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Benchmarking VMware Horizon View VDI on Kaminario's K2 All-Flash Array

Virtual Desktop Infrastructure or VDI enables IT groups to easily provision, manage, and secure rapidly proliferating enterprise desktop computing. However, virtualized desktop operating systems and applications generate a random blend of I/O requests with periodic storms from boot, login, and shutdown heavily stressing both VDI servers and their storage infrastructure. Kaminario's fifth-generation K2 All-Flash Array combines advanced availability and high performance with a very low price per GB using inline global deduplication, enabling your VDI deployment to satisfy both demanding users and limited budgets.

K2 Benefits for Virtual Desktops:

- **Lowest Costs** – Deployment and operating costs can be two-thirds of legacy or hybrid storage arrays – after deduplication effective costs can be below \$1 per GB or under \$20/desktop
- **Simple to Deploy / Manage** – Integration with VMware and vCenter plug-in plus the browser-based K2 GUI speed deployments letting you manage your virtual desktops from anywhere
- **Latency / Throughput** – Performance ensures virtual desktops remain responsive even under extreme peak workloads
- **No Single Point of Failure** – Shared nothing architecture ensures that desktops are still available even if up to two SSDs fail at once in a single shelf
- **High-Efficiency RAID** – K2's dual-protected K-RAID™ is highly available with 87.5% efficiency
- **Non-Disruptive Everything** – Upgrades and expansion done online with no user downtime and no loss of virtual desktop responsiveness
- **Efficient Data Reduction** – K2's native inline deduplication reduces desktop capacity needs by 90% or more reducing costs and speeding deployment
- **Advanced Features** – Consolidated writes, adaptive block sizes, and writeable native snapshots simplify management, optimize performance and save virtual desktop capacity

Benchmark Results:

Provision 1,000 Linked Clones

- 1,000 desktops created in 1 hour
- Latency under 1.0 ms

Provision 1,000 Full Clones

- 20,000 peak IOPS
- 2,600 MB/s average throughput

Power Down 1,500 Desktops

- 800 MB/s throughput
- Completed in 3 minutes

Boot 1,500 Desktops

- 170,000 peak IOPS
- Completed in 8 minutes

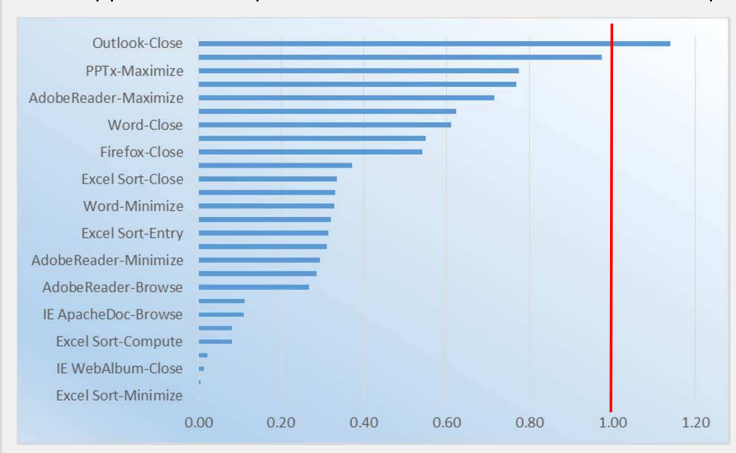
Desktop Deduplication

- 95% reduction in capacity
- Allocated to physical ratio of 20:1

Application Performance

- 1,250 View Planner desktops
- 24,500 peak IOPS
- Average application response time of only 0.38 seconds well below 1 second passing mark

Mean Application Responses from 1,250 View Planner Desktops



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Cost Effectiveness of Kaminario K2 for VMware View VDI

Kaminario's fifth-generation K2 All-Flash Array delivers unique cost benefits for VMware Horizon View virtual desktops:

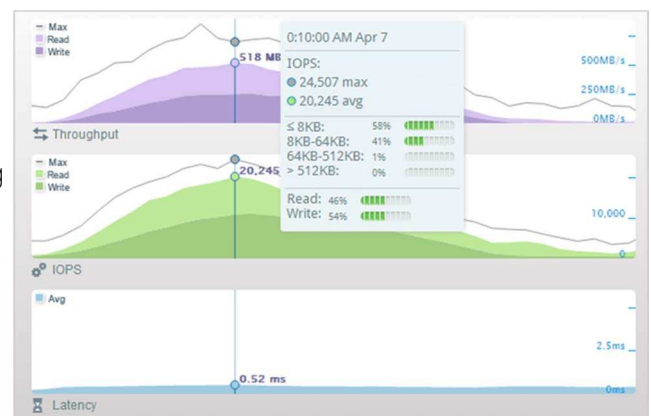
Data Reduction Saves Capacity – K2's native global inline deduplication can lower virtual desktop storage capacity needs by over 95%. K2's effective pricing can be as low as \$20 per virtual desktop.

Highly Responsive Virtual Desktops – K2's consistent low latency and high IOPS/throughput deliver responsive virtual desktops and ensures users are both productive and satisfied.

Simpler Management – K2 makes storage management simpler, eliminating any need for manual tuning while VMware integration ensures that you get the best results from your VDI investments.

Less Over-Provisioning for Peak Demands – K2's consistent performance lets you stop over-provisioning storage hardware while still ensuring that peak demands from boot or login storms can be easily met.

K2 GUI during test of 1,250 View Planner desktops



Test System Configurations

The system configuration used for VDI testing was:

K2 Storage	Dual K-Block array with 90 TB using an out-of-box configuration with no manual tuning. Each K-Block in the K2 array consisted of one SSD shelf holding 24 SSDs.
Server Hardware	Sixteen M610 Dell Blades used for desktop virtual machines, each with two Intel Xeon E5649 @ 2.53GHz CPUs (total of 24 cores per server) and 96 GB DRAM of memory, and two dual-port 8 Gb Qlogic FC HBAs. Management virtual machines ran on a Dell R810 server with four Intel Xeon E7-4850 @ 2.00Ghz CPUs (total of 80 cores), 256 GB DRAM, and two dual-port 8 Gb Qlogic FC HBAs.
Virtual Desktops	Windows 7 Enterprise SP1 with 1,024 MB vMemory
Server Software	VMware ESX 5.5U1 VMware vCenter Appliance 5.5 VMware View Manager and View Composer 5.3 VMware View Planner 3.0.1 Windows Server 2008 Active Directory Domain Controller



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