



# kaminario.

## Benchmarking Oracle Database on Kaminario's K2 All-Flash Array

Oracle databases play a critical role in many companies IT infrastructures, handling both revenue-producing transactions and analytical queries that drive business insights. Virtualized Oracle servers create an especially demanding blend of I/O traffic for storage infrastructure. Kaminario's fifth-generation K2 All-Flash Array combines consistent low latency, high throughput, and IOPS with a very low price per GB, making it the most cost-efficient primary storage for all virtual and physical environments including Oracle databases.

### K2 Benefits for Oracle Databases:

- **Lowest Costs** – Deployment and operating costs can be two-thirds that of legacy or hybrid storage arrays – averaging \$2 per effective GB after compression
- **Consistent Low Latency and High Throughput/IOPS** – Keeps Oracle databases highly responsive even under peak demands and mixed OLTP and OLAP workloads
- **No Single Point of Failure** – Fully Active/Active design and scalable fault domains ensure high availability and no downtime
- **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** – K-RAID™ is highly efficient and robust with 87.5% utilization and up to two SSD failures per SSD shelf with no loss of performance
- **Non-Disruptive Everything** – Upgrades, expansion and maintenance can be done online with no downtime and no loss of performance
- **Native Data Compression** – K2's compression saves 63% of database capacity – more than Oracle's native compression with no additional load on database server CPUs
- **Advanced Features** – Adaptive block size, selective deduplication, zero elimination, Flash management and native snapshots deliver optimized performance, save capacity and enhance media endurance

### Oracle Benchmark Results:

#### OLTP Queries

- Peak 110,000 IOPS and 870 MB/s throughput
- Latency under 0.4 ms

#### OLAP ETL Insert Rows

- 2.5 million rows inserted per second
- Peak 880 MB/s throughput and 14,000 IOPS
- Latency 0.75 - 0.85 ms

#### OLAP Validation Scan

- Peak 2.3 GB/s throughput and 37,000 IOPS
- Latency 0.55 ms or less

#### K2 vs. Oracle Compression

- Native K2 compression saves 63% of physical capacity, far better than Oracle OLTP compression

#### Mixed OLTP/OLAP Workloads

- 124,000 peak IOPS and 1.8 GB/s peak throughput while latency remained under 0.5 ms

#### Scale-Out of OLTP/OLAP

Scale-Out of the K2 yielded 2X of OLAP and OLTP processing:

- OLTP IOPS scaled to 220,000
- OLAP ETL throughput scaled to 1.8 GB/s, validation scan scaled to 4.8 GB/s
- Constant sub-millisecond latency

K2 Performance Analysis during mixed workload tests on Oracle:



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## Cost Effectiveness of Kaminario K2 for Oracle Databases

Along with excellent performance, Kaminario's fifth-generation K2 All-Flash Array provides a range of cost benefits for virtualized Oracle Database servers:

### Data Reduction Saves Capacity and Cost –

K2's native compression reduces the physical capacity required for database volumes by 63% while selective inline deduplication cuts the space needed for server virtual machines. After compression, K2 costs average \$2 per effective GB of database storage.

### Consistent Performance with Mixed Workloads Enables Consolidation –

K2's ability to easily scale up and out while handling challenging mixed workloads enables Oracle databases to be consolidated onto a shared K2 array. Consolidation reduces required investment in software licenses and server hardware. K2's consistent high performance allows demanding business intelligence analytics and backups to run concurrently with OLTP production systems, all on a single shared K2 All-Flash Array.

### Snapshots for Fast Database Backups/Cloning –

Using K2's native writeable snapshots to clone or back up Oracle databases saves time and prevents disruption to ongoing transaction workloads. Snapshots can save up to 90% of the capacity needed for cloned or backup databases and let OLAP analytics run against snapshots on the same K2 array without risk to production database SLAs.

K2 Management GUI:



## Test System Configurations

The system configuration used for these Oracle Database benchmarks was:

K2 Storage	Single K-Block array with 45 TB from one shelf with 24 SSDs using an out-of-box configuration with no manual tuning.
Server Hardware	Dell PowerEdge R810 with four 1.994 GHz Intel Xeon E7-4850 CPUs, providing 80 hyperthreaded cores, 256 GB DRAM, and two dual-port 8 Gb Qlogic FC HBAs.
Server Software	Oracle 11.2.0.3 Enterprise Edition Oracle Linux 2.6.32 VMware vSphere ESXi 5.5 Oracle ESX virtual machine was configured with VMs were configured with 8 vCPUs in 1 socket and 8 GB of vRAM.

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