



Flash Memory Summit

Using QLC SSDs to Improve Cost/Performance Tradeoffs for Warm Data

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30 Trends Driving Data Growth



163 Zetabytes by 2025 (IDC)

Fraud Prevention

XaaS

Artificial Intelligence

Machine Learning

Virtual & Augmented Reality

Big Data & Real-Time Analytics

Ecommerce

Deep Learning

Personalized Medicine

Online Education & Healthcare Delivery

Workforce Automation

Media Streaming

Self-Driving Cars

Real-Time Inventory

Cryptocurrency

Smart Home

Automated Manufacturing

Programmatic Advertising

Social Media

Smart Ag

5G Connectivity

Internet of Things

Surveillance

Genomic Analysis



Dynamic Pricing

Drones

eSports

Cloud Computing

Wearables



**This data needs
to be read and
analyzed quickly.**

**Not rewritten
repeatedly.**



Fraud Prevention

XaaS

Artificial Intelligence

Machine Learning

Virtual & Augmented Reality

Big Data & Real-Time Analytics

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AI Is Shifting the Data Center IO Pattern

Application	Read-to-write ratio
Traditional Data Center	4:1
	VS.
Deep Learning for AI	5000:1

Source: EnterpriseStorageforum.com: "Data Storage, AI, and IO Patterns"

The Evolution of Enterprise SSDs

Business priorities drive workloads.
Workloads drive performance & capacity.
Budgets drive reality.



SLC
2007

Expensive
Low Capacity

MLC
2011

TLC
2016

QLC
2018



World's first
QLC SSD!

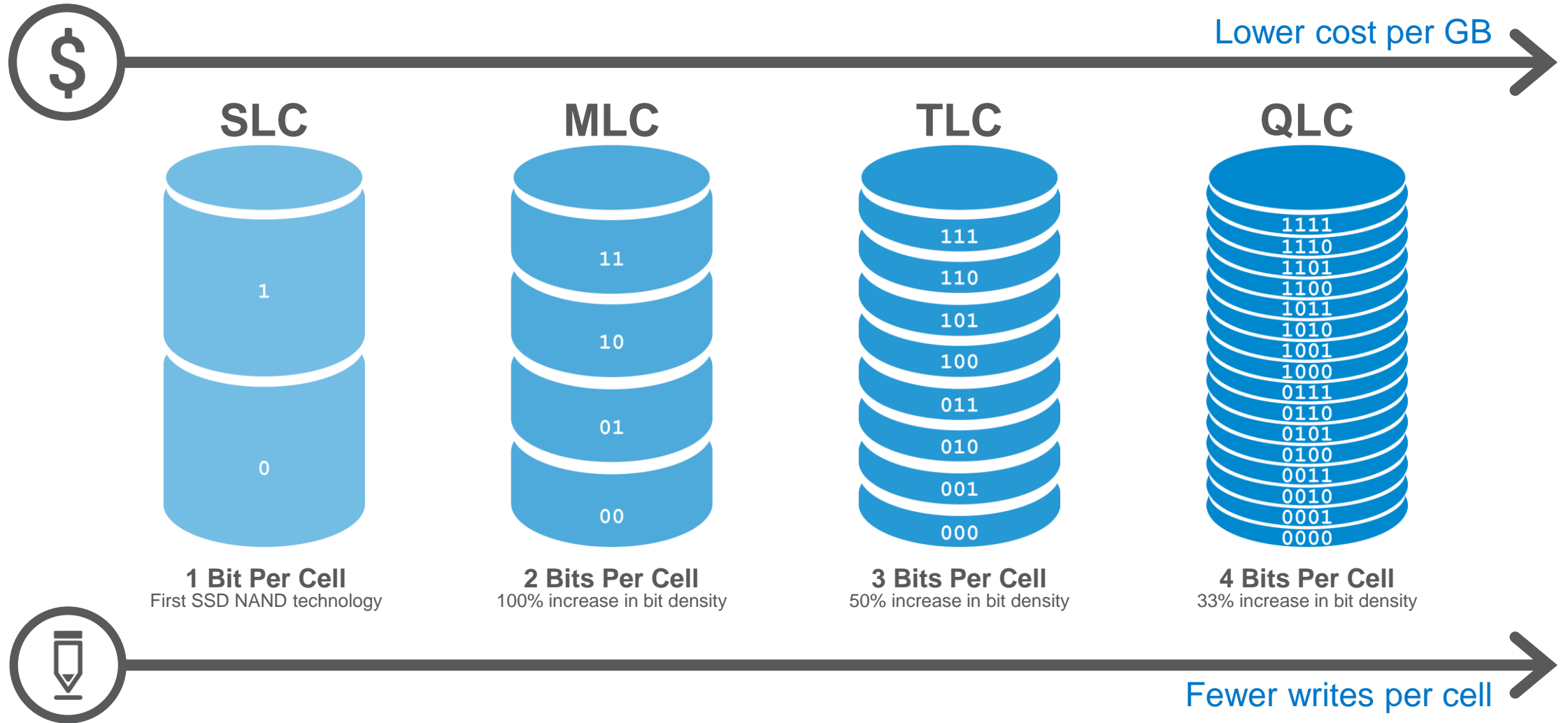
Affordable
High Capacity



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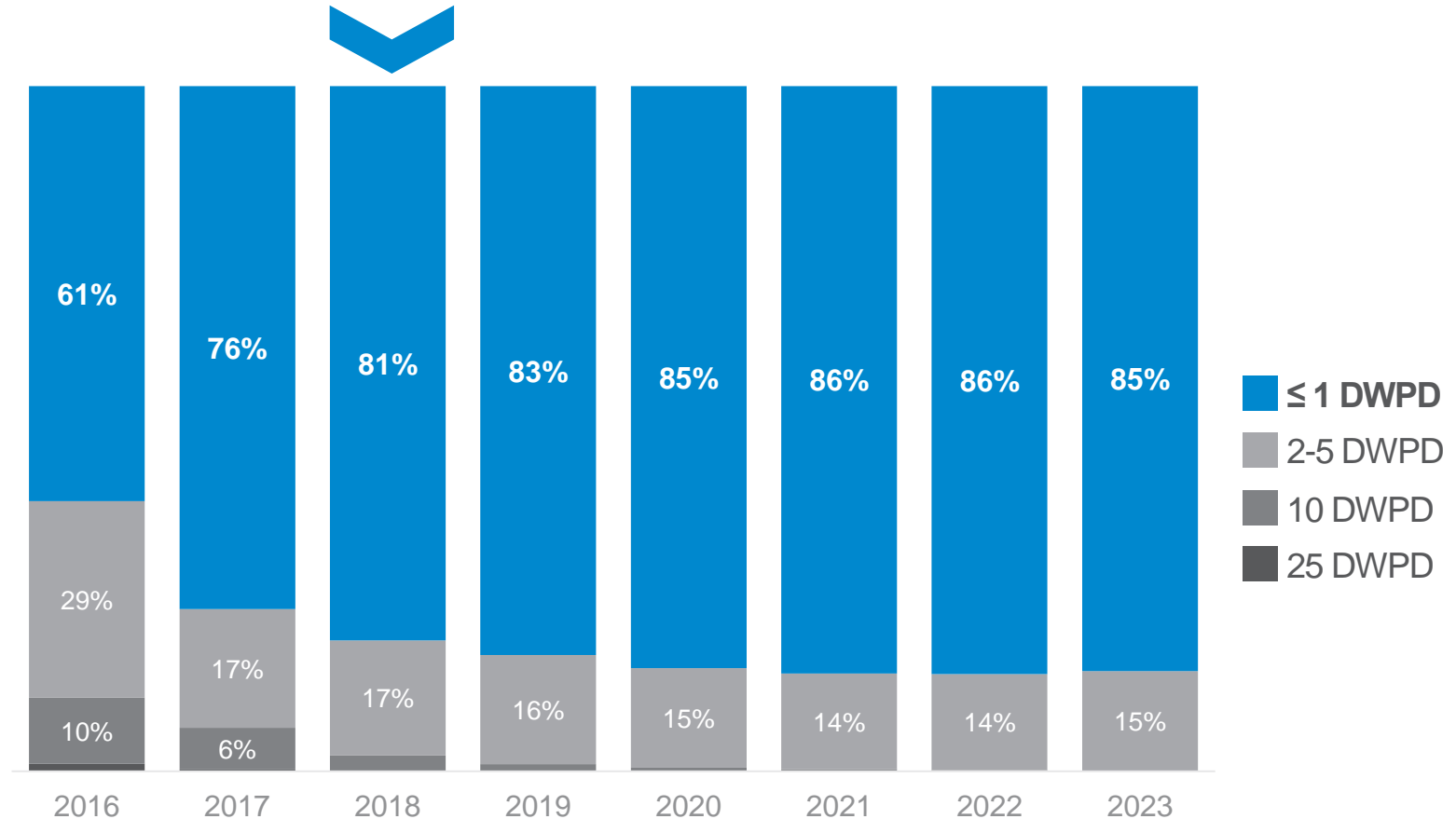
QLC = Fast Capacity For Less



Endurance Needs are Decreasing

Enables Industry Expansion to QLC

4/5 of ALL enterprise SSDs shipped worldwide in 2018 were ≤ 1 DWPD



Source: Forward Insights Datacenter, May 2019

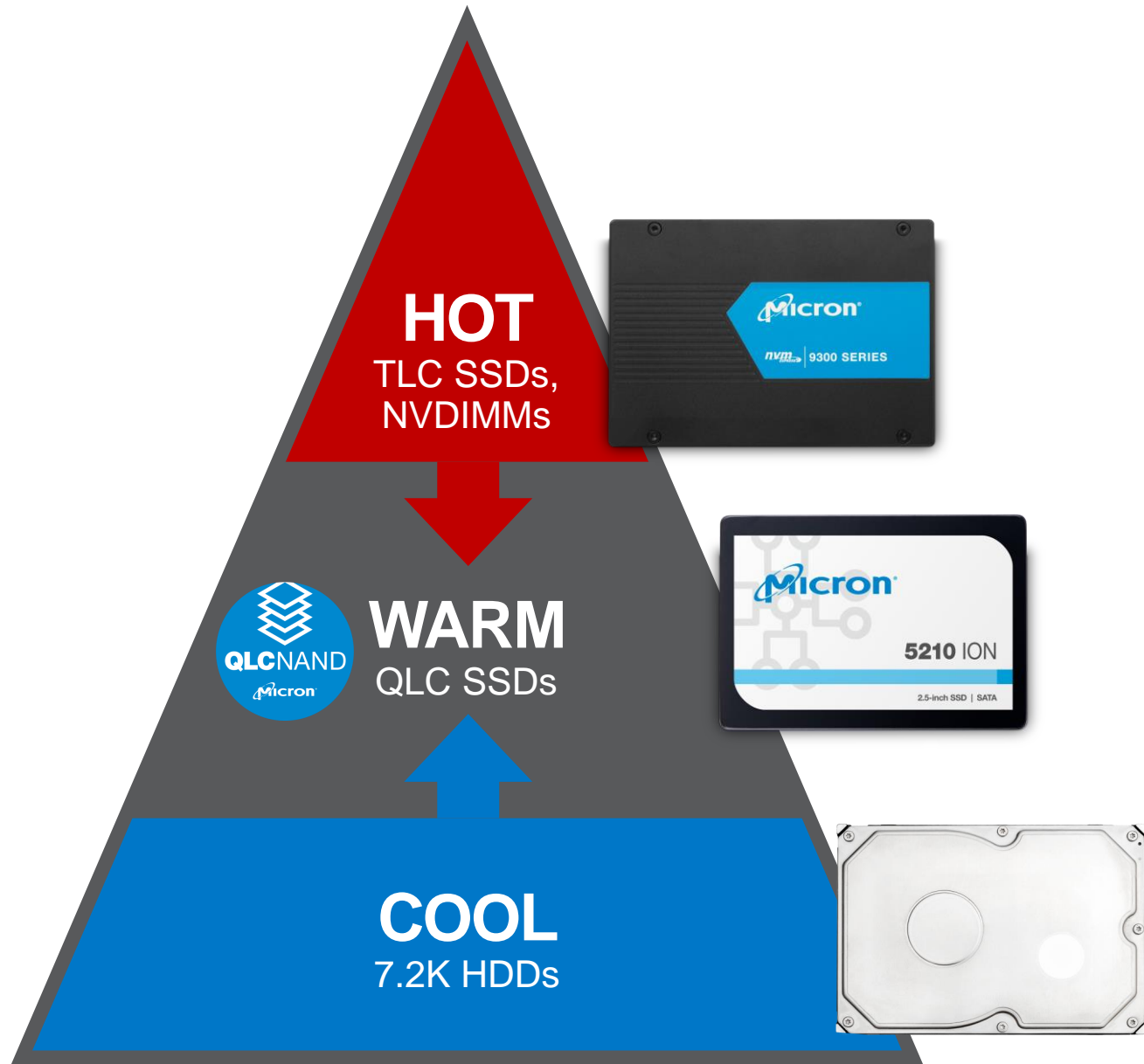


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Tiering with QLC SSDs

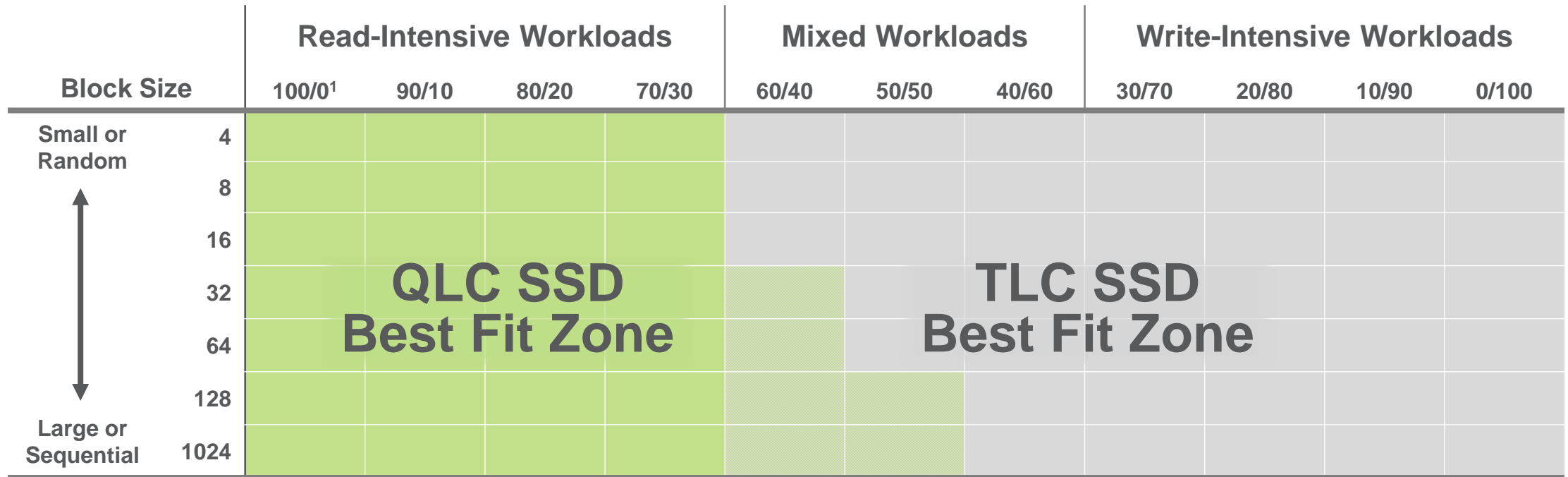
QLC Is Designed To:

- Augment TLC; not replace it
- Transition HDDs to SSDs*










Conceptual illustration showing how enterprise and data center customers tier data

Understanding Best-Fit Workloads for QLC SSDs



Workloads in QLC Best-Fit Zone:

						
Read-Intensive AI Data Lakes	Machine & Deep Learning Data Lakes	Real-Time Analytics & Big Data Hadoop HDFS	Ceph Large Block & Object Stores	SQL Business Intelligence	NoSQL Mongo DB, Cassandra	Media Streaming CDNs
CY'17-21 CAGRs²	43%	13%	36%	9%	20%	14%

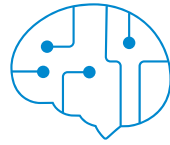
¹Read/write ratio

²Based on industry analysis from IDC, Gartner, Statista, Forbes

10 Performance Sensitive Workloads Historically Run on HDDs

These workloads:

- Read data 90+% of the time
- Rely heavily on random reads & sequential writes
- ... yet have typically been run on HDDs



AI/ML/DL
Data Lakes



Edge Analytics
(5G, etc.)



Analytics
& Big Data
(Hadoop)



Object Stores
(Ceph)



SQL Databases
(BI/DSS)



NoSQL
Databases
(Cassandra)



CDN



Cloud
Services



vSAN
Capacity Tier



Financial
Regulatory &
Compliance
Storage

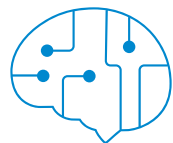


10 Workloads Moving from HDDs to QLC

SATA QLC Enables You to Immediately Replace HDDs in Performance-Sensitive Workloads

SATA QLC offers:

- Up to 450x **faster** performance
- **Lowest** possible TCO of any SSD
- Same interface as HDDs for platform **continuity**
- Architected for HDD environments to **exceed** requirements



AI/ML/DL
Data Lakes



Edge Analytics
(5G, etc.)



Analytics
& Big Data
(Hadoop)



Object Stores
(Ceph)



SQL Databases
(BI/DSS)



NoSQL
Databases
(Cassandra)



CDN



Cloud
Services



vSAN
Capacity Tier



Financial
Regulatory &
Compliance
Storage



HDD Throughput Limits & Their Impact on Reliability

- HDD failure rates increase once HDDs hit their **Workload Rating**, an HDD metric of total throughput
- **Workload Rating as defined on HDD datasheets**: “Maximum rate of <550TB/YR (5-year warranty). Workloads exceeding the annualized rate may degrade the drive MTTF and impact reliability”
- HDD throughput limits apply to reads *and* writes, whereas SSDs only wear when writing

The Impact of HDD Throughput Limits & Reliability Concerns

Drive	Capacity	Workload Rating (TB/Year)	DWPD	5210 Advantage
Micron® 5210 (QLC)	7.68TB	2,242* <small>(and only limited on writes)</small>	0.80	N/A
Vendor B 7.2K HDD	8TB	550	0.19	4x
Vendor B 7.2K HDD	10TB	550	0.15	5x
Vendor B 7.2K HDD	12TB	550	0.13	6x
Vendor C 7.2K HDD	14TB	550	0.11	7x

*Numbers in blue aren't on datasheets, but can be calculated as follows based on sequential transfers:

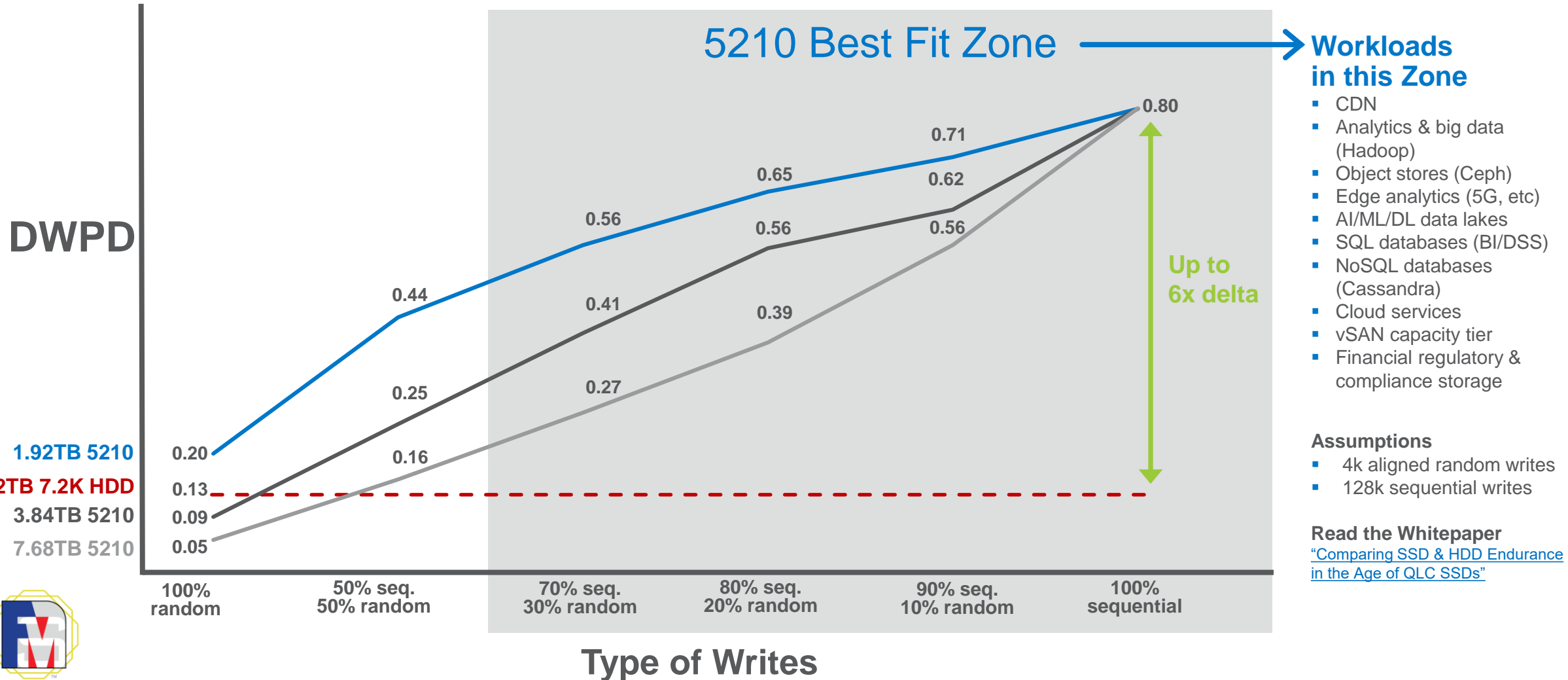
Workload Rating: DWPD x capacity x 365 days per year

DWPD: (Workload Rating / 365 days per year) / capacity



5210 vs. 7.2K HDD Warranted Endurance Comparison

Of all the writes you do, what percent are sequential vs. random in nature?





Don't just take our word for it.

Test 5210 against HDDs in your performance-sensitive workloads and compare the difference.



