMs, we recommend spreading out the OS, log, and database drives to reduce resource contention. Ensure the log and database drives are thick provision eager zeroed, and click Next.
6. In Select clone options, accept defaults, and click Next.
7. In Ready to complete, verify your options, and click Finish.
8. When the VM has finished cloning, log into it, and make the IP address of the VM unique.
9. Change the VM hostname in Server Manager.
10. Complete steps 1 through 9 for all remaining SQL Server VMs.

Running the HammerDB benchmark

Performing a test run

1. On all HammerDB client VMs, navigate to the HammerDB directory:

```
cd HammerDB-4.11
```

2. On all HammerDB client VMs, type the following command but do not execute it:

```
./hammerdbcli auto ~/HammerDB-4.11/tpcroc-c.tcl
```

3. On all HammerDB client VMs, simultaneously execute the command from step 2.

Performing a restore after a test run

We performed the following steps on all database VMs after completing a test run.

1. Shut down the database VM to clear virtual memory lease.
2. Power the database VM on.
3. Use SSMS to log into the VM database.
4. Right-click the tpcc database, and select Delete.
5. In Delete Object, check Close existing connections, and click OK.
6. Right-click Databases, and select Restore Files and Filegroups.
7. In Destination to restore, type `tpcc`.
8. In Source for restore, select From Device.

9. In Select backup devices, navigate to /data/backup/backup.bak, and click OK.
10. Verify that the system is restoring the files to their appropriate locations, and click OK.
11. When the database has restored, click OK.
12. Complete steps 1 through 10 for the remaining database VMs.

Read the report at https://facts.pt/WT3Go6U ▶

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