

The Quantum logo features the word "Quantum" in a bold, blue, sans-serif font. The letter "Q" is significantly larger than the other letters and has a registered trademark symbol (®) to its upper right.

Your difference is in your data.™

## ActiveScale Cold Storage

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## Combining Quantum's Object Storage and Tape Expertise

# Quantum<sup>®</sup>

### Leader in data archival at Hyperscalers

#### Example Metrics Dataset:

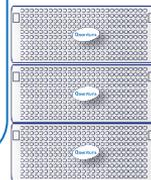
- Total Data Written = 56 EB
- Total Data Read = 122 EB
- 2.4 *billion* miles of tape movement
  - ~5000 times to the moon and back!



### ActiveScale acquisition (2020)

#### ActiveScale / Amplidata

- Pioneer in using Erasure Coding for Object Storage



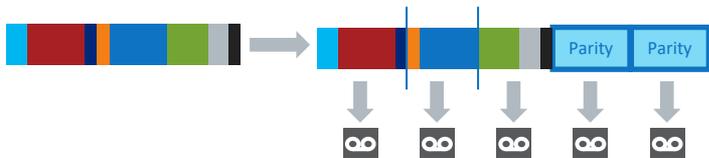
Combined Hyperscaler and Erasure Coding expertise

ActiveScale Cold Storage

# Most important learnings from using Tape at the Hyperscalers

## DATA DURABILITY

- Durability of single copy of data on Tape
  - About 3.2 Nines
    - Store 10,000 objects: on average 6 per year will be lost
- Solution
  - Multi-copy approach: 3 or 4 copies ☹️
  - **Across-Tape Erasure Coding**
    - Needs to be architected carefully, to have good performance



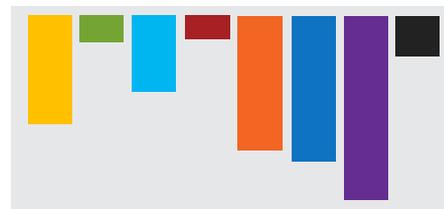
## MOST COMMON READ ERRORS

- Part of a tape is unreadable/damaged
  - Section of data < 2 GB unreadable
  - ~100 times more frequent than any other read error
- Solution
  - Multi-copy approach: read from another tape ☹️
  - **Within-tape Erasure Coding**
    - Very wide Erasure Code (= low storage overhead)
    - Automatically recover unreadable data without mounting other tapes

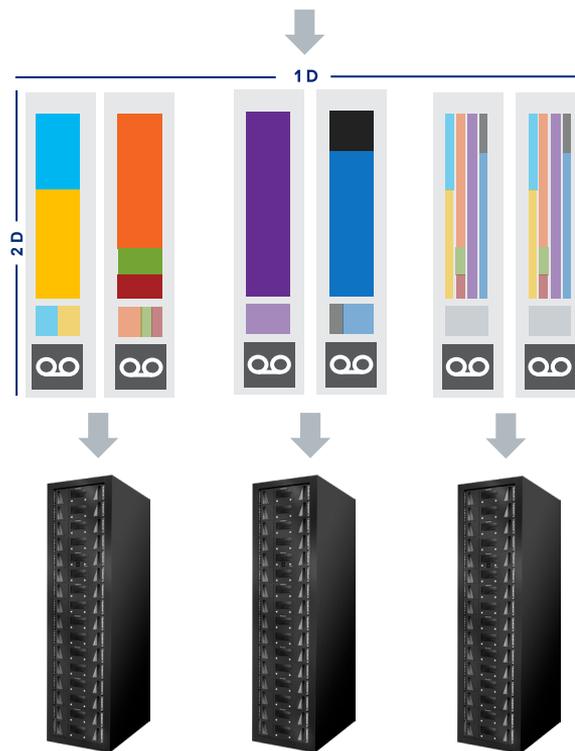


# Patented 2-Dimensional Erasure Coding (2D EC)

- Across-Tape EC
  - Protect against multiple tape failures
  - Read object from a single tape
  - Optional library (RAIL) or Geo (3-Geo) failure protection
    - RAIL = Redundant Array of Independent Libraries
- Within-Tape EC
  - Quickly recover from most common read errors
- Low storage overhead (e.g. 20%)

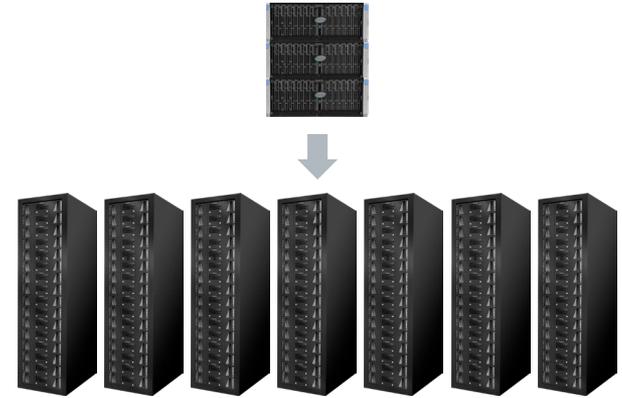


HDD  
or  
NVMe



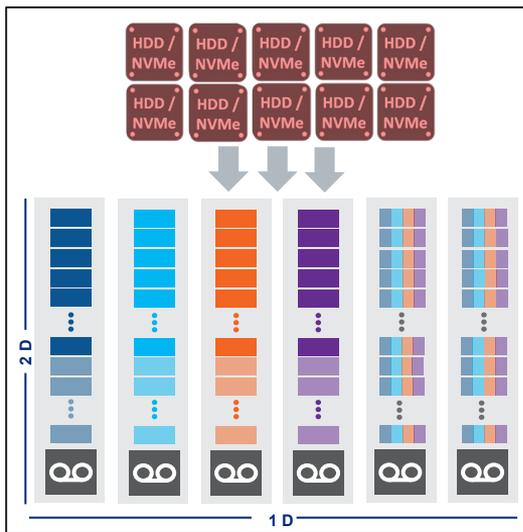
# ASCS: less storage overhead & better durability

- RAIL w/ 7 Scalar i6 tape libraries
- Patented 2-dimensional Erasure Coding (18+3)
  - Protect across 21 tapes but read from SINGLE TAPE
  - Protect from up to 3 simultaneous tape failures or 1 tape library going down (e.g. robot failure)
  - Overhead = 25%: 75PB usable system only requires 91PB RAW



| 75PB usable systems                   | Legacy Tape 1-Copy | Legacy Tape 2-Copy | ASCS 2D EC                      | Legacy Tape 3-Copy          | ASCS 3-Geo 2D EC (6+3)             |
|---------------------------------------|--------------------|--------------------|---------------------------------|-----------------------------|------------------------------------|
| LTO-9 Tapes                           | 4,167              | 8,334              | 5,243                           | 12,501                      | 6,741                              |
| Durability                            | 3.2 Nines          | 6.4 Nines          | 15.5 Nines                      | 9.7 Nines                   | 17 Nines                           |
| Objects Lost Per Year with 1B Objects | 603,000            | 363                | 0.0000003<br>(one every 3M yrs) | 0.22<br>(one every 4.6 yrs) | 0.00000001<br>(one every 100M yrs) |

# ActiveScale Cold Storage Combines Quantum's Object Storage and Tape Expertise



## Single integrated system

Standard and Glacier Storage Classes  
Codesigned by object storage and tape experts  
Single Vendor & Pane of Glass

## Patented 2D Erasure Coding

Restore object from a single tape  
Recovery from multiple tape failures  
As low as 15% overhead (wide EC)  
Soft tape errors can be recovered from the same tape

## Object Storage levels of Durability

Up to 19 9's of durability  
Periodic Tape Checking  
End-to-end data integrity via checksums

## Optimal Drive Performance & Durability

Only terabyte-sized writes  
Restore queue  
No striping / parallel drive speed matching / ...  
Enables "active cold tier"

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