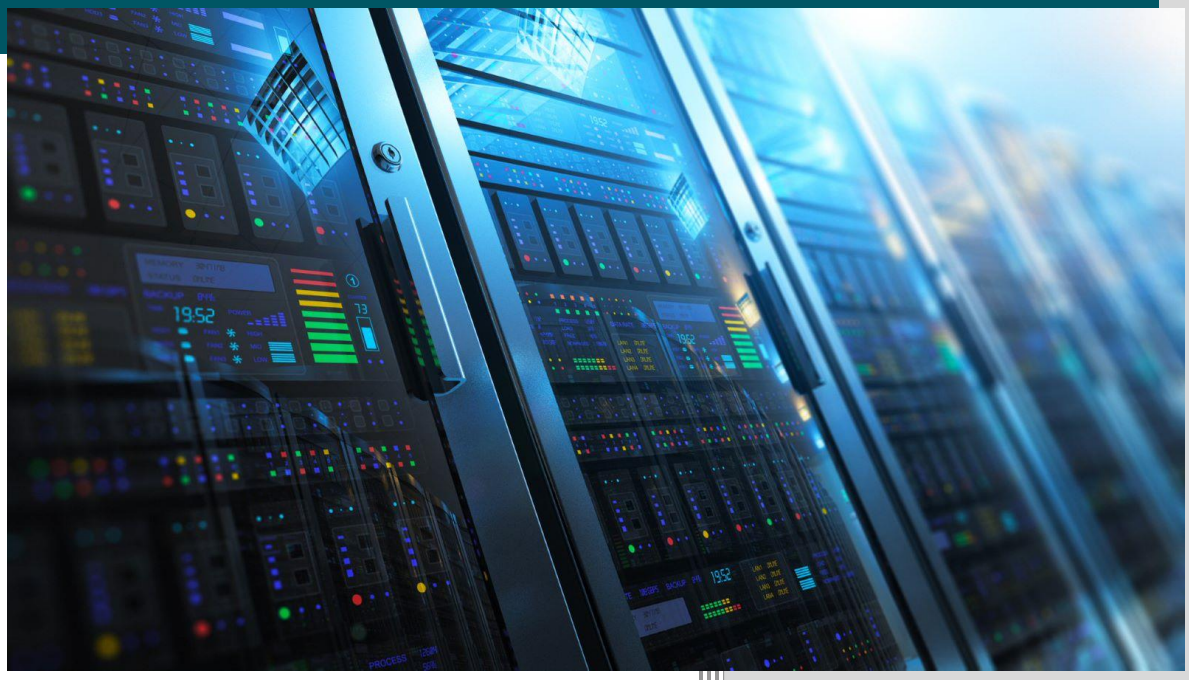
Lenovo ThinkAgile HX665 V3 Systems Integrated with Nutanix Software Deliver Scalable Performance for Oracle 21C Databases



Looking to move from a bare metal to hyperconverged environment in your datacenter for database workloads?

Look no further. AMD EPYC™ processor-powered Nutanix-integrated Lenovo ThinkAgile HX665 V3 appliances are the answer!

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Introduction

Hyperconverged Infrastructure (HCI) simplifies IT and data center operations. Enterprises have been implementing HCI technologies in IT ecosystems for many years, deploying and managing IT resources and software to help improve TCO and scalability in their business environments. Nutanix-integrated Lenovo ThinkAgile HX665 V3 appliances are the result of a collaboration between industry leaders. These appliances simplify and modernize datacenters to run applications at scale.

Oracle® Database delivers leading-edge innovations in relational database management systems (RDBMS) with exceptional performance and ease-of-use for on-premise, cloud, and hybrid workloads. Lenovo ThinkAgile HX665 V3 servers powered by AMD EPYC™ 9004 processors and running Nutanix Acropolis™ software deliver high Online Transaction Processing (OLTP) performance and exceptional scaling on Oracle Database 21C.

Dual-socket Lenovo ThinkAgile HX665 V3 servers powered by AMD EPYC 9004 Series Processors are an excellent choice for deploying Oracle® Database in a hyperconverged environment thanks to their high clock speeds, memory bandwidth, and transactions per VM.

AMD EPYC Powered Nutanix-Integrated Lenovo ThinkAgile HX665 V3 Lenovo ThinkAgile HX665 V3 Appliance Offers:

- Flexibility – Custom size VMs based on your requirements.
- High Availability – Nutanix includes powerful self-healing, data protection, and disaster recovery capabilities to keep databases and applications running and your critical data well protected.
- Performance – High frequency processors bring the highest base frequency, max boost[1], and all-core boost frequency that optimizes your per core performance and license costs.
- Scalability – Scale up by increasing the resources in the same VM to meet DB requirements or scale out by spinning up more VMs or adding more nodes/cores as your needs evolve.
- Cost-effective - Create multiple databases in the same cluster farm to reduce TCO.

If you are looking to move from a bare metal to hyperconverged environment in your datacenter for database workloads, then **AMD EPYC 9004-powered Nutanix-integrated Lenovo ThinkAgile HX665 V3 appliances** are your answer. This combination brings you the power, performance, scalability, value, and freedom of choice needed to fit your datacenter requirements.

AMD EPYC 9004 Series Processors with Nutanix Demonstrate Superior Performance on Transaction Processing Workloads with Oracle Database 21C

AMD EPYC 9004 Series Processors provide a leadership throughput computing foundation for Nutanix HCI. Scaling is critical to HCI applications. AMD EPYC 9004 Series Processors provide high bandwidth between nodes with support for PCIe® Gen 5 enabled network devices. AMD and Nutanix collaborated to thoroughly test solutions that deliver excellent workload performance and help improve availability and scalability.

Performance Benchmarking

In our AMD internal testing performed during February 2025, we measured the throughput scaling between 8 vCPUs (24 VMs), 16 vCPUs (12 VMs), and 32 vCPUs (8 VMs) on Oracle Database 21C Enterprise Edition. This kind of transaction throughput scaling can help business start at an appropriate level for its current needs and grow with consistent and predictable performance as needs expand.

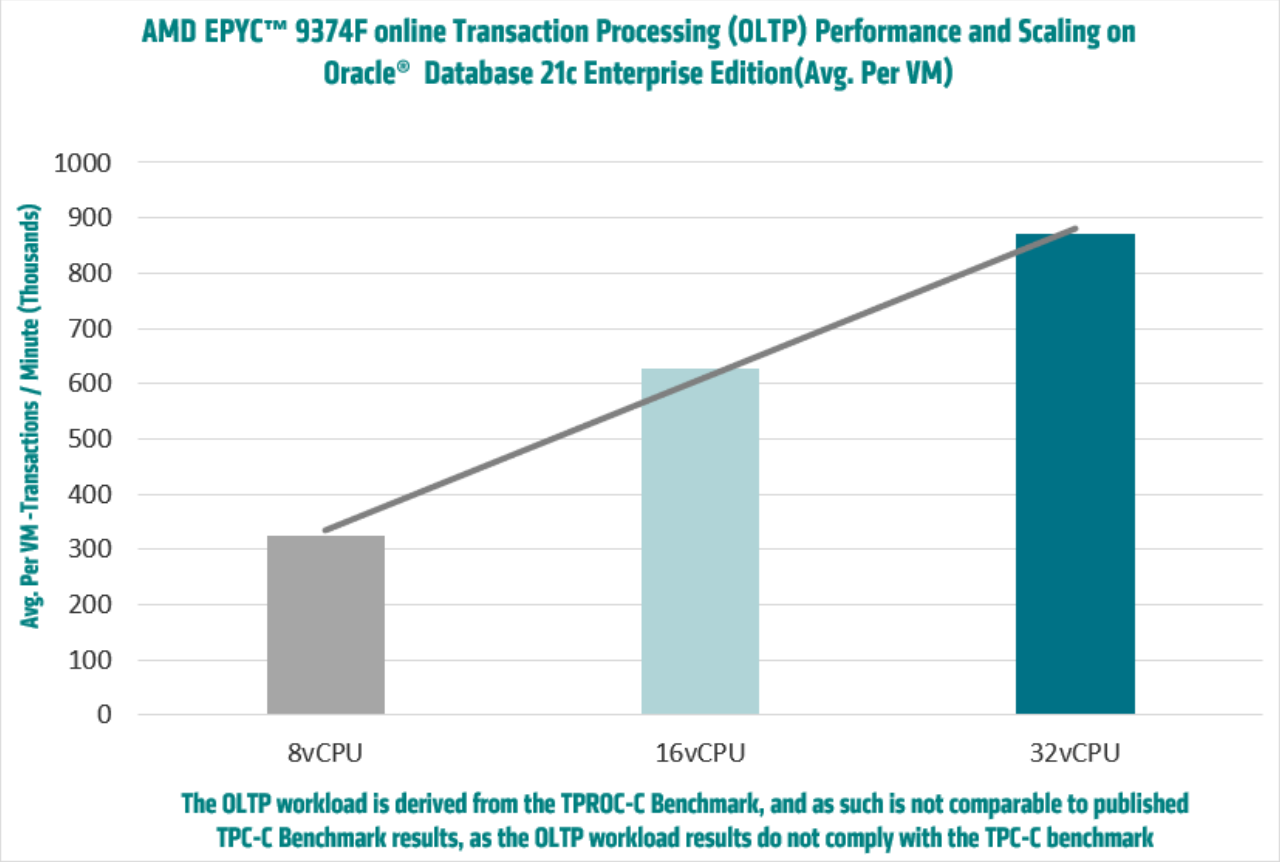

Figure 1 AMD EPYC 9374F OLTP performance scaling on Oracle DB 21C on two sockets, 4 host Lenovo ThinkAgile HX665 V3 servers.

Workload

The OLTP workload models an order fulfilment system where the database receives requests for data, adds new data, and makes multiple changes to the data from many users.

Figure 1 shows an Avg. Per VM online transaction processing (OLTP) benchmark workload derived from the TPROC-C™ HammerDB benchmark. AMD engineers ran tests derived from industry standard benchmarks on Oracle Enterprise Linux® based VMs in a Nutanix environment. Five tests were performed on three instance types with different vCPU and memory configurations. All benchmark runs for all configurations used the same Online Transaction Processing (OLTP) workload. These results demonstrate the effectiveness of the VMs at optimizing the I/O throughput for database applications.

Nutanix Acropolis Software

Nutanix Acropolis™ software converges compute and storage to provide a cloud-like infrastructure that can run applications at scale. Nutanix Hyperconverged Infrastructure (HCI) software tightly integrates storage, networking, and compute resources into a powerful software-defined virtualized pool with a single point of management. Integrating these resources into a single infrastructure building block avoids having to manually stitch together separate discrete computing devices. Nutanix software enables databases and application workloads that deliver excellent user performance and scalability.

Test Methodology

HammerDB is a database load testing and benchmarking tool. AMD used HammerDB to create a test schema, load it with data and simulate a workload of multiple virtual users against the database for both transactional and analytic scenarios. This workload can then be used to derive meaningful information about an environment, such as hardware performance comparisons and software configurations. The benchmark involves a mix of five concurrent transactions of different types and complexity that are executed either online or queued for deferred execution. AMD performed TPROC-C derivative benchmarking with Oracle 21C using the widely accepted open-source benchmarking tool HammerDB. Note: The HammerDB TPROC-C workload is an open-source workload derived from TPC-Benchmark™ Standard, and as such is not comparable to published TPC-C™ results, as the results do not comply with the TPC-C Benchmark Standard. Table 1 lists the test sizes:

Size	Small	Medium	Large
CPU Per VM	8vCPU	16vCPU	32vCPU
Host1	6VM X 8vCPU	3VM X 16vCPU	2 VM X 32vCPU
Host2	6VM X 8vCPU	3VM X 16vCPU	2 VM X 32vCPU
Host3	6VM X 8vCPU	3VM X 16vCPU	2 VM X 32vCPU
Host4	6VM X 8vCPU	3VM X 16vCPU	2 VM X 32vCPU
Memory (GB) Per VM	128	256	512

Table 1 Test Methodology and Benchmarking

- The TPROC-C derivative (OLTP) test was performed with 50-150 warehouses with a test duration of 15 minutes and a ramp up time of 2 minutes. This technical brief shows the average of five runs.
- The Oracle workloads were performed with 50 WH for 8vCPU, 100 WH for 16vCPU and 150 WH for 32vCPU.
- OS HugePages memory and Oracle parameters needed tuning for optimum performance. Please see the details of these parameters in the Nutanix Best Practice Guide for Virtualizing Oracle*.

Test Configurations

AMD configured four dual-socket servers with AMD EPYC 9374F processors with 32 cores per socket and 1.5 TB of memory per host was added in a high-throughput, dual-DIMM-per-channel configuration. The storage configuration used Nutanix software with 12 NVMe drives for data and 2 NVMe drives M.2 for boot per server. Each disk capacity was 3.84 TB for a total of ~156 TB of high-speed usable storage. Nutanix deduplication and erasure coding were disabled, and compression was enabled. Cisco 100 Gbps switches connected the servers.

Component	Details
Server	4 x Dual-Socket Server (Lenovo ThinkAgile HX665 V3 Appliance)
CPU	2 socket, AMD EPYC 9374F 32 Core @ 3.85 GHz
RAM	1.5 TB (24 x Lenovo ThinkSystem 64GB TruDDR5 4800MHz)
Network adapter	ThinkSystem Mellanox ConnectX-6 Dx 100GbE QSFP56 2-port PCIe Ethernet Adapter)

Disks	12 x ThinkSystem 2.5" U.3 7450 PRO 3.84TB Read Intensive NVMe PCIe 4.0 x4 HS SSD 2 x ThinkSystem M.2 7450 PRO 960GB Read Intensive NVMe PCIe 4.0 x4 NHS SSD
Hypervisor	AHV v.20230302.100173
Nutanix AOS	6.8
Oracle Database (Enterprise Edition)	Oracle Database 21c Enterprise Edition Release 21.0.0.0.0 – Production-Version 21.3.0.0.0
BIOS Version	4.06 (Build ID: GNL104X)
HammerDB	4.11
Linux®	Oracle Enterprise Linux (OEL) 8.10 (Kernal 4.18.0-553.el8_10.x86_64)

Table 2 Hardware and Software versions

Oracle Database Configuration

Testing used the following Per-VM Oracle configuration variations:

- vCPU Counts.: 8, 16, 32
- Memory GB: 128, 256, 512
- 11 Disks
    - 1 OS Boot (Size: 1 x 64 GB)
    - 1 SWAP (Size: 1 x 128 GB)
    - 4 Data (Size: 4 x 50 GB)
    - 4 Redo Log (Size: 4 x 50 GB)
    - 1 Oracle Binaries (Size: 1 x 200 GB)

For the purposes of this test, the following Oracle database configurations were used:

- Oracle Instance parameter file init.ora
- Linux HugePages

Oracle Database Instance parameters (e.g.) init.ora

Table 4 shows the settings used during Oracle database testing. AMD recommends using HugePages to optimize performance, because it can substantially improve virtual memory management. An Oracle parameter file (init.ora) was created to define the overall instance configuration, such as how much memory should be allocated to the instance, the file locations, and internal optimization parameters.

Table 4 shows the relevant parameters and their values for the tests performed.

Parameters	8 vCPU	16 vCPU	32 vCPU
NTNXTPCC.__db_cache_size	61 g	121 g	242 g
NTNXTPCC.__large_pool_size	268435456	536870912	1073741824
NTNXTPCC.__shared_io_pool_size	268435456	536870912	1073741824
NTNXTPCC.__shared_pool_size	8321499136	16642998272	33285996544
*.pga_aggregate_target	21 g	42 g	63 g
*.sga_target	69 g	138 g	276g
*.log_buffer	1048576000	1048576000	1073741824
*.db_writer_processes	4	4	4
*.dml_locks	6896	6896	6896
*.parallel_max_servers	640	640	640
*.parallel_min_servers	64	64	64

Table 3 Instance Parameters

HugePages

The HugePages parameter in /etc/sysctl.conf was used in addition to Oracle's recommended OS's sysctl parameters.

Please see Configuring HugePages for Oracle Database* for information on calculating the vm.nr_hugepages parameter via Oracle's script hugepages_settings.sh.

Parameter	8 vCPU	16 vCPU	32 vCPU
vm.nr_hugepages	35500	70700	141350

Table 4 Huge Pages Parameter

HammerDB Client Configuration

The performance benchmarks were executed in parallel execution mode, i.e., running multiple HammerDB clients (Linux user1 to user24) pointing to specific Oracle Database Instances respectively according to the individual ip address and its associated Oracle listener at any given point in time. All the Oracle database instances brought up at the same time and connected to the HammerDB clients respectively.

The HammerDB resource configuration used for testing was:

- vCPU 128
- Memory 256 GB

Test Result Summary

Creating multiple instances on the cluster as shown in Figure 1 demonstrates the value of maximizing performance per VM by saturating both the hosts and the cluster at the same time. Three database sizes were tested as part of the performance test:

- Small with 8 vCPUs
- Medium with 16 vCPUs
- Large with 32 vCPUs.

AMD test validation demonstrates that increasing CPU resources to Oracle Database VMs on AMD EPYC processors running Nutanix HCI software is preferable, as opposed to increasing the performance of the individual Oracle instance. The performance results shown Figure 1 that for Small to Medium instances which are equally divided vCPUs to database instances and performance scaled as per assigned resource and expections. Large instances we have provisioned more vCPU to the individual database instances which resulted in higher cpu utilization and showing the performance chart based on allocated compute resources. Nutanix HCI can leverage AMD EPYC 9004 high frequency x86-architecture server processors. Oracle based OLTP applications show excellent performance and scalability.

Conclusion

Lenovo ThinkAgile HX665 V3 servers integrated with Nutanix Software can help customers optimize their IT infrastructure and streamline operations. Servers powered by AMD EPYC processors deliver outstanding performance with over 500 world records across a broad range of workloads[5]. The above performance results clearly shows that customers can benefit from small, medium, and large Oracle database instances in both SMB and SME organizations. Increasing CPU resources (vCPU) per VM increases overall OLTP performance. High availability features available with Nutanix software offer powerful self-healing, data protection, and disaster recovery capabilities. This solution also offers a high degree of flexibility and scalability that allows you to cost-effectively optimize your IT infrastructure and seamlessly scale as your organization grows.

Related Links

- AMD EPYC Server Processors for Hyperconverged Infrastructure
- AMD Data Center Solutions
- AMD EPYC™ Tech Docs and White Papers Library
- Nutanix*
- Lenovo ThinkAgile HX665 V3 Product Guide*

FOOTNOTES

1. Install Oracle client software on the client machine and configure as per the below instruction
   https://www.hammerdb.com/docs/ch04s02.html#d0e699
2. For a complete list of AMD EPYC world records see https://www.amd.com/en/products/processors/server/epyc/epyc-world-records.html

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