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DATA STREAMING PERFORMANCE

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Self-Hosted Database Transactional

Performance Testing

Enterprise DB
Microsoft SQL Server

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Executive Summary

A self-hosted database provides control, security, cost-effectiveness, flexibility and compliance. It allows organizations to customize and optimize performance, ensuring data resides securely within their infrastructure.

Performance in these databases is critical. By enabling fast transaction processing, low latency, high throughput and scalability, performance profoundly impacts the user experience, business operations and data integrity. Slow performance frustrates users, hindering productivity and satisfaction, while delays in transaction processing affect revenue and competitiveness. Moreover, poor performance increases the risk of data corruption and loss.

Scalability is also compromised by inefficient performance, limiting growth and causing system overload. Furthermore, performance vulnerabilities create security risks, providing entry points for cyber threats. Resource utilization is also affected, wasting computing resources.

High performance ensures seamless transactions, efficient data processing and reliable operations. It maintains organizational credibility, prevents maintenance complexities and safeguards against security threats. Effective performance is essential. Organizations that prioritize performance benefit.

By investing in the most fit database, including consideration of performance, companies can ensure their applications are running smoothly and securely, ultimately leading to better overall business outcomes.

EnterpriseDB (EDB) is a leading provider of enterprise-class data management solutions that help organizations achieve optimal database performance. Their expertise in database optimization and compliance ensures that businesses can operate efficiently and securely, driving success in today's competitive landscape.

We tested EnterpriseDB against popular database SQL Server to determine what, if any, would be the performance, cost difference and the potential worth of going beyond enterprise agreements for a self-hosted transactional database. We used HammerDB TPROC-C, based on TPC-C which is a widely recognized benchmark for measuring database performance.

The results showed that EnterpriseDB outperformed SQL Server in terms of speed and cost-effectiveness, making it a top choice for businesses looking to optimize their database operations. This is well worth it for a critical application that requires high performance and cost efficiency.

The HammerDB TPROC-C benchmark results show that EDB and SQL Server perform well under varying concurrency levels. EDB consistently outperforms SQL Server, making it suitable for demanding enterprise environments. Peak performances are reached at 32 virtual users.

EDB's cost-effectiveness is noteworthy, with a mere $0.21 per unit, compared to SQL Server's $1.26. In a 3-year comparison, EDB ($205,605) offers substantial cost savings compared to SQL Server ($957,768). EDB's superior performance makes it ideal for mixed enterprise workloads where efficient resource utilization and concurrency management are crucial for maximizing high transaction throughput as well as handling large volumes of semi-structured data.

These tests highlight EDB's compelling value proposition, making it a prime choice for enterprises seeking a single database as a high-performance transactional database without breaking the bank.

Platforms

EDB

EnterpriseDB is an open-source relational database management system based on PostgreSQL. It offers enterprise-class features, scalability and reliability. EnterpriseDB supports various platforms and programming languages. Its security features include encryption, row-level security and multi-factor authentication. EnterpriseDB's flexibility makes it suitable for web, cloud and on-premises applications.

SQL Server

Microsoft SQL Server is a comprehensive relational database management system. It offers robust security, scalability and performance. SQL Server supports advanced analytics, machine learning and data visualization. Its features include encryption, access control and auditing. High availability, disaster recovery and backup options ensure data protection. SQL Server integrates seamlessly with Microsoft tools and platforms.

Platform Summary

For the transactional performance study, we tested the following releases of the platforms:

Vendor	EDB Postgres	Microsoft SQL Server
Tier	Advanced Server	Enterprise 2022
Version	17.2	CU15 (16.0.4145.4)
OS	RHEL 9	RHEL 9

Setup

This section analyzes the methods we used in our database transactional testing.

AWS EC2 Instances

To perform our testing, we used Amazon Web Services EC2 instances. We chose the following EC2 instance types for their high memory and attached NVMe storage:

Instance Type	i4i.8xlarge
Processors	32 vCPU Intel Xeon Scalable Ice Lake Processors
RAM	256 GB
Disks	Root on EBS gp3 + Data on 2x 3,750GB NVMe SSD Mirrored Disks (RAID1)

For each EC2 instance, we installed the database software and HammerDB as specified in the previous section. See the **Appendix** for all configuration settings used.

Transactional Workload: HammerDB TPROC-C

The workload and data used in the transactional test were a workload derived from the well-recognized industry standard benchmark TPC-C. From tpc.org[1]:

> "TPC-C is an on-line transaction processing (OLTP) benchmark. TPC-C involves a mix of five concurrent transactions of different types and complexity either executed on-line or queued for deferred execution. The database is comprised of nine types of tables with a wide range of record and population sizes. TPC-C is measured in transactions per minute (tpmC). While the benchmark portrays the activity of a wholesale supplier, TPC-C is not limited to the activity of any particular business segment, but, rather represents any industry that must manage, sell, or distribute a product or service."

However, this is NOT an official TPC-C benchmark, and the results are not comparable with other published TPC-C results, as the HammerDB implementation does not comply with all requirements of the TPC-C benchmark. To perform a TPC-C-like workload, most people use a driver that is already built. There are several TPC-C-like drivers available for free. We used HammerDB 4.11[2].

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[1] More can be learned about the TPC-C benchmark at http://www.tpc.org/tpcc/.

[2] For more information about or to download HammerDB, visit https://www.hammerdb.com/.

Transactional Test Measurements

Our benchmark collected two measurements.

- **NOPM (New Orders Per Minute)** – measures the throughput of new order transactions that a system can handle per minute, reflecting its transaction processing capability.
- **Price-Performance** – measures the cost-effectiveness of a system by calculating the total price per transaction per minute (NOPM), indicating how efficiently the system performs transactions relative to its price.

NOPM and Price-Performance are pivotal measurements for evaluating self-hosted transactional databases. NOPM assesses transaction throughput, scalability and real-world applicability by measuring the database's ability to process transactions efficiently, handle concurrent requests and simulate real-world workloads. Price-Performance evaluates cost-effectiveness, comparing performance to costs, enabling value assessments across databases and optimizing resource allocation.

These measurements are chosen for their relevance to transactional use cases, facilitating comparability across databases and informing optimization, scaling and cost management decisions. By considering NOPM and Price-Performance, users gain comprehensive insights into database performance, scalability and cost-effectiveness, guiding informed decisions for optimal database selection and configuration.

Results

This section analyzes the results of our transactional and NoSQL workload scenarios for the platforms we tested.

Transactional NOPM (New Orders Per Minute)

The following chart shows the NOPM of the three databases at various levels of virtual (concurrent) users, up to 320. A typical concurrency load for an enterprise workload similar to TPC-C can vary but average ranges are probably in the 25-75 range.

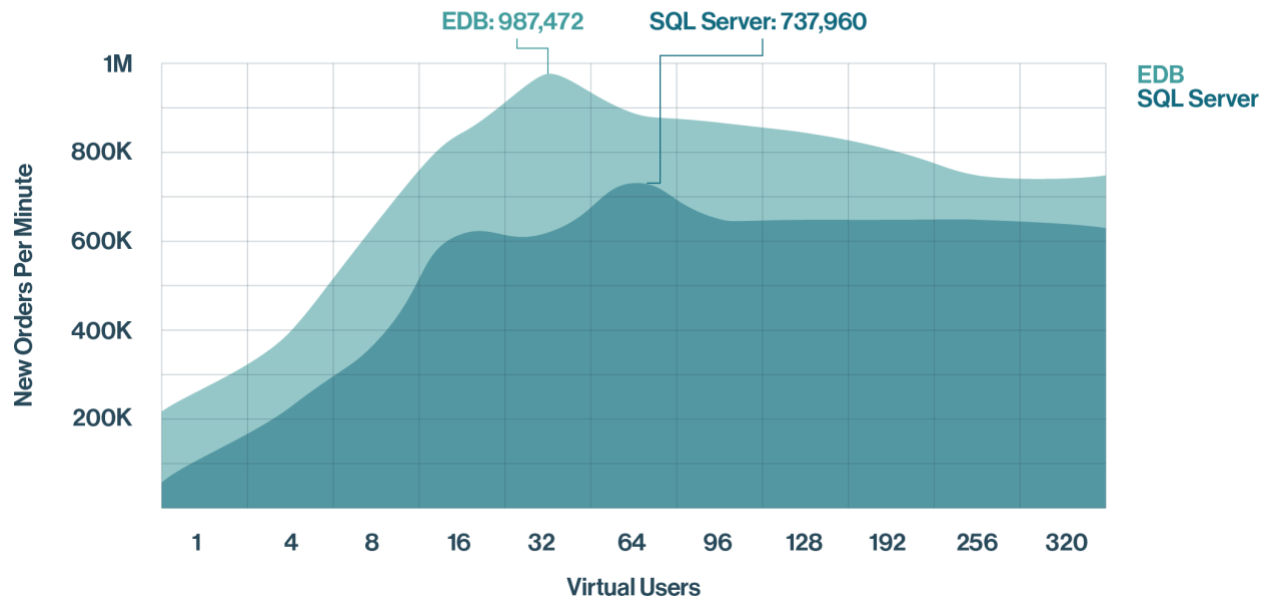### HammerDB TPC-C on i4i.8xlarge using 1,000 warehouses

Figure 1: New Orders Per Minute by Number of Virtual (Concurrent) Users

The HammerDB TPROC-C benchmark results offer valuable insights into EDB and SQL Server performance under varying concurrency levels. Notably, both databases exhibit scaling improvements up to 64 virtual users, indicating efficient resource utilization. However, beyond this point, NOPM growth slows or declines, signaling concurrency limits.

EDB consistently outperforms SQL Server, showcasing its suitability for demanding enterprise environments. Peak performances were reached between 32 and 64 virtual users: EDB (987,472 NOPM) and SQL Server (758,682 NOPM).

These findings have significant implications. EDB's superior performance makes it ideal for high-concurrency enterprise workloads. Efficient resource utilization and

concurrency management are crucial for maximizing NOPM. Understanding scalability limits informs capacity planning and infrastructure investments. Database selection should be informed by performance benchmarking.

Price-Performance

EDB took the top spot for maximum New Orders Per Minute (NOPM), processing an impressive 987,472 transactions. SQL Server trailed at 758,682 NOPM.

However, the real surprise came with price-performance comparisons. EDB's cost-effectiveness shone, boasting a mere $0.21 per unit. SQL Server's $1.26 rendered them 6 times more expensive.

This stark pricing disparity underscores EDB's compelling value proposition. Its unparalleled performance, coupled with unmatched affordability, makes it a prime choice for enterprises seeking high-performance transactional databases without breaking the bank.

Key takeaways

1. EDB excelled in transactional performance.
2. SQL Server trailed in performance.
3. EDB offered superior price-performance.
4. SQL Server was significantly pricier.

For enterprises demanding high-performance, cost-effective transactional databases, EDB stands out as the optimal solution.

Total Cost

We compared the total cost for the transactional competitors.

A cost comparison of EnterpriseDB (EDB) and SQL Server on AWS reveals significant pricing disparities. Instance costs were held identical at $24,055/year. Software licensing costs differ substantially: EDB's per-core licensing ($2,780) and SQL Server's 2-core pack ($15,123).

Support costs also vary: EDB's is included and SQL Server's ($3,327). Total annual costs were $68,535 (EDB) and $319,256 (SQL Server). The three-year projections are $205,605 (EDB) and $957,768 (SQL Server).

The implications are clear. **EDB's per-core licensing offers substantial savings, making it a cost-effective choice.** Support costs significantly impact total expenses.

Enterprises must carefully evaluate licensing models, factor support costs and consider long-term commitments to optimize database expenditures.

	EDB	SQL Server
Edition	Enterprise	Enterprise
Cloud	AWS	AWS
Region	US East 1	US East 1
Instance Type	i4i.8xlarge	i4i.8xlarge
vCPU	32	32
Instance $/hour	$2.746	$2.746
Instance $/year	**$24,055**	**$24,055**
Software UoM	Per Core	2 Core Pack
Software Units	16	16
Software Period	Annual	Annual
Software $/unit	$2,780	$15,123
Support $/unit	included	$3,327
Software + Support $/unit	**$2,780**	**$18,450**
Software + Support $/year	**$44,480**	**$295,201**
3 Year Cost	**$205,605**	**$957,768**

Conclusion

EDB offers cost-effective per-core licensing, compared to SQL Server's two-core pack. It performs better in demanding business settings, with 32 virtual users achieving peak performance. EDB processed the highest New Orders Per Minute (NOPM) total, with each unit costing $0.21, compared to SQL Server's $1.26. Support charges significantly impact total expenses.

EDB offers enterprises significant benefits through its cost-effective per-core licensing, superior performance and lower support charges. EDB's scalability, reliability and streamlined operations enhance financial efficiency, reducing Total Cost of Ownership. Its competitive pricing ($0.21/unit vs. SQL Server's $1.26) and peak performance with 32 virtual users make it ideal for demanding business settings. EDB is vastly cheaper than SQL Server over three years.

By choosing EDB, enterprises boost return on investment, gain budget flexibility and drive strategic growth through innovation and digital transformation, ensuring a forward-thinking technology infrastructure, all in a single database.

Appendix: Test Configuration

We tested each platform under the following configurations and conditions:

EDB

For the disk configuration, we moved **pgdata** and **pg_wal** to the mirrored NVMe disks.
In the **edb-as-17.service** configuration file, we added:

```
After=tuned.service
```

In **postgresql.conf**, we changed:

```
max_connections = 1000
shared_buffers = 64GB
effective_cache_size = 128GB
work_mem = 8MB
maintenance_work_mem = 64GB
autovacuum_work_mem = 1GB
effective_io_concurrency = 200
maintenance_io_concurrency = 200
max_worker_processes = 128
max_parallel_maintenance_workers = 64
synchronous_commit = on
wal_level = replica
wal_buffers = 512MB
checkpoint_timeout = 1d
checkpoint_completion_target = 0.9
max_wal_size = 1TB
min_wal_size = 64GB
random_page_cost = 1.0
vacuum_cost_limit = 8000
autovacuum = off
autovacuum_freeze_max_age = 800000000
autovacuum_multixact_freeze_max_age = 800000000
max_locks_per_transaction = 512
edb_dynatune = 0
```

In **HammerDB**, we used the following build parameters:

```
diset tpcc pg_count_ware 1000
diset tpcc pg_num_vu 32
diset tpcc pg_oracompat false
diset tpcc pg_storedprocs false
diset tpcc pg_partition true
```

Also in **HammerDB**, we used the following run parameters:

```
diset tpcc pg_allwarehouse true
diset tpcc pg_oracompat false
diset tpcc pg_storedprocs false
diset tpcc pg_vacuum true
```

SQL Server

For the disk configuration, we moved the **data, log, and temp files** to the mirrored NVMe disks.

In **sqlcmd**, we ran:

```
EXEC sp_configure 'show advanced options', 1;
GO
RECONFIGURE WITH OVERRIDE;
GO
EXEC sp_configure 'max degree of parallelism', 1;
GO
RECONFIGURE WITH OVERRIDE;
GO
```

As **root**, we made the following OS and SQL Server changes:

```
sudo sysctl kernel.sched_min_granularity_ns=10000000
sudo sysctl kernel.sched_wakeup_granularity_ns=15000000
sudo sysctl vm.dirty_ratio=40
sudo sysctl vm.dirty_background_ratio=10
sudo sysctl vm.swappiness=10
sudo sysctl -w vm.max_map_count=262144
sudo sysctl -w kernel.numa_balancing=0
sudo /opt/mssql/bin/mssql-conf set filelocation.defaultdatadir /data
sudo /opt/mssql/bin/mssql-conf set filelocation.defaultlogdir /log
sudo /opt/mssql/bin/mssql-conf set network.tlsprotocols 1.2
sudo /opt/mssql/bin/mssql-conf traceflag 3979 on
sudo /opt/mssql/bin/mssql-conf set control.writethrough  1
sudo /opt/mssql/bin/mssql-conf set control.alternatewritethrough  0
sudo /opt/mssql/bin/mssql-conf set memory.memorylimitmb 235900
```

In **HammerDB**, we used the following build parameters:

```
diset tpcc mssqls_count_ware 1000
```

Also in **HammerDB**, we used the following run parameters:

```
diset tpcc mssqls_allwarehouse true
```

About EnterpriseDB

Nearly 1,500 customers worldwide have chosen EDB software, services, and support.

Enterprises and governments around the globe trust EDB to harness the full power of Postgres. With unmatched expertise, EDB ensures high availability, reliability, security, 24x7 global support and advanced professional services, both on premises and in the cloud, to help you control risk, manage costs and scale efficiently. As a leading contributor to the growing Postgres community, EDB is committed to driving technology innovation.

As your organization grows, you need strong strategies for the technologies you bet on. Postgres delivers superior technology, powered by a thriving, vibrant and fast-growing community. To accelerate your Postgres journey, and to run Postgres as your enterprise database standard, you need EDB.

EDB is the heartbeat of Postgres, with hundreds of technologists and developers, and more open source contributions to Postgres than any other company. EDB drives innovation, with enterprise-class software and services that enable businesses and governments globally to harness the full power of Postgres, the world's leading database.

About McKnight Consulting Group

Information Management is all about enabling an organization to have data in the best place to succeed to meet company goals. Mature data practices can integrate an entire organization across all core functions. Proper integration of that data facilitates the flow of information throughout the organization which allows for better decisions – made faster and with fewer errors. In short, well-done data can yield a better run company flush with real-time information... and with less costs.

However, before those benefits can be realized, a company must go through the business transformation of an implementation and systems integration. For many that have been involved in those types of projects in the past – data warehousing, master data, big data, analytics - the path toward a successful implementation and integration can seem never-ending at times and almost unachievable. Not so with McKnight Consulting Group (MCG) as your integration partner, because MCG has successfully implemented data solutions for our clients for over a decade. We understand the critical importance of setting clear, realistic expectations up front and ensuring that time-to-value is achieved quickly.

MCG has helped over 100 clients with analytics, big data, master data management and "all data" strategies and implementations across a variety of industries and worldwide locations. MCG offers flexible implementation methodologies that will fit the deployment model of your choice. The best methodologies, the best talent in the industry and a leadership team committed to client success makes MCG the right choice to help lead your project.

MCG, led by industry leader William McKnight, has deep data experience in a variety of industries that will enable your business to incorporate best practices while implementing leading technology. See www.mcknightcg.com.

Disclaimer

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