High IOPS SSDs for AI Use Cases

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the Future of Memory and Storage

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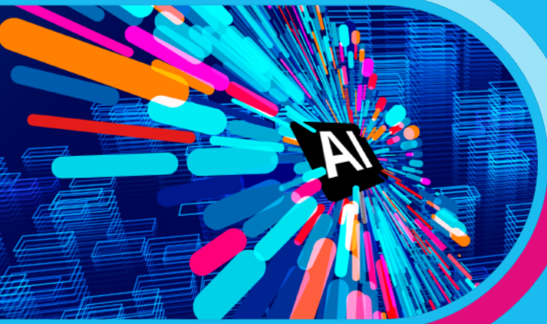
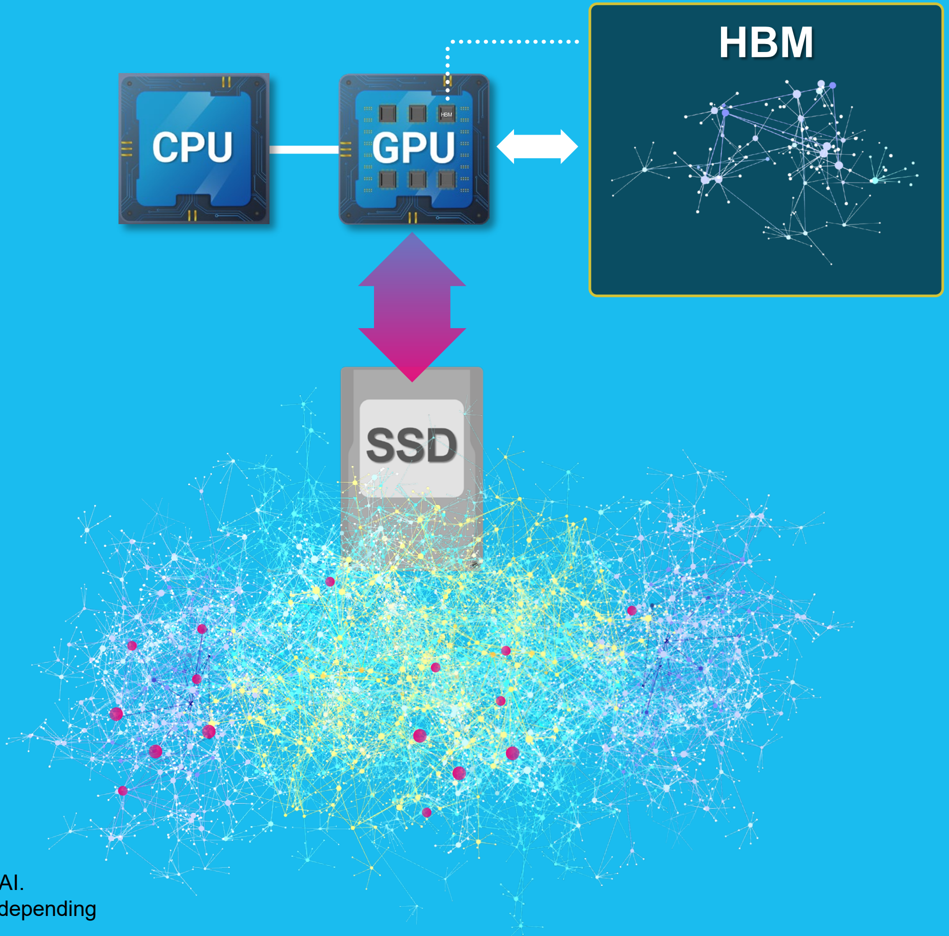
Emerging AI Use-Case: GPU Memory Extension



- **Addresses HBM expansion limitations and high costs**
- **Allows 10x – 100x larger datasets[1]**
- **GPU-initiated I/O**
  - up to 200M IOPS/GPU



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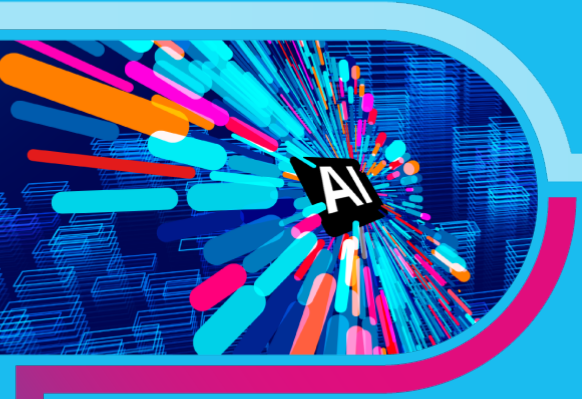
Emerging AI Use-Case: Near-GPU Caching

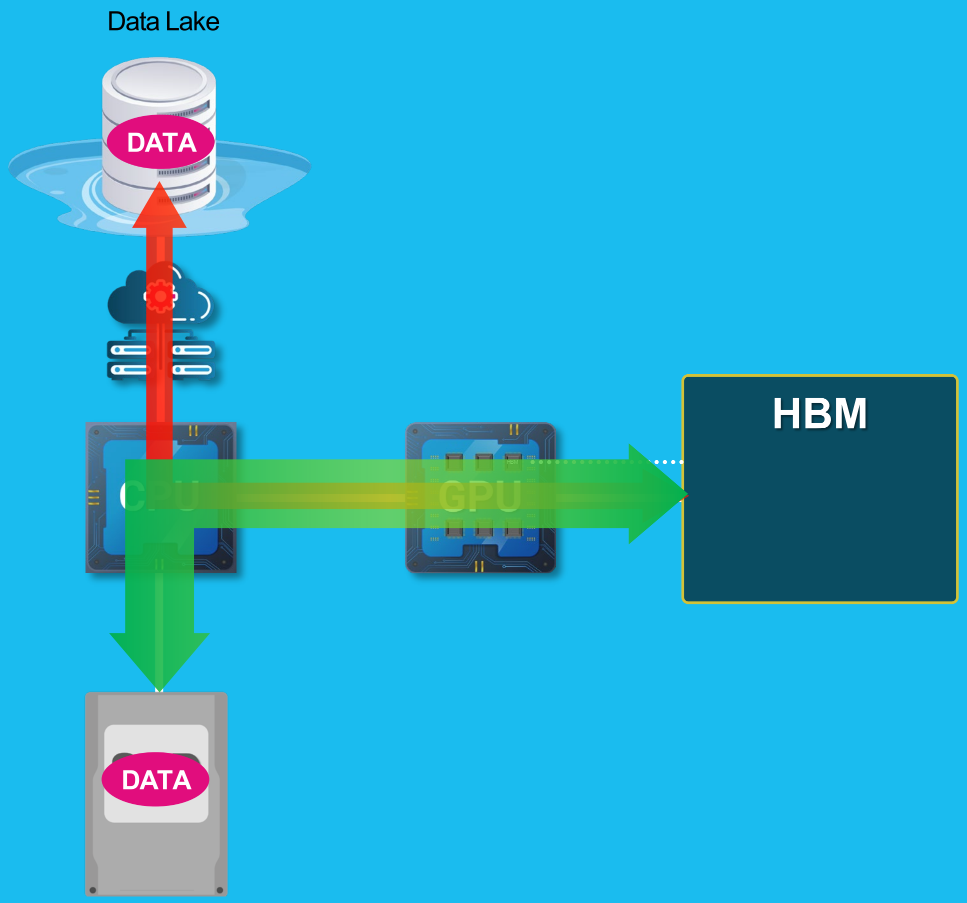


- Addresses inefficiency of small data accesses over very high-speed networks

- Large, efficient transfers from data lake to load cache

- Small reads serviced from local SSD

- CPU-initiated I/O



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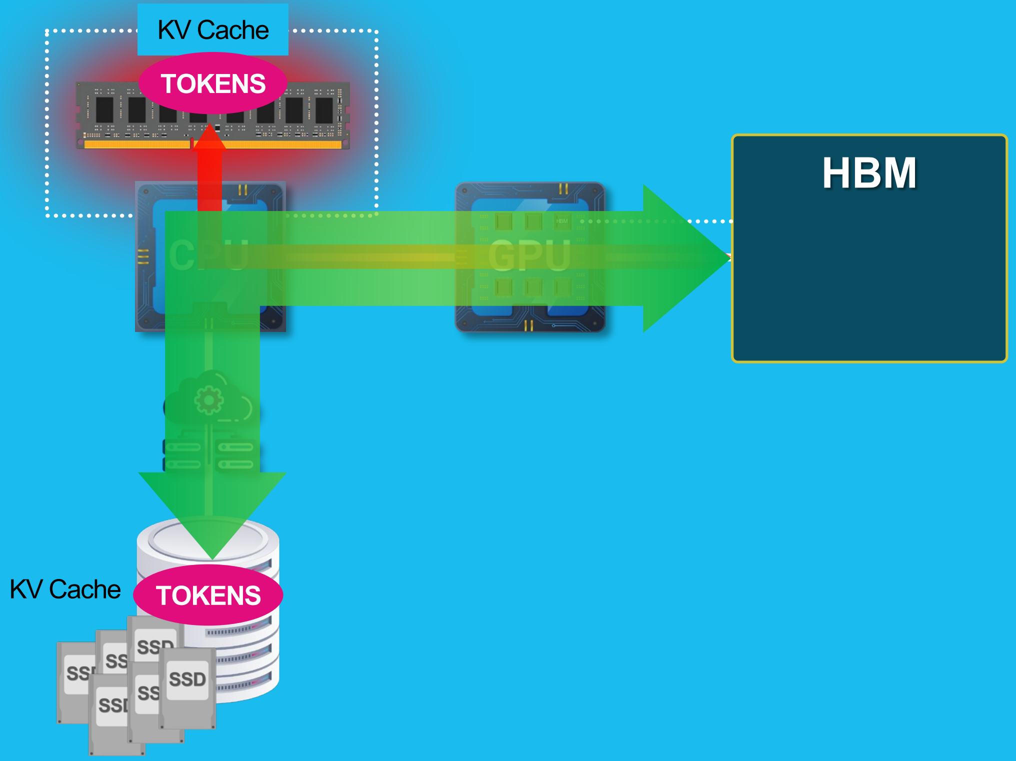
Emerging AI Use-Case: Key Value Caching

- **Prevents recomputation of previously generated tokens**
- **Extends local memory-based caches**
  - Error recovery & routing benefits
- **CPU initiated I/O**



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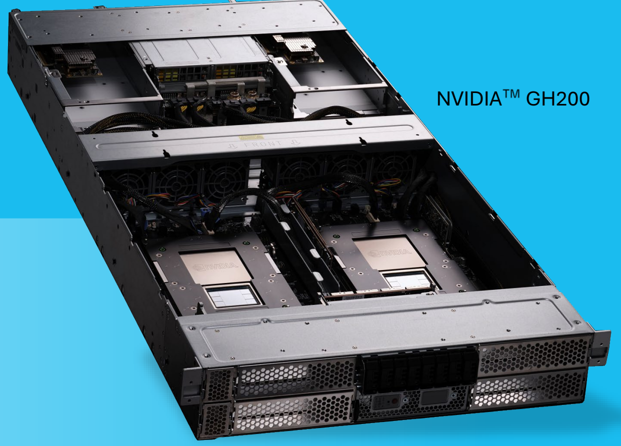
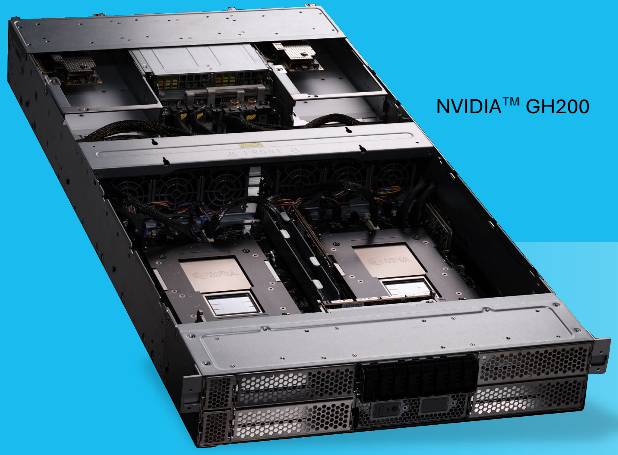
The Case for High IOPS

Alternate Paths to 200M IOPS

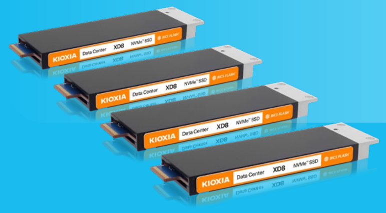
- Requires PCIe® switches
- Consumes lots of physical space
- Wasted capacity
- 32 TLC SSDs (800W for each GPU)



NVIDIA™ GH200



NVIDIA™ GH200



- 2~4 SSDs (100M or 50M IOPS) per GPU
- No PCIe switch needed
- ~120W

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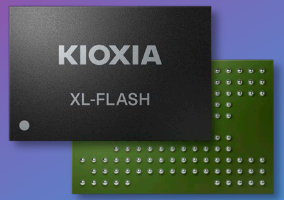
KIOXIA's Path to 100 Million I/Os Per Second



Enabled by XL-FLASH

2025

3M

4K Random Read IOPS
TLC Flash
PCIe® 5.0
14GB[2]/sec

2026

10M

512B[1] Random Read IOPS
XL-FLASH Gen. 2
PCIe® 6.0
23GB/sec

2027

100M

512B Random Read IOPS
XL-FLASH Gen. 3
PCIe® 7.0
50GB/sec

1. KIOXIA is collaborating with systems designers on liquid cooling solutions, in an effort to reach this targeting. 2. 512 byte block size. 2. Gigabytes (GB). All images and/or graphics within this slide are the property of KIOXIA America, Inc. (KIOXIA) and are reproduced with the permission of KIOXIA. Product images shown are a representation of a design model and not an accurate product depiction. PCIe is a registered trademark of PCI-SIG. NVMe is a registered or unregistered trademark of NVM Express, Inc. Other company and product names may be trademarks of the respective companies with which they are associated.

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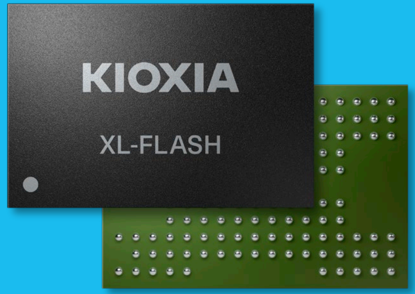
Low Latency Media is Key: Do The Math

- 100 Million IOPS requires a read to complete every 10 nsec[1]
- Typical TLC tRead ~ 60 usec[2]
- 60 usec / 10 nsec = 6,000 pipelined reads
- XL-FLASH tRead ~ 5 usec
- 5 usec / 10 nsec = 500 pipelined reads



Enabled by XL-FLASH

[1] Nanosecond (nsec), [2] Microsecond (usec). Product images shown are a representation of a design model and not an accurate product depiction. All images and/or graphics within this slide are the property of Kioxia Corporation (KIOXIA) and are reproduced with the permission of KIOXIA .

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GPUs Use SSDs Differently

- Massive parallelism is the key to GPU performance
- Typical x86 system can issue ~50M IOPS consuming 100% CPU
- An NVIDIA Hopper™ GPU can generate ~200M IOPS with a projected <10% utilization
- It is not unusual for GPUs to drive device queue depths into the 10s of thousands!

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Liquid Cooling Is In Your Future

- Faster flash media can be more power efficient!
- IOPS/Watt TLC: 480K vs XL-FLASH: 1.6M
- XL-FLASH @ 50M IOPS: ~ 35 Watts
- XL-FLASH @ 100M IOPS: ~ 60 Watts
- E3 may be required for surface area!

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Performance / Power Preliminary Comparison with TLC SSDs

1st Gen 10M IOPS SSD

	Best in Class TLC	Best in Class TLC	High IOPS Gen1 XL-FLASH
PCIe® Gen.	**Gen5 x4**	**Gen6 x4**	**Gen6 x4**
512B Random Read [MIOPS]	N/A	N/A	10.0
4KB Random Read [MIOPS]	3.0	6.0	4.2
Power [W]	25	25	25
IOPS/Power Ratio	**0.5**	**1.0**	**1.7**

2nd Gen 50M/100M IOPS SSD

	Best in Class TLC	High IOPS Gen2 XL-FLASH	High IOPS Gen2 XL-FLASH
PCIe Gen.	**Gen7 x4**	**Gen7 x4**	**Gen7 x4**
512B Random Read [MIOPS]	N/A	50	100
4KB Random Read [MIOPS]	12	TBD	TBD
Power [W]	25	<=35	<=60
IOPS/Power Ratio	**1.0**	**>=3.0**	**>=3.5**

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