

KIOXIA

The background of the entire image is a server room. It features several rows of server racks, each filled with various electronic components and glowing with blue light. The floor is a light-colored tile, and the ceiling has recessed lighting. The overall atmosphere is high-tech and professional.

G2M
RESEARCH

4 Ways Multi-Protocol Can Maximize Flash Value

G2M Research Webinar
Tuesday Feb 8, 2022



G2M Research Introduction and Ground Rules

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Managing Partner, G2M Research

- **Ground Rules and Webinar Topic Introduction (G2M)**
- **Problem: Supporting multiple flash protocols (G2M)**
- **4 Ways Multi-Protocol Can Maximize Flash Value (Kioxia)**
- **Live Survey #1**
- **Software-Enabled Flash + Software-Defined Flash (Kioxia)**
- **Live Survey #2**
- **Maximizing Flash Value with Multi-Protocol**
- **Audience Q&A**
- **Wrap-Up**

The Problem of Multiple Flash Protocols

- Multiple flash protocols exist and are in production data center environments today
- The number of protocols complicate a variety of data center maintenance actions:
 - Redeploying flash resources across servers
 - Provisioning spares inventory
 - Maintaining performance as applications are migrated across the data center
- This complicates data center provisioning, management, and evolution



ZNS

Block Protocol

CustomFTL

Kioxia/G2M Research Webinar on Software-Enabled Flash™ Memory



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What We Will Cover Today

- 1 Fixed function can leave value on the table**
- 2 Survey says...**
- 3 Flash needs to be software-defined**
- 4 Multi-protocol in action**
- 5 Survey says again...**
- 6 Maximizing flash value with multi-protocol**
- 7 Q & A**

Fixed Flash Protocols: Leaving Value on the Table

Legacy

- HDD-based
- Flash wasn't even considered

Fixed Function

- Set at factory
- Never advances

Limited

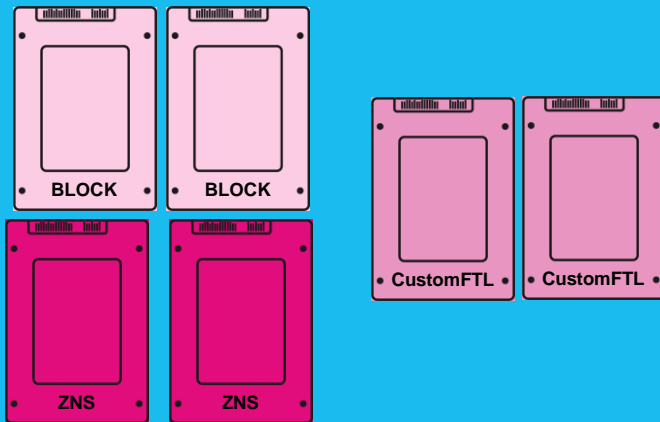
- Least-common denominator

Application needs and advances in flash technology often don't align with fixed protocols



Single-protocol flash presents operational and supply chain issues: **SKUs++**, **inflexibility**, **complex** and **challenging forecasting**

Inventory of different drive types



Web App

Streaming App

Database App

Fixed protocol flash leaves value on the table

TCO • **Restricted by hard drive limitations**

Ops • **Unable to adapt to changing workloads**

Sourcing • **Complex and challenging supply chain**

OSS • **Black-box, proprietary code**

**Survey
says....**

What is your biggest challenge with flash today?

- A) TCO – Difficulty in extracting the maximum value - 50%**
- B) Ops – Can't redeploy for different needs as applications change - 13%**
- C) Sourcing – Right flash in the right servers at the right time - 38%**
- D) OSS – Working with proprietary software - 0%**

Flash Needs to be Software-Defined

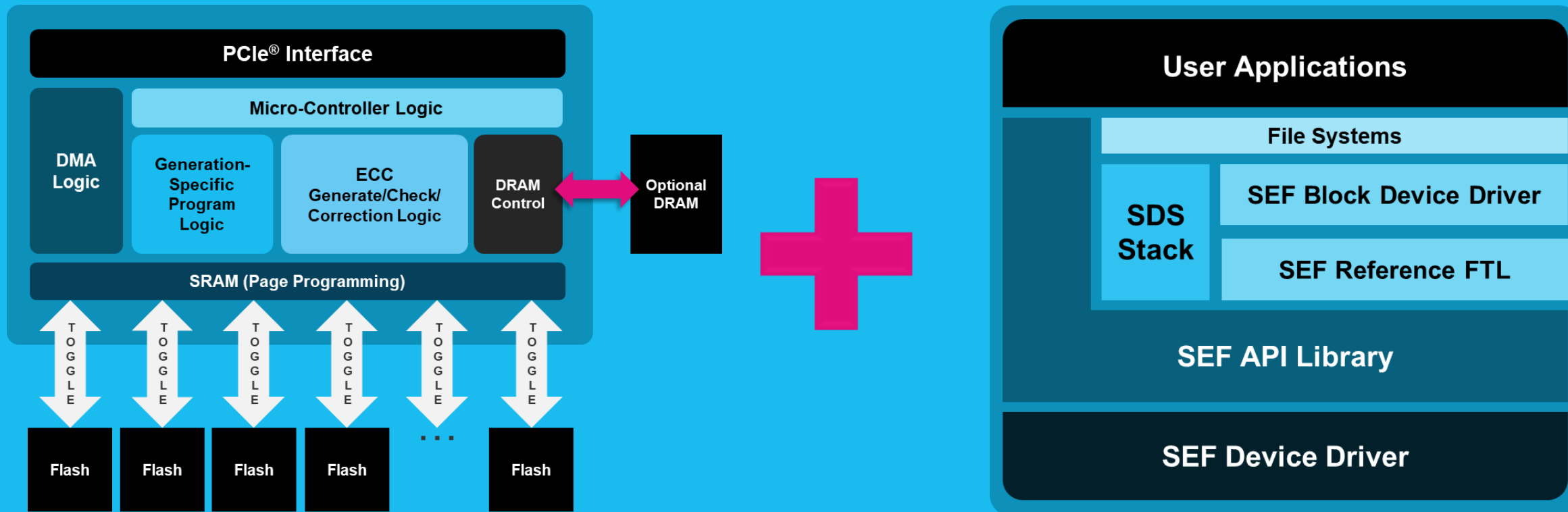
Open Source, Software-Defined Approach to Flash

**Fundamentally
redefines the
relationship
between **host**
and **flash** storage**

- Brings control of flash to software
- Cloud applications have complete control over storage functionality and behavior
- Solves legacy overhead problems and enables new features
- Maximizes flash flexibility, performance and parallelism...

in other words, flash's value.

Optimized Hardware + Open Source Software



PCIe is a registered trademark of PCI-SIG.

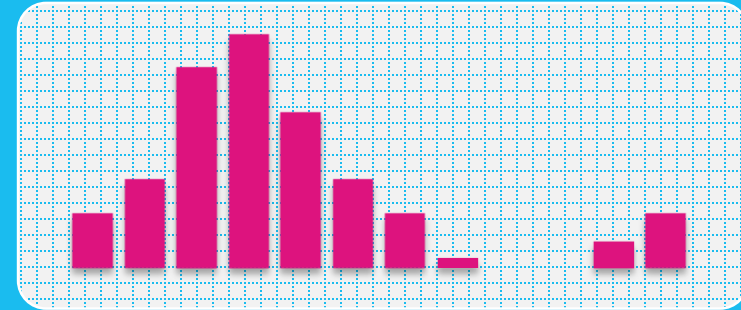
The hardware focuses on media management and host offload functionality...

...allowing software to orchestrate and manage protocols, latencies and data placement

Software-Enabled Flash™ Technology



Workload Isolation



Latency Management

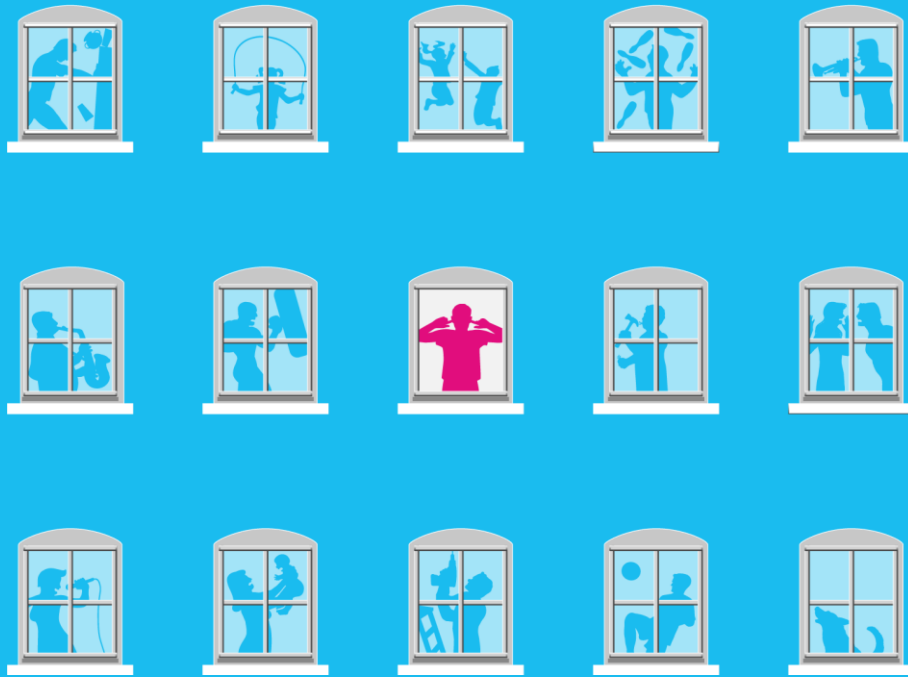


Flash Migration



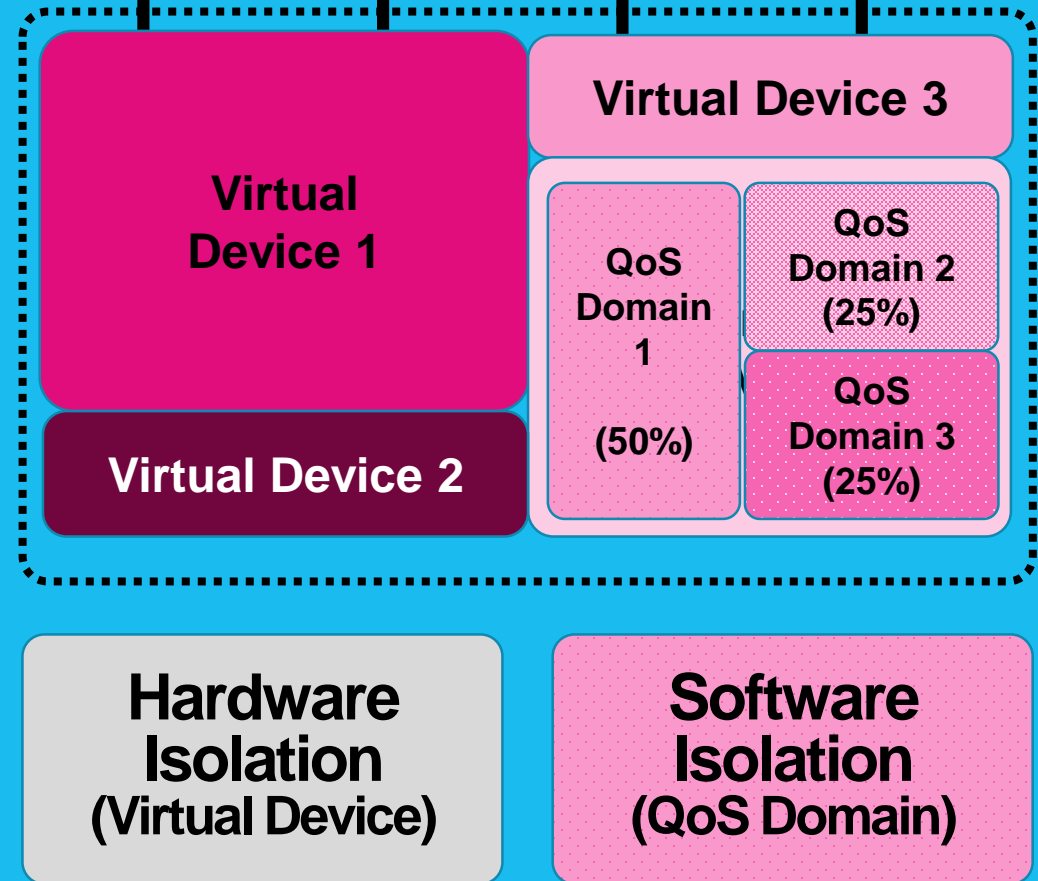
Flash Maintenance

WORKLOAD ISOLATION

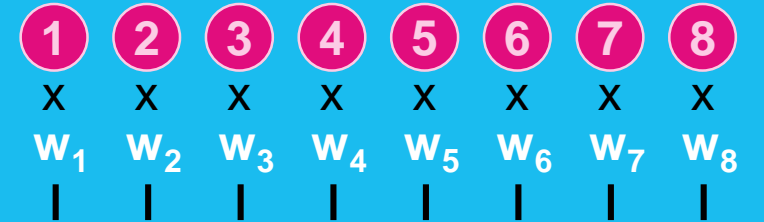
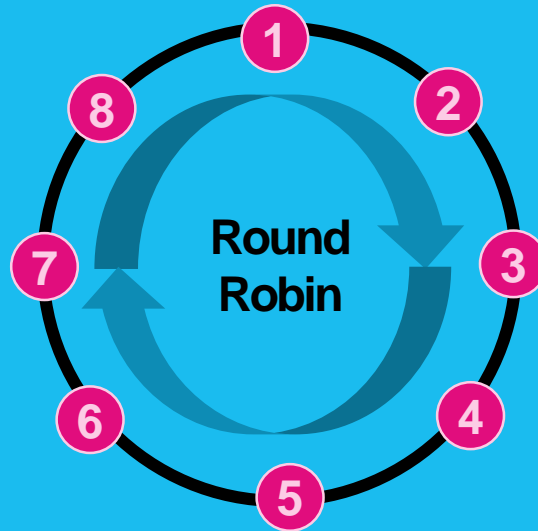
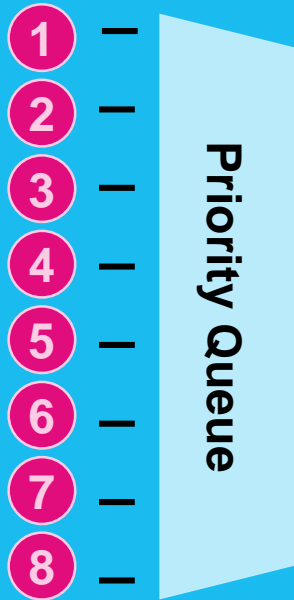
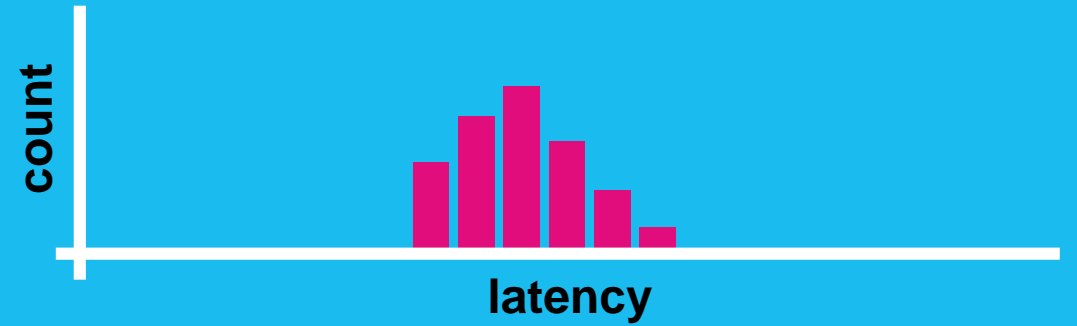
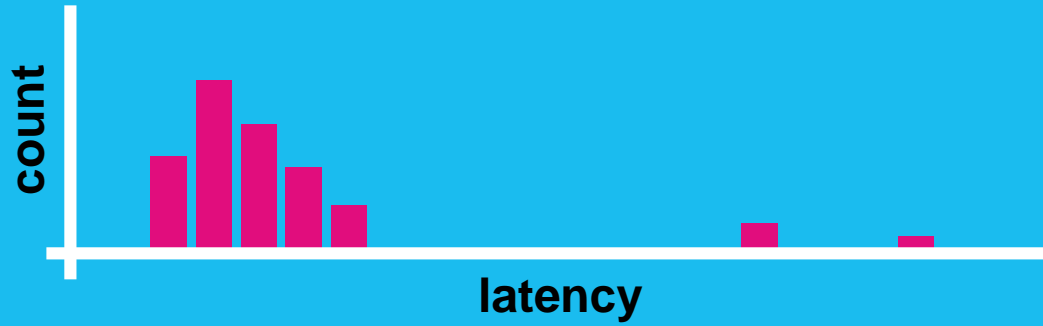


Noisy Neighbor Control

Software-Enabled Flash Controller

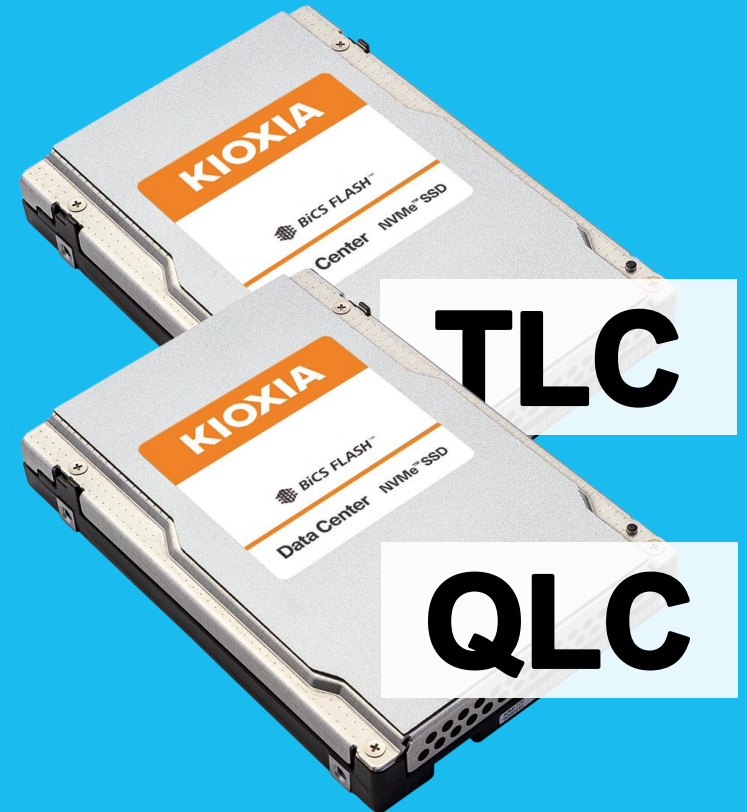
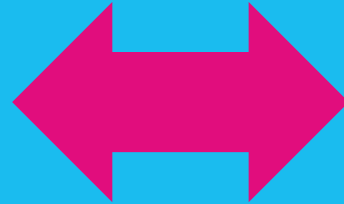


LATENCY MANAGEMENT



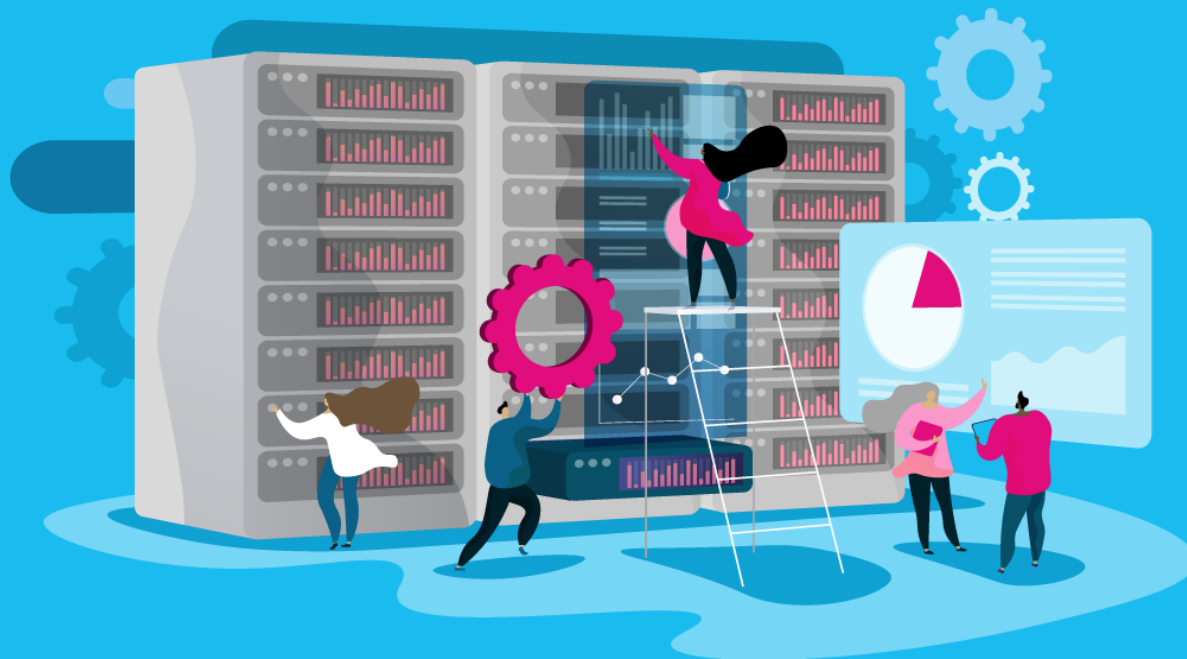
Die Time
Weighted Fair Queue

FLASH MIGRATION



Orchestrated by host software... ...performed by Software-Enabled Flash™ hardware

- Garbage collection
 - Wear leveling
 - Flash patrol reads
 - Compaction
- ...and more...



OPEN SOURCE



**Source code provided under open source licenses
Upcoming vendor-neutral Open Source Foundation
Enables sharing enhancements with the community**

Software-Enabled Flash™ Multi-Protocol in Action

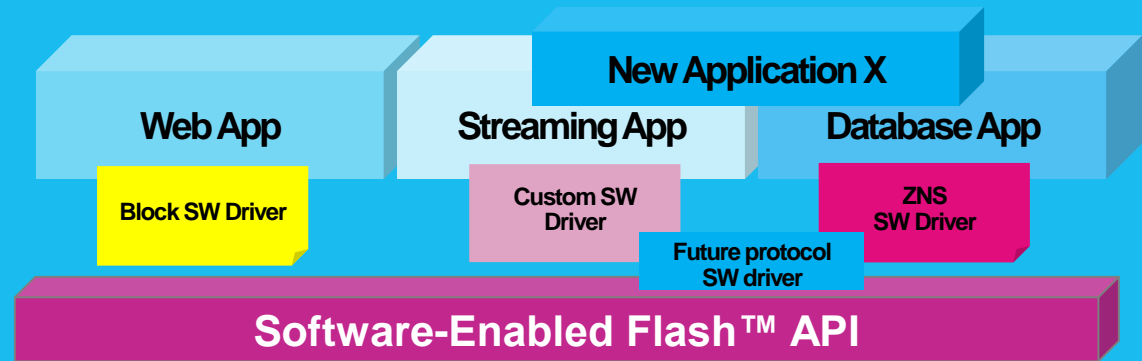
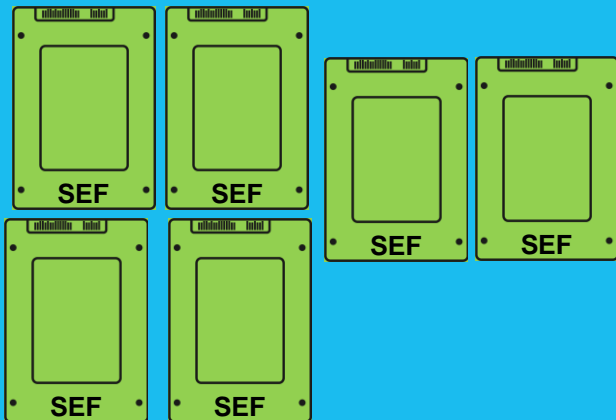
Enabling Software-Defined Protocols

**Redefinable,
application
optimized
protocols under
software control**

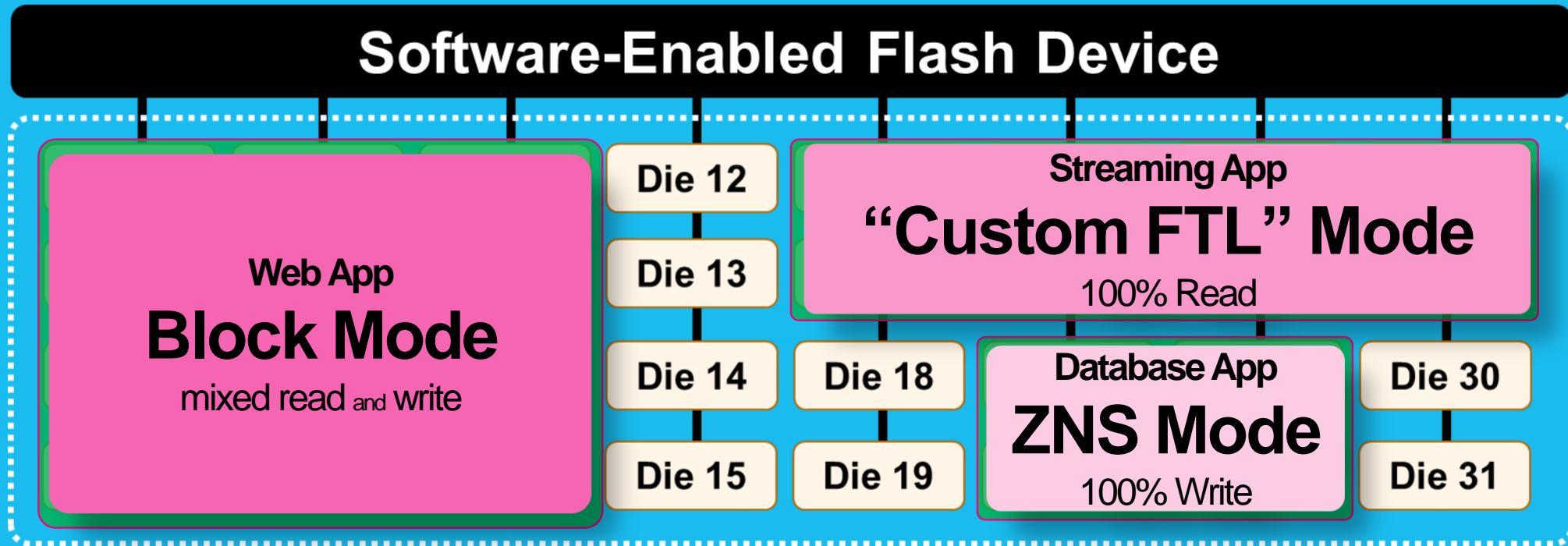
- **Utilizes isolation, latency control, offload, and abstraction via APIs and SDKs**
- **Single hardware device can more optimally serve many applications**
- **Dynamic deployment, redeployment, and reconfiguration under application control**

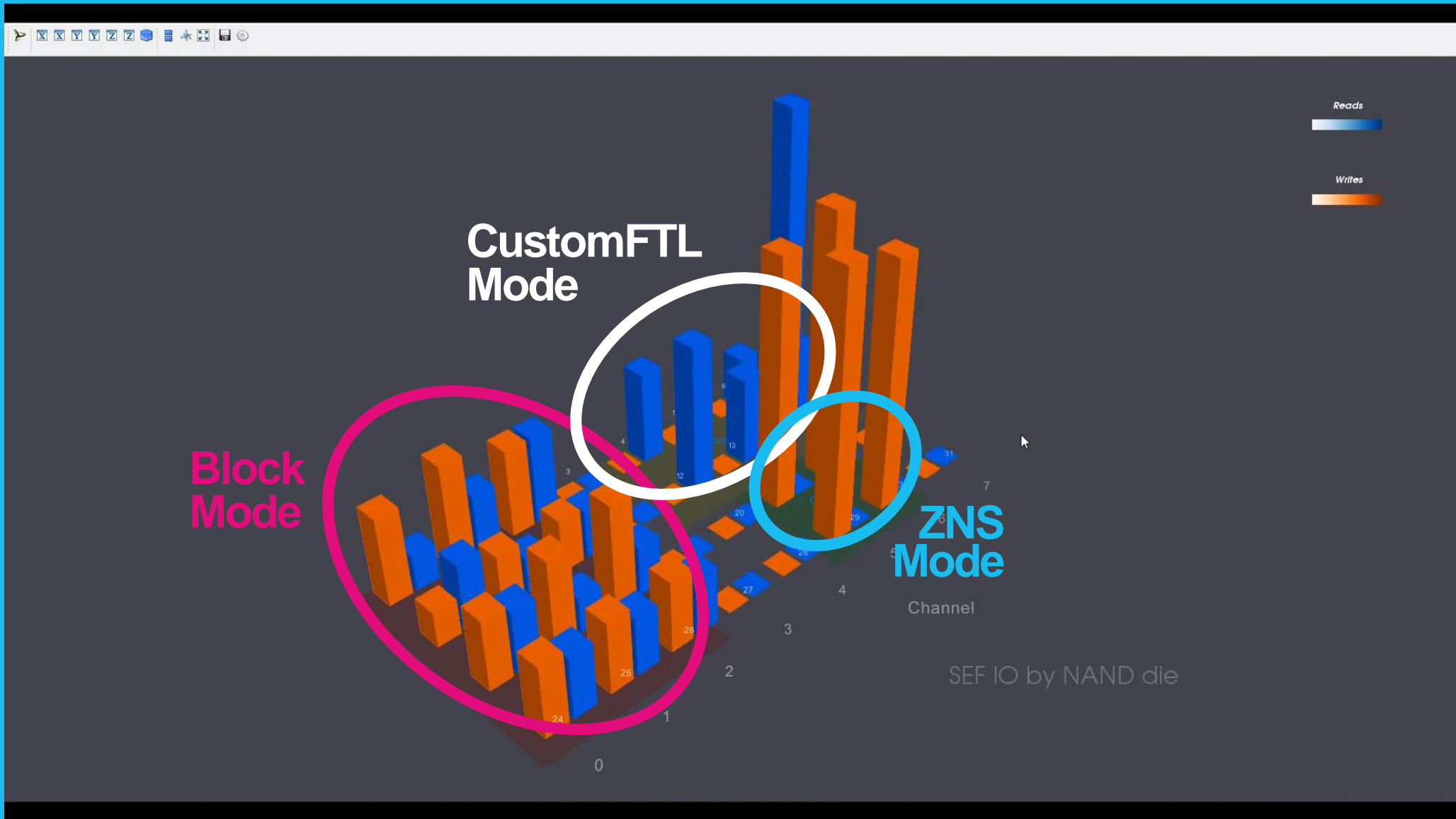
Multi-Protocol provides a simplified supply chain and allows flash to be redeployed in an agile manner, improving TCO via software-defined.

Inventory of identical SEF Units



Software-Enabled Flash™ allows one drive model to deploy multiple protocols, as needed, even down to the individual flash die level.





**Survey
says....**

Have you considered custom flash protocols?

- A) Have not considered or examined custom flash protocols - 67%**
- B) Looked at them, but it wasn't applicable to my workloads - 0%**
- C) Using custom protocols actively for specific workloads - 0%**
- D) Want to use custom protocols, but can't with current hardware - 33%**

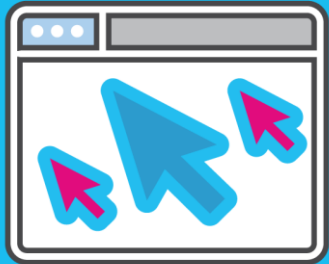
Maximizing Flash Value with Multi-Protocol

4 Ways Multi-Protocol Maximizes Flash Value

- ✓ **TCO – Better flash economics**
- ✓ **Ops – Redeployable per-application**
- ✓ **Sourcing – 1 SKU, multiple protocols**
- ✓ **OSS – Open source ecosystem**

More Information on Software-Enabled Flash™

1



Website

www.SoftwareEnabledFlash.com

2



Videos / Papers

available on the website

3



Code

<https://github.com/kioxiaamerica>



Audience Q&A

KIOXIA

Definition of capacity: KIOXIA defines a megabyte (MB) as 1,000,000 bytes, a gigabyte (GB) as 1,000,000,000 bytes and a terabyte (TB) as 1,000,000,000,000 bytes. A computer operating system, however, reports storage capacity using powers of 2 for the definition of 1GB = 2^{30} = 1,073,741,824 bytes and therefore shows less storage capacity. Available storage capacity (including examples of various media files) will vary based on file size, formatting, settings, software and operating system, such as Microsoft Operating System and/or pre-installed software applications, or media content. Actual formatted capacity may vary.

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Quantifiable Results