Running Oracle 21c on Lenovo ThinkAgile HX V3 Servers with AMD EPYC 9004 Processors

Last update: **12 June 2025**

Version 1.0

Lenovo hyperconverged infrastructure solution for Oracle deployment with Nutanix

Oracle 21c performance on Lenovo ThinkAgile HX V3 systems with AMD EPYC 9004 Processors and Nutanix software stack

Includes benchmark results and Bill of Material

Chandrakandh Mouleeswaran

Muhammad Ashfaq (AMD)

LENOVO PRESS

Running Oracle 21c on Lenovo ThinkAgile HX V3 Servers with AMD EPYC 9004 Processors

Enterprise Scale Database Infrastructure

Organizations today face increasing challenges related to growing enterprise applications and managing data volumes to meet increased performance, scalability and management of database environments. Lenovo ThinkAgile HX V3 with AMD EPYC 9004 Series processor is a hyperconverged infrastructure (HCI) solution powered by Nutanix software stack provides simplified management, ensuring optimal performance and availability in a hybrid cloud deployment for managing large number of Oracle databases. The solution support linear scaling of compute and storage to address different workloads and applications running on Oracle database and simplifies provisioning, data management, backup and replication of Oracle databases.

Oracle Database

Oracle 21c is a database platform provides industry leading performance, reliability, security and scalability for most demanding transactional and analytical application development requirements deployed in on-premises and cloud. Oracle supports deploying either as single database instance or with Real Application Clusters (RAC) for high availability. Oracle provides several features and tool to improve the performance of database workloads and single-pane-of-glass solutions to consolidate data for different applications and unified view of infrastructure and operations for management, monitoring and troubleshooting.

Oracle Enterprise Manager (OEM) is a tool to manage and monitor Oracle databases and applications across on-premise and cloud and it provides centralized console to perform configuration, backup, recovery, performance tuning, security, auditing, and patching.

True Cache is an in-memory, consistent, and automatically managed SQL cache designed to improve application performance and reduce database server load.

Oracle Database In-Memory provides optimizations to run billions of rows per second on each CPU core and enables real time business decisions by speeding up transaction processing.

Oracle Spatial database capabilities enable users to manage, store, index, and analyze geospatial data offering enhancements in performance, ease of use, and integration with other Oracle Database features.

Multitenant architecture enables an Oracle Database to function as a container database (CDB). A CDB consolidates multiple pluggable databases (PDB), a portable collection of schemas, schema objects, and non-schema objects. It enables large scale database consolidation and improves centralized management and lifecycle and simplified point in time recovery at the individual database level.

Lenovo ThinkAgile HX V3 Servers

Lenovo ThinkAgile HX Series V3 servers powered by AMD EPYC 9004 processors provide increased performance, bandwidth and speed. Lenovo ThinkAgile HX V3 servers are available as Integrated Systems and Certified Nodes. Both are pre-validated and factory integrated systems with Lenovo hardware, Nutanix software, and deployment services. Integrated systems provide a quick and convenient path to implement a hyperconverged solution powered by Nutanix and a single point of contact provided by Lenovo for purchasing, deploying, and supporting the solution. HX Certified Nodes come with optional Nutanix software and services. All ThinkAgile HX V3 models support configurations for all flash and hybrid storage deployment.

Lenovo ThinkAgile HX665 V3 (2U)

The Lenovo ThinkAgile HX665 V3 Integrated Systems and Certified Nodes are 2-socket 2U systems supports up to 96 cores per processor with fourth-generation AMD EPYC 9004 processors. High frequency processors optimize per core performance and license costs.

The server supports up to 6TB memory and 20 NVMe SSDs and 24 SAS/SATA SSDs and it is an ideal choice for high performance database workloads and provides higher consolidation ratio.

Key Advantages of running Oracle on Lenovo ThinkAgile HX V3

- **Software Defined Infrastructure:** Nutanix's HCI solution reduces latency and maximizing resource utilization for optimal PostgreSQL performance. ThinkAgile HX V3 servers with AMD EPYC 9004 Processors provide superior performance and higher consolidation ratio.
- **Simplified Management:** Nutanix Prism, Nutanix Cloud Platform (NCI) and Nutanix Kubernetes Engine (NKE) provides centralized management capabilities for streamlined database deployment across on premise and clouds, monitoring, automation, and scalability, significantly reducing operational complexity and administrative overhead.
- **DBaaS:** Nutanix Database Service (NDB) is a hybrid multicloud database-as-a service for Oracle to deliver a seamless developer experience, simplified database management, and end-to-end support. It provides self-service provisioning, large scale database deployments to meet performance, availability and security requirements.
- **Disaster Recovery and Availability:** Nutanix platform offers features like remote replication and metro-level availability to protect against hardware and software failures. Oracle replication options such as Data Guard and Golden gate are compatible with Nutanix.

- **Backup :** Nutanix supports using RMAN and third-party backup software such as Veeam to back up Oracle databases. NDB supports application-consistent backups to backup multiterabyte Oracle databases

Best Practices for Oracle deployment

- Set the BIOS UEFI operating mode to Maximum performance
- Use separate disks for data, redo and archive files
- Size Nutanix CVM resources appropriately
- Use RAC to achieve high availability
- Avoid auto extend for schema and undo tablespaces for better performance
- Create big file tablespace for schema
- Create multiple data files of large size (maximum 32767MB) for Undo tablespaces
- Create enough huge pages and use table partitioning
- Use Oracle Automatic Database Diagnostic Monitor (ADDM) to monitor database and tune appropriately
- Provide enough memory for System Global Area(SGA) and Program Global Area(PGA)
- Disbale logging for better performance
- Set online log retension period to long enough to avoid frequent flush to disk

Performance Testing Details and Results

HammerDB Configuration

HammerDB is an open-source database transactional and analytics load testing/benchmarking tool for databases. The OLTP workload is derived from the TPC-C Benchmark standard, and it is not comparable to published TPC-C and do not comply with the TPC-C benchmark standards. The testing described below used HammerDB instance running on a separate server. The testing was performed on 4 node ThinkAgile HX665 V3 cluster with the following configuration parameters for operating system and Oracle database.

Table 1. TPC-C performance testing hardware configuration

Component	Details
Server	4 x 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. TPC-C performance testing details and results

Size	**Small**	**Medium**	**Large**
VM Configuration	8 vCPU, 128 GB Memory	16 vCPU, 256 GB Memory	32 vCPU, 512 GB Memory
Disk	OS Boot 1 x 64 GB Swap 1 x 128 GB Data 4 x 50 GB Redo Log 4 x 50 GB Oracle Binaries 1 x 200 GB	OS Boot 1 x 64 GB Swap 1 x 128 GB Data 4 x 50 GB Redo Log 4 x 50 GB Oracle Binaries 1 x 200 GB	OS Boot 1 x 64 GB Swap 1 x 128 GB Data 4 x 50 GB Redo Log 4 x 50 GB Oracle Binaries 1 x 200 GB
Number of VMs/host	6	3	2
CVM Size	16 vCPU, 64 GB Memory	16 vCPU, 64 GB Memory	16 vCPU, 64 GB Memory
Number of warehouses	50	100	150
Virtual Users	18	48	80
Ramp Up	2 mins	2 mins	2 mins

Test Duration	15 mins	15 mins	15 mins
Average TPM per VM	**324619**	**628133**	**869210**
Transactions Per Minute (TPM)	**7.79 million**	**7.5 million**	**6.95 million**

Table 3.Oracle Database Instance parameters

Parameters	**Small** **8 vCPU**	**Medium** **16 vCPU**	**Large** **32 vCPU**
db_cache_size	61 g	121 g	242 g
large_pool_size	268435456	536870912	1073741824
shared_io_pool_size	268435456	536870912	1073741824
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

Bill of Materials: ThinkAgile HX665 V3 Integrated System

Part number	**Product Description**	**Qty**
7D9NCTO1WW	Server : ThinkAgile HX665 V3 Integrated System	1
BSQL	HX665 V3	1
BVGL	Data Center Environment 30 Degree Celsius / 86 Degree Fahrenheit	1
B15S	Nutanix SW Stack on Nutanix AHV	1
B0W1	3 Years	1
BM84	ThinkAgile HX Remote Deployment	1
BVKV	Nutanix Cloud Platform (NCP) Pro Software License with Mission Critical Support	1
BREC	ThinkSystem AMD EPYC 9334 32C 210W 2.7GHz Processor	2
BQ29	ThinkSystem SR665 V3 2U High Performance Heatsink	2
BQ3D	ThinkSystem 64GB TruDDR5 4800MHz (2Rx4) 10x4 RDIMM-A	8
BC4V	Non RAID NVMe	1

BH8D	ThinkSystem 2U/4U 8x2.5" NVMe Backplane	2
B0SW	Nutanix Flash Node Config	1
C6M3	ThinkSystem 2.5" U.2 Solidigm P5620 3.2TB Mixed Use NVMe PCIe 4.0 x4 HS SSD	4
B8P9	ThinkSystem M.2 NVMe 2-Bay RAID Adapter	1
BTTY	M.2 NVMe	1
BXMH	ThinkSystem M.2 PM9A3 960GB Read Intensive NVMe PCIe 4.0 x4 NHS SSD	2
BN2T	ThinkSystem Broadcom 57414 10/25GbE SFP28 2-Port OCP Ethernet Adapter	1
BPQU	ThinkSystem V3 2U x16/x8/x8 PCIe Gen5 Riser 1 or 2	1
BPK9	ThinkSystem 1800W 230V Titanium Hot-Swap Gen2 Power Supply	2
6400	2.8m, 13A/100-250V, C13 to C14 Jumper Cord	2
BLL6	ThinkSystem 2U V3 Performance Fan Module	6
B8LA	ThinkSystem Toolless Slide Rail Kit v2	1
BQQ2	ThinkSystem 2U V3 EIA Latch Standard	1
BPKR	TPM 2.0	1
BQ2B	ThinkSystem SR665 V3 MB	1
C8WQ	SR665 V3 Laser service indicator	1
B6C1	Node Cores	64
B6C2	Node Tebibytes	12
9220	Preload by Hardware Feature Specify	1
5977	Select Storage devices - no configured RAID required	1
BRPJ	XCC Platinum	1
B7Y0	Enable IPMI-over-LAN	1
BK15	High voltage (200V+)	1
BHSS	MI for PXE with RJ45 Network port	1
BTT7	ThinkAgile HX665 V3 IS	1
ATSB	Nutanix Solution Code MFG Instruction	1
BU8W	ThinkAgile HX665 V3 - Nutanix IP	1
BPK3	ThinkSystem WW Lenovo LPK	1
AUTQ	ThinkSystem small Lenovo Label for 24x2.5"/12x3.5"/10x2.5"	1
BSYD	ThinkSystem SR665 V3 PCIe Gen4 Cable, Swiftx8-SLx8, 350mm	2
BPE0	ThinkSystem SR650 V3 MCIO8x to SL8x CBL, PCIe4, 8x2.5AnyBay, 650mm	2
BPDZ	ThinkSystem SR650 V3 MCIO8x to SL8x CBL, PCIe4, 8x2.5AnyBay, 530mm	2
BS6Y	ThinkSystem 2U V3 M.2 Signal & Power Cable, SLx4 with 2X10/1X6 Sideband, 330/267/267mm	1
BR69	Cable32	2
BMPF	ThinkSystem V3 2U Power Cable from MB to Front 2.5" BP v2	2
BE0C	N+1 Redundancy Without Over-Subscription	1
B986	ThinkSystem HV 2U WW General PKG BOM	1
BQ15	G5 x16/x8/x8 PCIe Riser BPQU for Riser 1 Placement	1
AVEN	ThinkSystem 1x1 2.5" HDD Filler	8
BQ31	ThinkSystem MS 2U common Airduct Filler	2

B8MM	ThinkSystem 2U MS 3FH Riser Filler	1
BC4X	MS 2FH Riser Filler	1
AVEP	ThinkSystem 4x1 2.5" HDD Filler	1
AVEQ	ThinkSystem 8x1 2.5" HDD Filler	1
C1QN	Warranty Services Upgrade	1
BXGY	Right EIA with FIO assembly	1
BQ2Z	ThinkSystem 2U MS main Airduct	1
BPKD	ThinkSystem 2U MS 3FH Riser 1&2 Cage w/Label1	1
BQQ6	ThinkSystem 2U V3 EIA right with FIO	1
BQ35	ThinkSystem SR665 V3 Absolut-RoW RoT Module	1
7S0PCTO3WW	Nutanix P&P Software for ThinkAgile HX	1
SAPU	Nutanix Cloud Platform Pro, Mission Critical Support Per Core, 3Yr	64
7S0XCTO5WW	XClarity Controller Platin-FOD	1
SBCV	Lenovo XClarity XCC2 Platinum Upgrade (FOD)	1
5WS7C01439	3Yr Premier 24x7 4Hr Resp ThinkAgile IS HX665 V3	1
5PS7C01448	3Yr KYD Add-On ThinkAgile IS HX665 V3	1
5MS7B00045	ThinkAgile HX Remote Deployment (up to 3 node cluster)	1

References:

Lenovo ThinkAgile HX665 V3 Integrated System and Certified Node
https://lenovopress.lenovo.com/lp1649.pdf

Oracle on Nutanix Best Practices
https://portal.nutanix.com/page/documents/solutions/details?targetId=BP-2000-Oracle-on-Nutanix:BP-2000-Oracle-on-Nutanix

Nutanix Validated Design(NVD) for Nutanix Database Service
https://portal.nutanix.com/page/documents/solutions/details?targetId=NVD-2155-Nutanix-Databases:NVD-2155-Nutanix-Databases

AMD Data Center Solutions
https://www.amd.com/en/products/processors/server/epyc.html

Trademarks and special notices

References in this document to Lenovo products or services do not imply that Lenovo intends to make them available in every country.

Lenovo, the Lenovo logo, ThinkSystem, ThinkAgile, ThinkCentre, ThinkVision, ThinkVantage, ThinkPlus and Rescue and Recovery are trademarks of Lenovo.

IBM, the IBM logo, and ibm.com are trademarks or registered trademarks of International Business Machines Corporation in the United States, other countries, or both.

Microsoft, Windows, Windows NT, and the Windows logo are trademarks of Microsoft Corporation in the United States, other countries, or both.

Intel, Intel Inside (logos), MMX, and Pentium are trademarks of Intel Corporation in the United States, other countries, or both.

Other company, product, or service names may be trademarks or service marks of others.

Information is provided "AS IS" without warranty of any kind.

All customer examples described are presented as illustrations of how those customers have used Lenovo products and the results they may have achieved. Actual environmental costs and performance characteristics may vary by customer.

Information concerning non-Lenovo products was obtained from a supplier of these products, published announcement material, or other publicly available sources and does not constitute an endorsement of such products by Lenovo. Sources for non-Lenovo list prices and performance numbers are taken from publicly available information, including vendor announcements and vendor worldwide homepages. Lenovo has not tested these products and cannot confirm the accuracy of performance, capability, or any other claims related to non-Lenovo products. Questions on the capability of non-Lenovo products should be addressed to the supplier of those products.

All statements regarding Lenovo future direction and intent are subject to change or withdrawal without notice and represent goals and objectives only. Contact your local Lenovo office or Lenovo authorized reseller for the full text of the specific Statement of Direction.

Some information addresses anticipated future capabilities. Such information is not intended as a definitive statement of a commitment to specific levels of performance, function or delivery schedules with respect to any future products. Such commitments are only made in Lenovo product announcements. The information is presented here to communicate Lenovo’s current investment and development activities as a good faith effort to help with our customers' future planning.

Performance is based on measurements and projections using standard Lenovo benchmarks in a controlled environment. The actual throughput or performance that any user will experience will vary depending upon considerations such as the amount of multiprogramming in the user's job stream, the I/O configuration, the storage configuration, and the workload processed. Therefore, no assurance can be given that an individual user will achieve throughput or performance improvements equivalent to the ratios stated here.

Photographs shown are of engineering prototypes. Changes may be incorporated in production models.

Any references in this information to non-Lenovo websites are provided for convenience only and do not in any manner serve as an endorsement of those websites. The materials at those websites are not part of the materials for this Lenovo product and use of those websites is at your own risk.