

# kaminario.

## Benchmarking Microsoft SQL Server on Kaminario's K2 All-Flash Array

Databases like SQL Server form the circulatory system of most organizations, delivering both revenue-producing customer transactions and business analysis needed for insights and innovations. Virtualized SQL Server databases create an especially demanding blend of I/O traffic for storage infrastructure. Kaminario's fifth-generation K2 All-Flash Array combines consistently low latency and high throughput and IOPS with a very low price per GB, making All-Flash storage economical for all of your SQL Server databases.

### K2 Benefits for SQL Server:

- **Lowest Costs** – Deployment and operating costs can be two-thirds of legacy or hybrid storage arrays – averaging \$2 per effective GB after compression
- **Consistent Low Latency and High Throughput/IOPS** – Keeps SQL Server databases highly responsive even under extreme peak workloads
- **No Single Point of Failure** – Shared nothing architecture guarantees that databases are still available even if up to two SSDs fail at once in a single shelf
- **Simple Management** – No disk groups to plan or manage, no manual tuning or monitoring, all managed via a single web browser-based GUI
- **High-Efficiency RAID** – K2's dual protected K-RAID™ is highly available with 87.5% efficiency
- **Non-Disruptive Everything** – Upgrades, expansion and maintenance can be done online with no downtime and no loss of performance
- **Native Data Reduction** – K2's inline compression saves over two-thirds of database capacity, matching best-case SQL Server compression with no additional CPU load on host servers
- **Advanced Features** – Consolidated writes, adaptive block sizes and writeable native snapshots simplify management, optimize performance, save capacity and enhance media endurance

### Benchmark Results:

#### OLTP Queries

- 135,000 peak IOPS
- Over 2,500 MB/s throughput
- Latency under 0.5 ms

#### OLTP Transaction

- 2.57 million HammerDB peak transactions per minute
- 51,000 peak IOPS
- Latency under 0.8 ms

#### OLAP Queries

- 760,000 rows inserted per second
- Latency 0.6 - 0.8 ms

#### Mixed OLTP/OLAP Workloads

- No delays from blended I/O

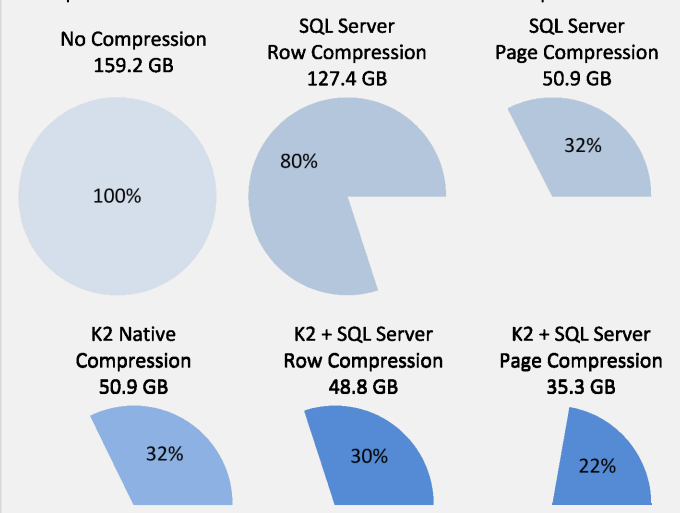
#### K2 Native Compression

- 68% capacity savings
- Matched best-case SQL Server compression but with no delays in test workloads

#### Scale-Out of OLTP/OLAP

- Doubling of K2 storage yielded scaling of 1.8X to 2.0X in throughput and IOPS

Comparison of SQL Server and K2 Native Compression:





## Cost Effectiveness of Kaminario K2 for SQL Server

Kaminario's fifth-generation K2 All-Flash Array delivers unique cost benefits for virtualized Microsoft SQL Server database servers:

**Database Server Consolidation** – Consolidating database servers on a shared K2 array greatly reduces required investment in software licenses and server hardware. K2's high performance and writeable snapshots can allow formerly long-running queries and reports to share the same database with business-critical OLTP workloads.

**Snapshots for Fast Database Backups/Cloning** – Using K2's native writeable snapshots to clone or back up SQL Server databases saves time and prevents disruption to ongoing transaction workloads. Snapshots can save up to 90% of the capacity needed for cloned databases and let OLAP analytics run against snapshots without risk to production databases or SLAs.

**Data Reduction Saves Capacity and Cost** – K2's native compression can save up to two-thirds of the capacity required for databases – equivalent to the best-case results from using the native compression of SQL Server. After compression, K2 costs average \$2 per effective GB of database storage.

### K2 Management GUI:



## Test System Configurations

The system configuration used for these SQL Server tests was:

K2 Storage	Single K-Block array with 45 TB using an out-of-box configuration with no manual tuning. The K2 array consisted of one SSD shelf holding 24 SSDs.
Server Hardware	Dell PowerEdge R810 with four 1.994 GHz Intel Xeon CPU E7-4850, CPUs, providing 80 hyperthreaded cores, 256 GB DRAM, and two dual-port 8 Gb Qlogic FC HBAs.
Server Software	SQL Server 2012 SP1 Enterprise Edition Windows Server 2012 R2 Standard VMware vSphere ESXi 5.5

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