

# Will QLC Displace Near Line HDD?

Presented by: Dave Verburg, IBM STSM Storage Technology and Quality

Co-author : Samuel Sitorus, IBM Senior HDD/SSD Procurement Engineer



# Agenda

---

- In Favor of QLC SSD
  - Density
  - Reliability
  - Performance
  - Sustainability
  - Endurance!
- In Favor of HDD
  - Retention
  - Cost
- Conclusion



# Agenda

---

- In Favor of QLC SSD

- Density

- The total volume generated in the AI era is estimated to be 660 zettabytes\*
    - One vendor shipping 75TB SSD module\*
      - “Something brewing in the lab” ... 150 TB
      - 300 TB on Roadmap for 2026?
    - SK Hynix is working on a 300 TB solid-state drive\*
    - IBM FCM currently 38.4 TB usable, 115.2 TB effective with compression\*
    - Max capacity of HDD ~30TB, with larger form factor

\*Source: tomshardware.com,  
www.ibm.com



# Agenda

---

- In Favor of QLC SSD

- Reliability

- Backblaze found an AFR of 1.64% for HDD and 0.98% for TLC SSD; 40% less for SSD\*
      - SSD were quite small ...may not have been data drives
      - IBM has observed improved reliability for SSD at most customers
    - SSD drive issues are more likely to be able to be addressed with firmware
      - HDD issues are more likely to be head or media related
      - HDDs are also more vulnerable to vibration
    - We still need more reliability data for QLC SSD
      - QLC has more voltage levels vs TLC; may have higher bit error rate
      - One vendor advertising 2 M Hours MTBF for 60TB, WD 2.5 M hours ... will it be a wash?
      - IBM leading industry with Flash Core Module



\*Source: [blocksandfiles.com](http://blocksandfiles.com)

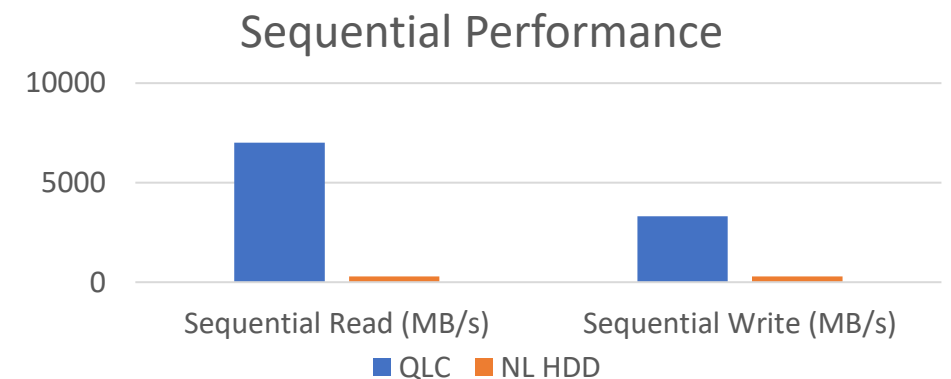
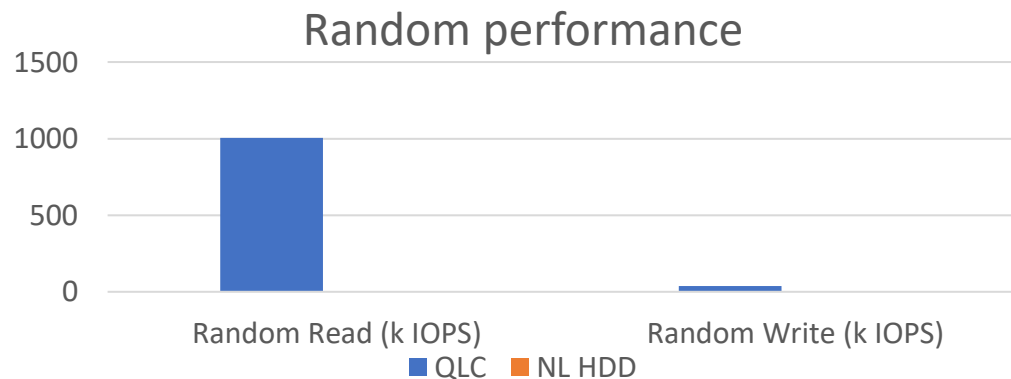
# Tradeoffs

Source: Blocks and Files, Storage Review, Supplier public specs

- In Favor of QLC SSD

- Performance

- Solidigm advertising 1M IOPS Random Read for D5-P5336 vs 212 for 22TB HDD
      - 500X difference; Sequential is closer in performance
    - For AI training, need to feed the (expensive) beast quickly!
      - With the cost of GPUs, need to maximize utilization
      - Training will involve a lot of reading



# Tradeoffs

- In Favor of QLC SSD
  - Sustainability
    - CO2 used for creation
      - SSD has higher “embodied CO2” on creation
      - Graph to the right based on 2023 SSD sizes
    - Cooling
      - SSDs run reliably at higher temperatures; data centers may be able to run warmer
    - Density
      - SSDs is getting denser leading to less footprint needed

Table 1: Emissions of SSD and HDD.

Storage	Energy (KWh)		OPEX CO2e (Kg)		CAPEX CO2e (Kg)		Total CO2e (Kg)	
	5yr	10yr	5yr	10yr	5yr	10yr	5yr	10yr
HDD (1TB)	183.9	367.9	79.6	159	20	40	99.6	199
SSD (1TB)	56.9	113.8	24.6	49.2	160	320	184	369.2

<https://futuraumgroup.com/insights/are-ssds-really-more-sustainable-than-hdds/>



# Tradeoffs

---

- In Favor of QLC SSD
  - Endurance
    - NL Limit currently 550 TB per year
      - Equates to 0.05 DWPD if will still be the limit when reach 30 TB HDD
      - Both Read and Write limitations
      - Perhaps 0.02 DWPD limit for Writes
      - 1/10<sup>th</sup> the endurance of SSD ... although also lower performance



# Tradeoffs

---

- In Favor of NL HDD

- Retention

- TLC now at 3 months retention (EOL)

- QLC may be shorter

- Unusual circumstances may lead to data loss

- For example, system shut down during the pandemic

- HDD have longer retention

- Some applications will need this.

- Key building blocks in AI data cycle – content archival for future training (retrospective)\*

\*Source: [Storagenewsletter.com](http://Storagenewsletter.com)





# Tradeoffs

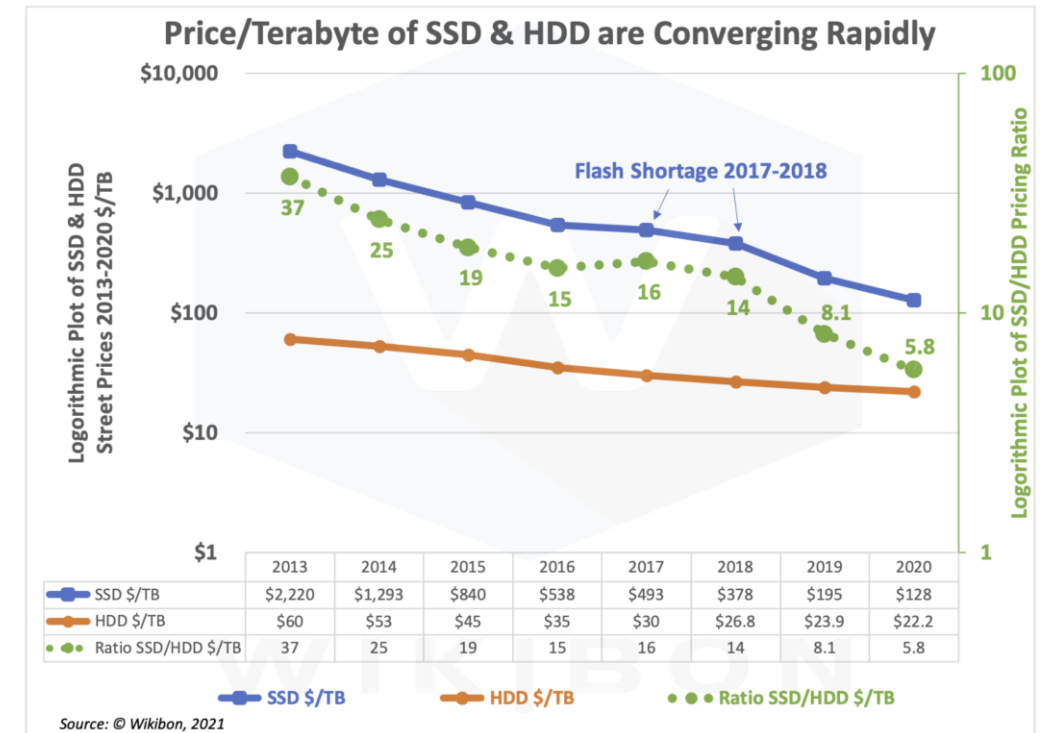
- In Favor of NL HDD

- Cost

- Lower cost, about ~5X Lower

- Gap may close with NAND layer growth
      - “Sustainable” CapEx investment in acquisition cost.
      - But demand will go up with the explosion of data needed for AI
        - With limited NAND availability, will likely drive pricing up in short term
      - Rakers from Well’s Fargo predicting SSD cost/GB will fall 13 percent from 2022 to 2027 and NL HDD only 8 percent in the same period\*

- But TCO favors SSD for some scenarios



<https://thecuberresearch.com/qlc-flash-hamrs-hdd/>



\*Nearline drives will be last HDD holdout by 2028 – Blocks and Files

# Conclusion

- QLC or NL HDD Prediction

- Expect QLC will take off

- Perfect for AI training

- Density
      - Reliability
      - Performance
      - Endurance

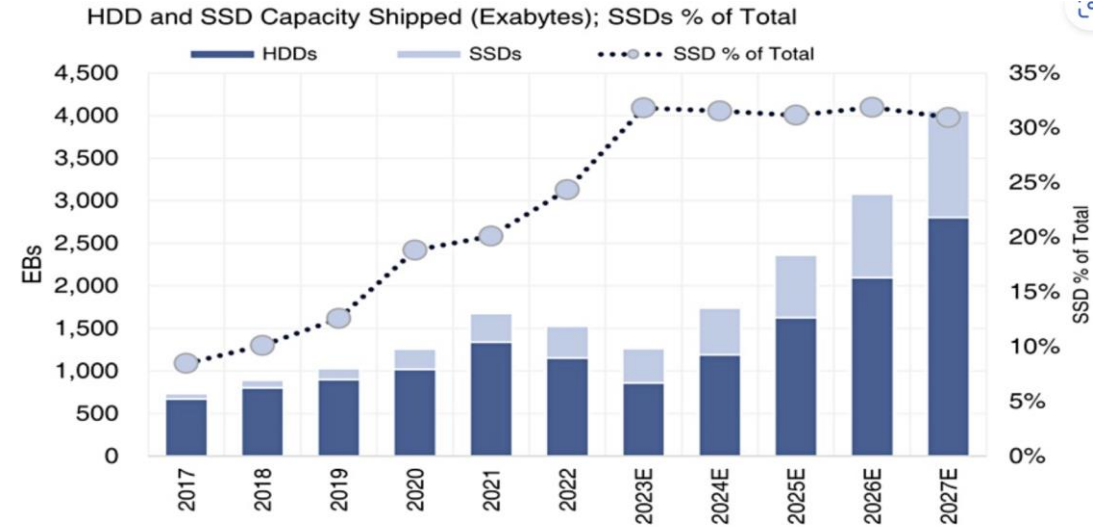
- NL HDD will still have a place

- Tailored fit application with “mixed media type” architecture.

- Many applications still won't need the performance of QLC
    - Some applications will need the retention, lower cost of HDD NL

- AI applications will lead to explosion of data; will still need HDD

- HDD may stay at parity as far as EB shipped as one study from Gartner predicts
    - SSD % of EB shipped may level off for a time, but expect the upward trend to continue



Source: Gartner; Wells Fargo Securities, LLC.

[Nearline drives will be last HDD holdout by 2028 – Blocks and Files](#)



When you interact with IBM, this serves as your authorization to Flash Memory Summit or its vendor to provide your contact information to IBM in order for IBM to follow up on your interaction.

IBM's use of your contact information is governed by the IBM Privacy Policy.

