HDDs for Mass Capacity Storage

MANUEL A OFFENBERG

MARCH 2023
01  Total HDD Exabytes shipped is aligning to market evolution
    HDD demand driven primarily by High Capacity (average 7.8TB & growing)
    Post-covid demand is down but seeing some encouraging indicators
    Market outlook for High-Capacity HDD is positive as inventories are being depleted

02  Ongoing adoption of 20+TB platform, representing nearly
    60% of Seagate nearline EB shipped in Q2FY23

03  Confidence in Heat Assisted Magnetic Recording keeps growing
    "We are meeting or exceeding all product development milestones and reliability metrics, and
    we will be shipping prequalification units to key cloud customers in the coming weeks. As a
    result of this progress, we now expect to launch our 30-plus terabyte platform in the June
    quarter, slightly ahead of schedule." (Dave Mosley, CEO, Q2FY23 earnings call)
Cloud Data Centers Choose Mass Capacity HDDs

Hyperscale Data Centers

89% Mass Capacity HDDs

<table>
<thead>
<tr>
<th>Cloud #</th>
<th>% Exabytes Stored</th>
<th>% HDD</th>
<th>% SSD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>89%</td>
<td></td>
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<tr>
<td>2</td>
<td></td>
<td>94%</td>
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<tr>
<td>3</td>
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<td>81%</td>
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<tr>
<td>4</td>
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<td>5</td>
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<td>6</td>
<td></td>
<td>96%</td>
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<td>7</td>
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<td>90%</td>
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<td>8</td>
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<td>68%</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>90%</td>
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<tr>
<td>10</td>
<td></td>
<td></td>
<td>99%</td>
</tr>
</tbody>
</table>

Source: IDC Cloud Infrastructure Index 2021
Good Progress in HAMR Recording Technology

- 50TB Target (10 Disc)
- 30TB Target (10 Disc)
- HAMR V1 Design (Lab demos)
- HAMR V2 Design (Lab demos)
- HAMR V3 Design (Lab demos)

Areal Density (Gb/in²)

- Longitudinal Recording Products
- Perpendicular Recording Products
Dramatic Capacity Growth & Power Reduction

HAMR Enables Continued Watts/PB Decline
Increasing Need for Circularity

Raw Materials
Parts Manufacture
Product Manufacture
Distribute/Service
Collection

Avoid Linear Consumption & Landfill

Recycle
Reclaim
Refurbish
Redeploy
Media Sanitization is a Must

A process or method to render access to target data on storage media infeasible for a given level of effort.

Sanitization Defined for each Media Type.

Interface-specific techniques (e.g., SATA, SAS, NVMe).
Built on a Solid Storage Security Foundation

Self-Encrypting
- Data Confidentiality
  - At-speed Data Encryption
  - Instant Secure Erase

Standards
- Government Grade
  - FIPS 140-2 Certified
  - TCG Storage Security

Ubiquitous
- Root-of-Trust
  - Digitally Signed Firmware
  - Secure Boot & Diagnostics

Assurance
- Device/Supply Chain
  - ISO / NIAP Common Criteria
  - ISO Trusted Technology Provider

Transparency
- Trustworthiness
  - Secure Isolation
  - Open Secure Hardware

2007 2010 2014 2018 Now
Security Transparency

Open Hardware Standards

RISC-V’s open and clean-slate design presents an opportunity to re-think security for the next generation of storage infrastructures

“OpenTitan is the first open source project building a transparent, high-quality reference design and integration guidelines for silicon root of trust (RoT) chips.”

(OpenTitan website, https://opentitan.org/)
HAMR is working! Seagate is shipping HAMR based products.

Will launch >3 TB/disk this year, ahead of schedule.

Increasing focus on Sustainability, Circularity, Data Security, and Media Sanitization as device capacities keep growing.