Transforming business intelligence: PCIe Gen5 NVMe SSDs propel performance to new heights

Business intelligence / decision support systems workloads (BI/DSS) can give organizations an edge in logistics, healthcare, and retail, among many other use cases.[1]

Logistics: Optimize delivery routes
BI/DSS can plan the most efficient delivery routes, reduce fuel consumption, and shorten delivery times through route optimization.

Healthcare: Clinical decision support
Healthcare providers can utilize BI/DSS to analyze patient and population data, allowing them to predict potential health risks to help optimize outcomes.

Retail: Forecasting
Retailers can use BI/DSS to help predict future sales trends, manage inventory, and increase margins.

This technical brief highlights work done by Advanced Micro Devices (AMD). It demonstrates the performance uplift of a PCIe Gen5 SSD (Micron® 9550 NVMe™ SSD) compared to a PCIe Gen4 NVMe SSD (Micron 7450 NVMe SSD) using the popular, open-source PostgreSQL in a decision support workload.[2] It shows results using an SF1000 (1TB) and an SF300 (300GB) data set. Results are normalized to the PCIe Gen4 Queries per Hour (QphH) values.

About the HammerDB TPROC-H workload: The HammerDB TPROC-H workload is an open-source benchmark derived from the TPC-H Standard. It measures a system's performance in executing complex queries and handling large data volumes, making it ideal for testing database performance in decision support systems.[3]

About PostgreSQL: PostgreSQL is a reliable, open-source database that excels in various market segments. It supports complex queries and large datasets, making it well-suited for mission-critical applications. As of March 2025, PostgreSQL ranks 4th in database popularity.[4]

Key findings

Testing showed improvements in database queries per hour (QphH) BI/DSS metrics enabled by PCIe Gen5 SSDs for both tested data set sizes.

The performance increase from PCIe Gen4 to PCIe Gen5 SSDs is based on the tested database size. Results may vary with different databases.[5]

1.45X **QphH @SF1000 improvement (1TB data set)**

1.33X **QphH @SF300 improvement (300GB data set)**

Throughput@size (1TB and 300GB) measures the system's query throughput when multiple concurrent users submit queries. It indicates the system's capability to manage multiple queries simultaneously.

The Micron 9550 NVMe™ SSD is a high-performance data center SSD, offering leading PCIe® Gen5 performance, flexibility, and security[6] for AI and beyond.

micron.com/9550

The Micron 7450 NVMe™ SSD offers exceptional quality-of-service and PCIe® Gen4 with extensive security[6] and deployment options.

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1. For additional information on BI/DSS workload use cases, see *"How do businesses use decision support systems (DSS)"* on decisionmakershub.com.
2. The PCIe Gen5 NVMe SSD tested was the Micron 9550 SSD. The PCIe Gen5 NVMe SSD tested was the Micron 7450 SSD.
3. See https://www.hammerdb.com/docs/ch11s01.html for additional information on this workload.
4. See https://db-engines.com/en/ranking for additional information on database ranking.
5. In the context of benchmarks, "@size" refers to the size of the database against which the performance metrics are measured. For additional information, see https://www.tpc.org/tpch/.
6. No hardware, software, or system can provide absolute security under all conditions. Micron assumes no liability for lost, stolen or corrupted data arising from the use of any Micron products, including those products that incorporate any of the mentioned security features.

PCIe Gen5 SSDs offer a significant application performance uplift.

Like many data-intensive workloads, BI/DSS on PostgreSQL leverages SSD performance to support its primary delivery: high QphH. As expected, the greater bandwidth and data transfer rates of the PCIe Gen5 SSD are relative to a PCIe Gen4 PCIe SSD aligned to distinct QphH advantages, as seen in both data sets (Figures 1 and 2 below).

The PCIe Gen5 SSD showed 1.45X the QphH of the PCIe Gen4 SSD when tested using SF1000 (1TB dataset) and 1.33X the QphH when tested using SF300 (300GB dataset). These performance uplifts make the PCIe Gen5 SSD an excellent choice where the highest BI/DSS QphH is a deciding factor. At the same time, the PCIe Gen4 SSD is an excellent solution for tasks that require mainstream QphH performance from their RDBMS (Relational Database Management System) platform.

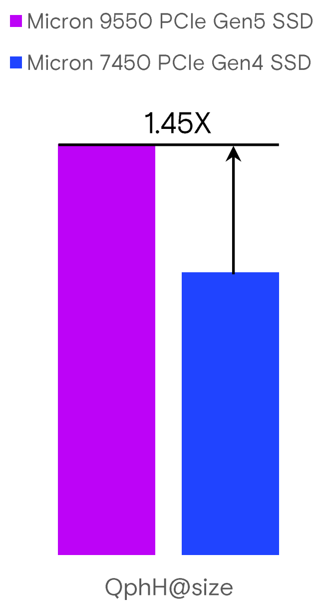

Figure 1: SF1000 results

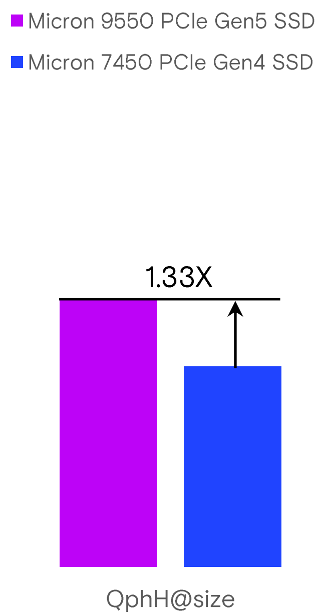

Figure 2: SF300 results

Conclusion

This testing conducted by Advanced Micro Devices (AMD) demonstrates significant performance improvements can be realized with the PCIe Gen5 SSD compared to the PCIe Gen4 SSD. The results showed a 1.45X increase in database queries per hour (QphH) for the 1TB dataset and a 1.33X increase for the 300GB dataset. These findings highlight the superior capabilities of the PCIe Gen5 SSD in handling high-demand business intelligence and decision support system workloads.

Test methodology

AMD used the HammerDB benchmark tool to build and generate the PostgreSQL TPROC-H workloads at SF1000 and SF300. The HammerDB TPROC-H workload is an open-source workload derived from the TPC-H Benchmark Standard and, as such, is not comparable to published TPC-H results, as the results do not comply with the TPC-H Benchmark Standard.

The 5th Gen AMD EPYC (formerly codenamed "Turin") system, described in Table 1 below, ran the workload three times with each SSD, and the median performance was then calculated and used in the analysis. The reported performance uplift was calculated as the median PCIe Gen5 SSD QphH performance divided by the median PCIe Gen4 SSD QphH performance. The maximum boost for AMD EPYC processors is the maximum frequency achievable by any single core on the processor under normal operating conditions for server systems.

AMD NODE CONFIGURATION	
CPUs	1 x AMD EPYC 9355P
Frequency: Base | Boost[7]	3.55 GHz | 4.40 GHz (up to)
Cores	32 cores/socket (64 threads)
L3 Cache	256 MB per CPU
Memory	704 GB DDR5-6400 (11 x 64GB DIMMS), 1 DPC [SF1000] 176 GB DDR5-5200 (11 x 16 GB DIMMs), 1 DPC [SF300]
Storage	1 x Micron 7450 PCIe Gen4 NVMe SSD 7.68TB (reference SSD)[8] 1 x Micron 9550 PCIe Gen5 NVMe SSD 7.68TB (test SSD)
BIOS Version	RPUT1002D
BIOS Settings	SMT=ON, NPS=1, Determinism=Power
OS	Ubuntu® 24.04.1 LTS (kernel 6.8.0-48-generic)
OS Settings	vm.swappiness=1 kernel.sem=250 32000 100 128 fs.file-max=6815744 net.ipv4.ip_lo-cal_port_range=9000 65500 net.core.rmem_default=262144, net.core.rmem_max=4194304 net.core.rmem_default=262144 net.core.wmem_max=1048576 fs.aio-max-nr=1048576
PostgreSQL Version	14.15
PostgreSQL Tunings	SF300: shared_buffers=80GB huge_pages=ON, wal_level=minimal effective_io_concurrency=16 synchronous_commit=local SF1000: shared_buffers = 540GB effective_cache_size = 24MB wal_buffers = 1024MB max_wal_size = 80GB min_wal_size = 40GB wal_level = replica

Table 1: Configuration details

7. The maximum boost for AMD EPYC processors is the maximum frequency achievable by any single core on the processor under normal operating conditions for server systems as per AMD.
8. Unformatted. 1GB = 1 billion bytes. Formatted capacity is less.