

New Tape Technology in LTO-10

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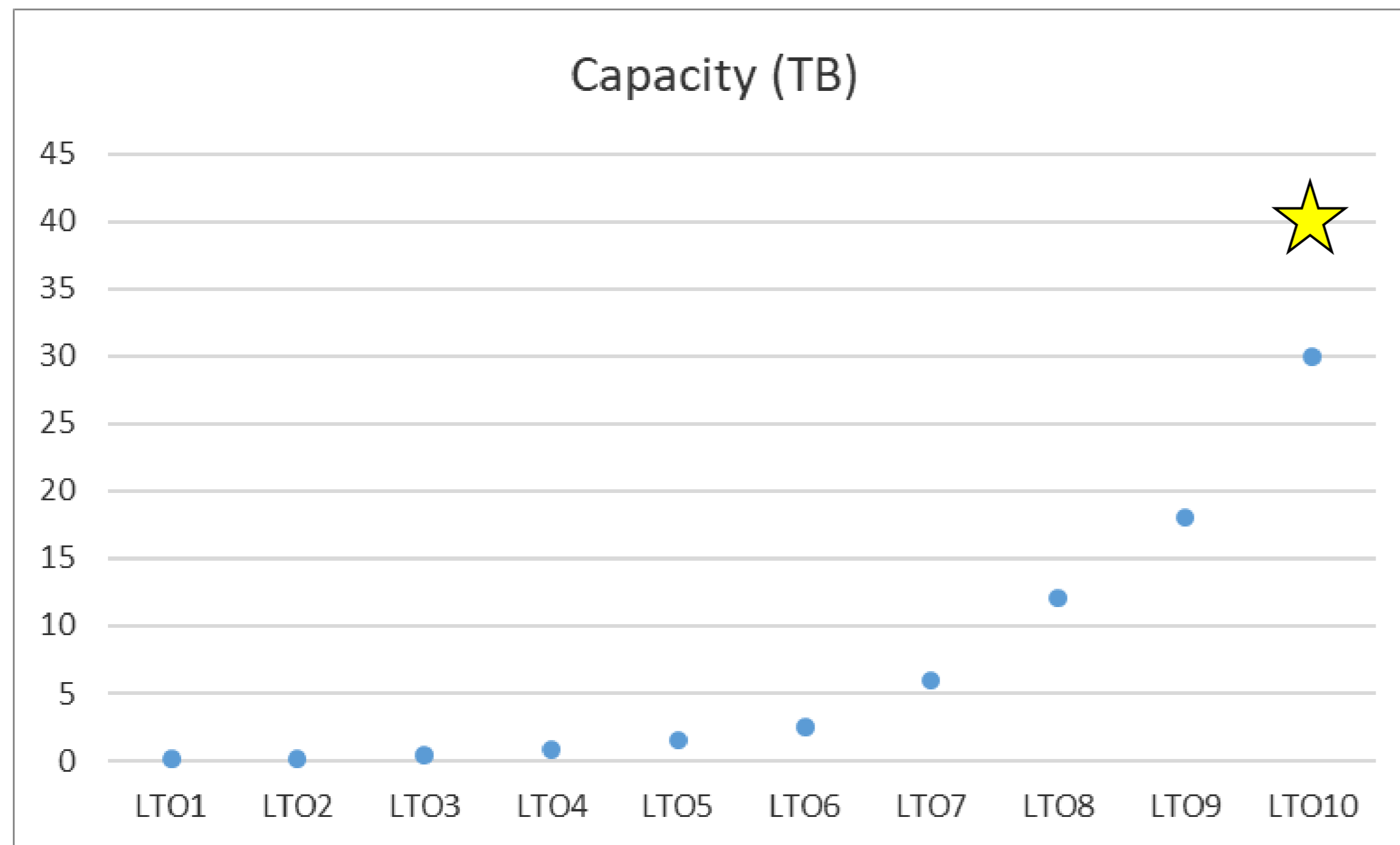
Designing Storage Architectures
Library of Congress
2026



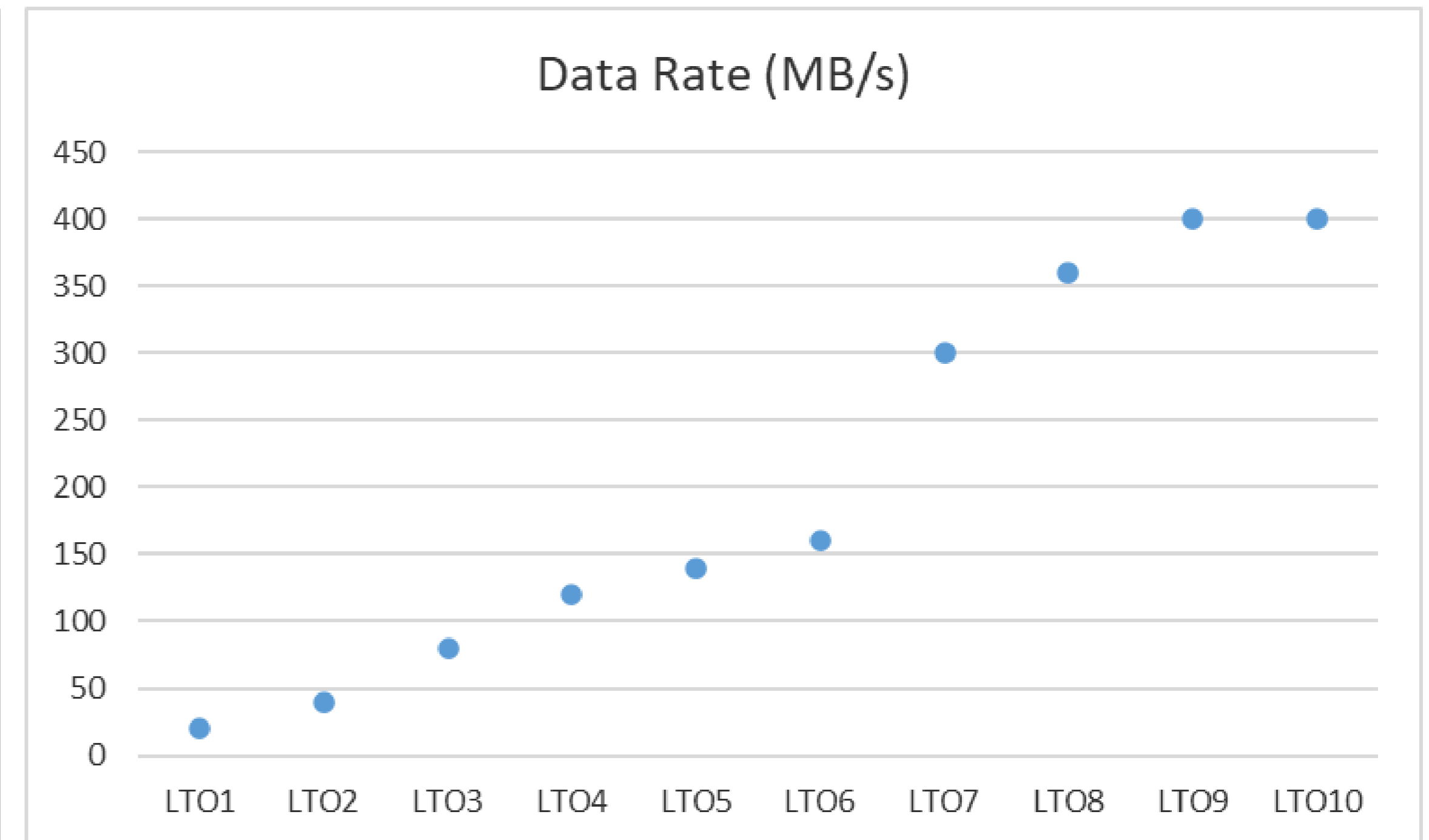
25 Years of LTO Technology



400x Capacity Increase

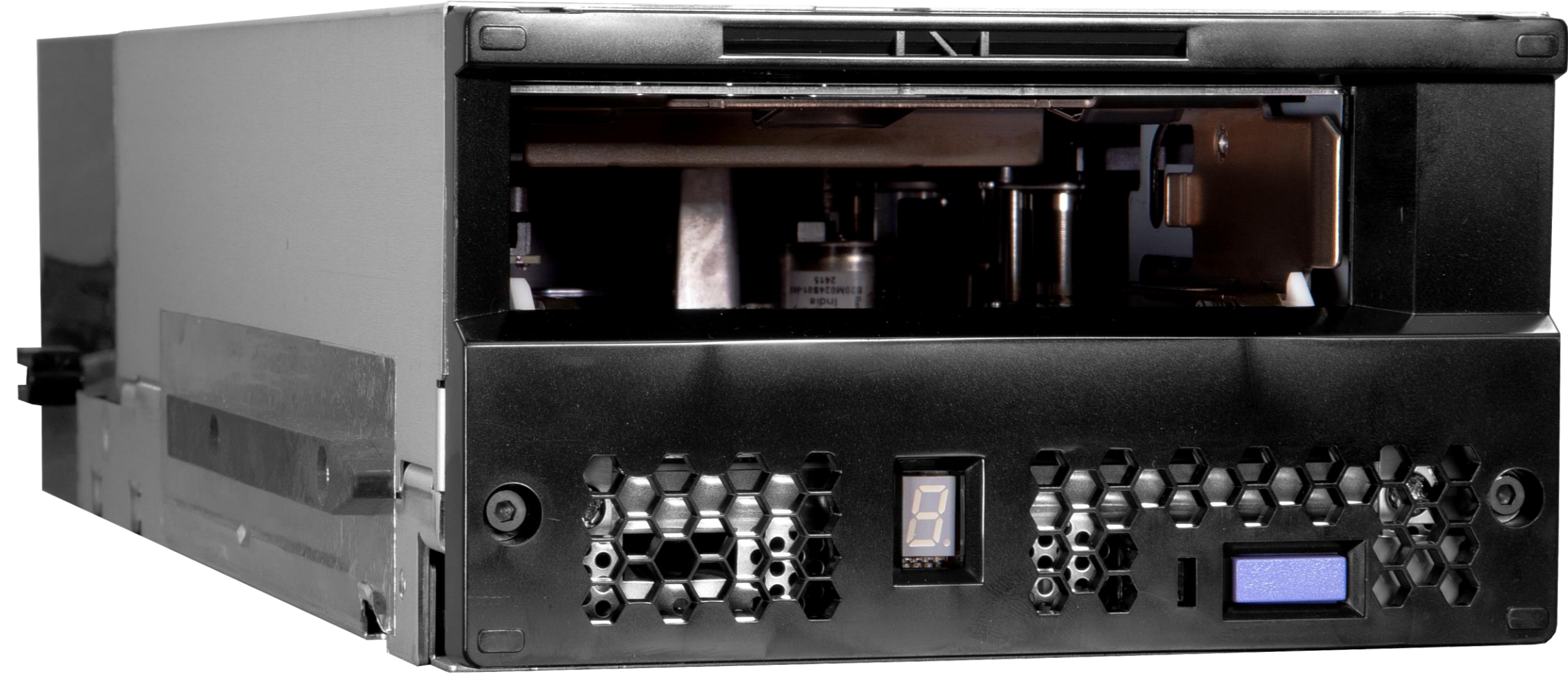


20x Data Rate Increase



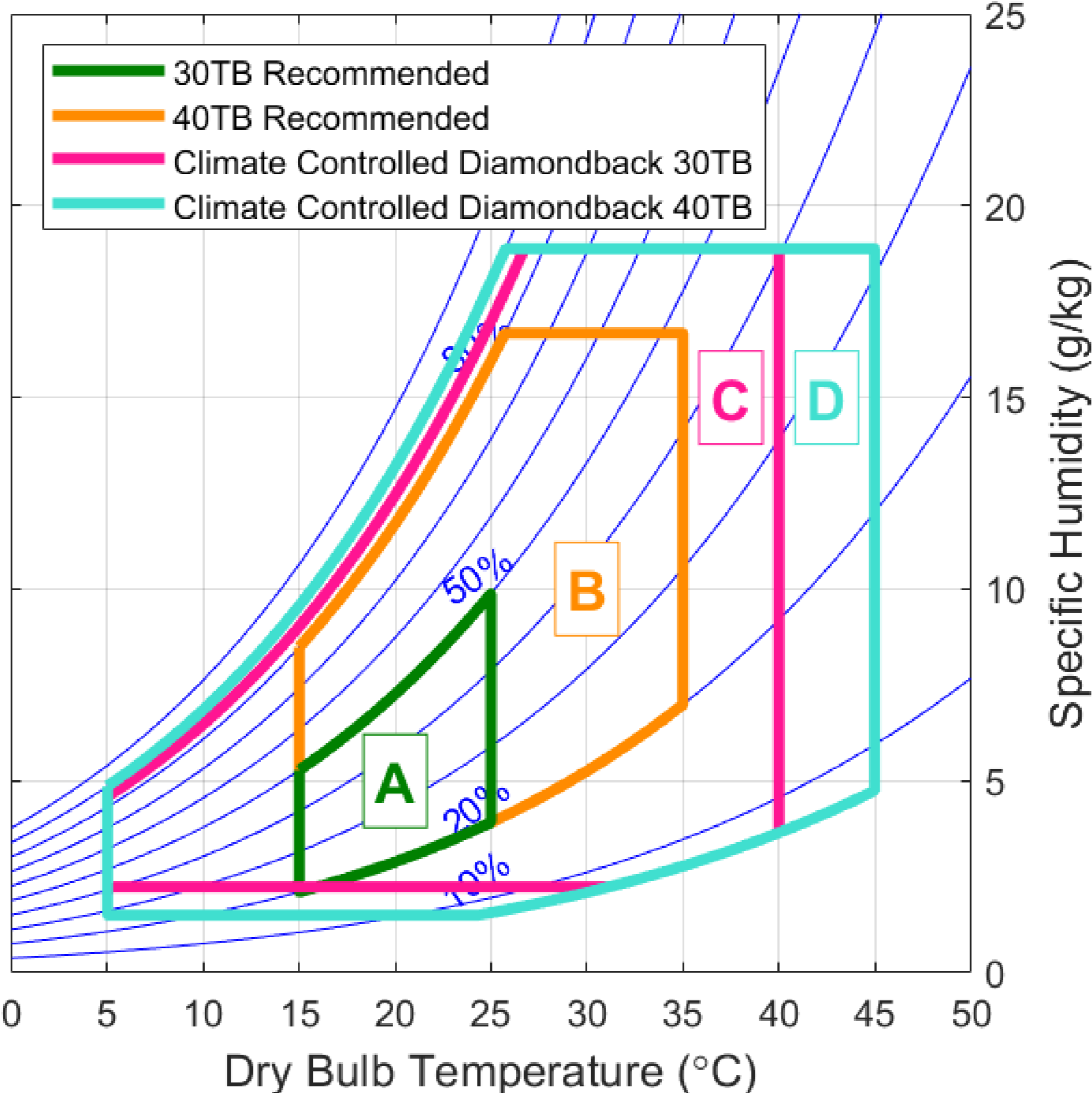
LTO-10: The Largest Technology Advancement since LTO-1

- Higher Capacity
 - 30TB (1.7x LTO-9)
 - 40TB (2.2x LTO-9)
- Faster Interfaces
 - 32G FC (4x LTO-9)
 - 12G SAS (Mini-SAS HD)
 - Copper
 - Active Optical
- New Components
 - ASICs
 - Mechanisms
 - Write/read head



LTO-10: Environmental Expansion

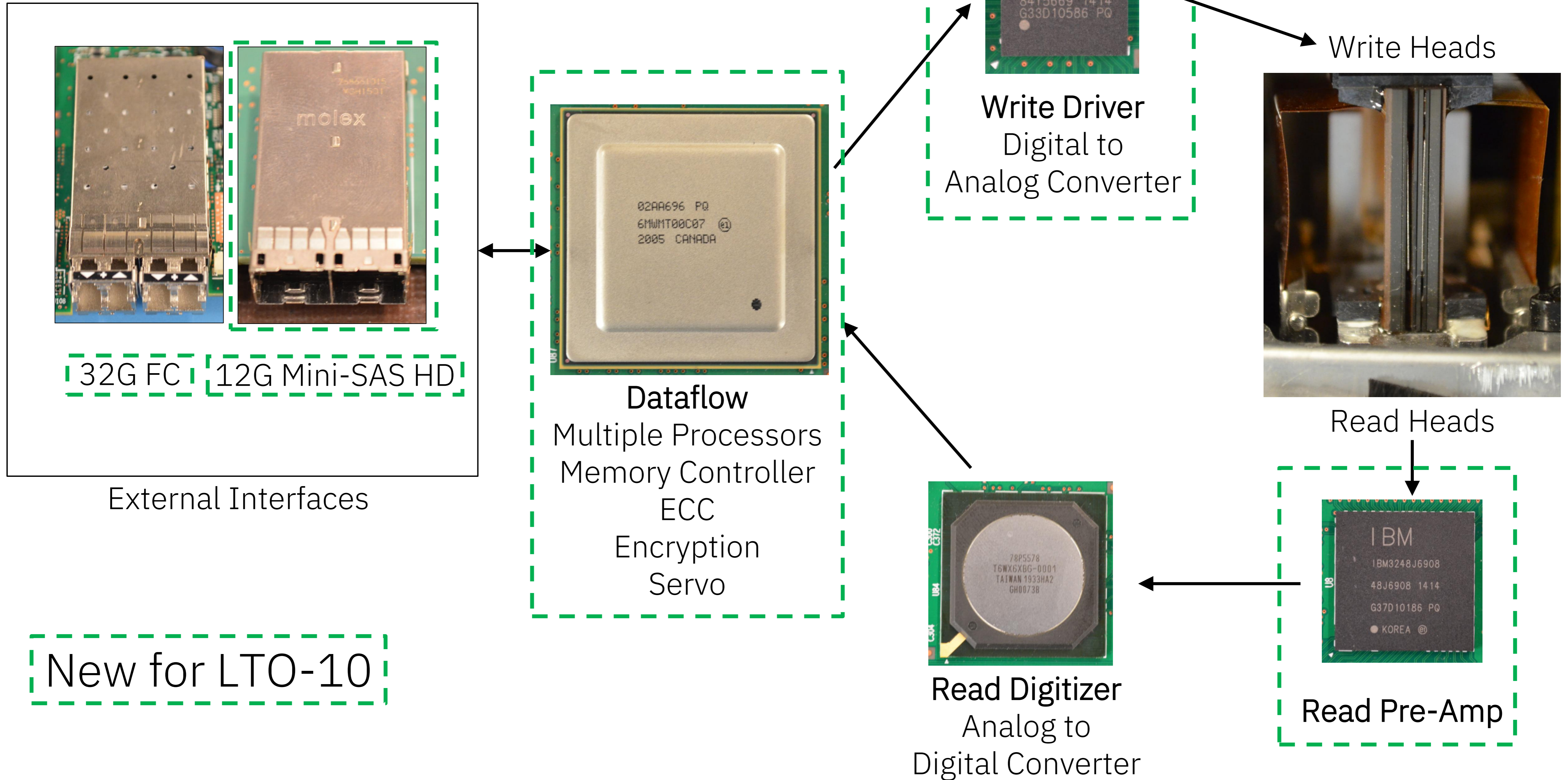
- 40TB enables larger environmental range at the cartridge/drive level
- Climate Controlled Diamondback Tape Library
 - 30TB
 - 46 PB (2x LoC)
 - ASHRAE A3
 - 40TB
 - 63 PB (3x LoC)
 - ASHRAE A4



In 2022, the Library managed 21 petabytes of digital collection content

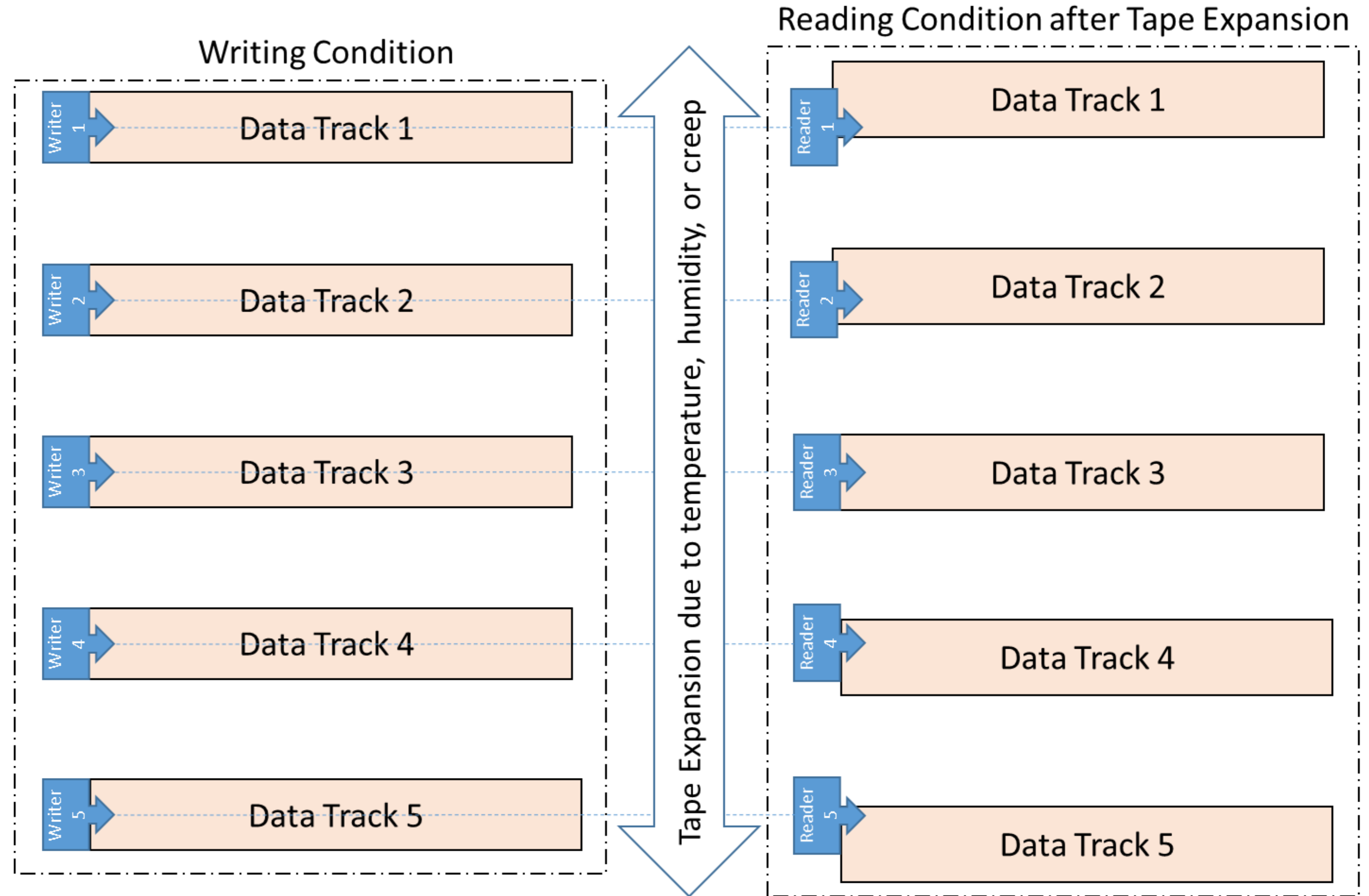


LTO-10 ASICs



Tape Dimensional Stability (TDS)

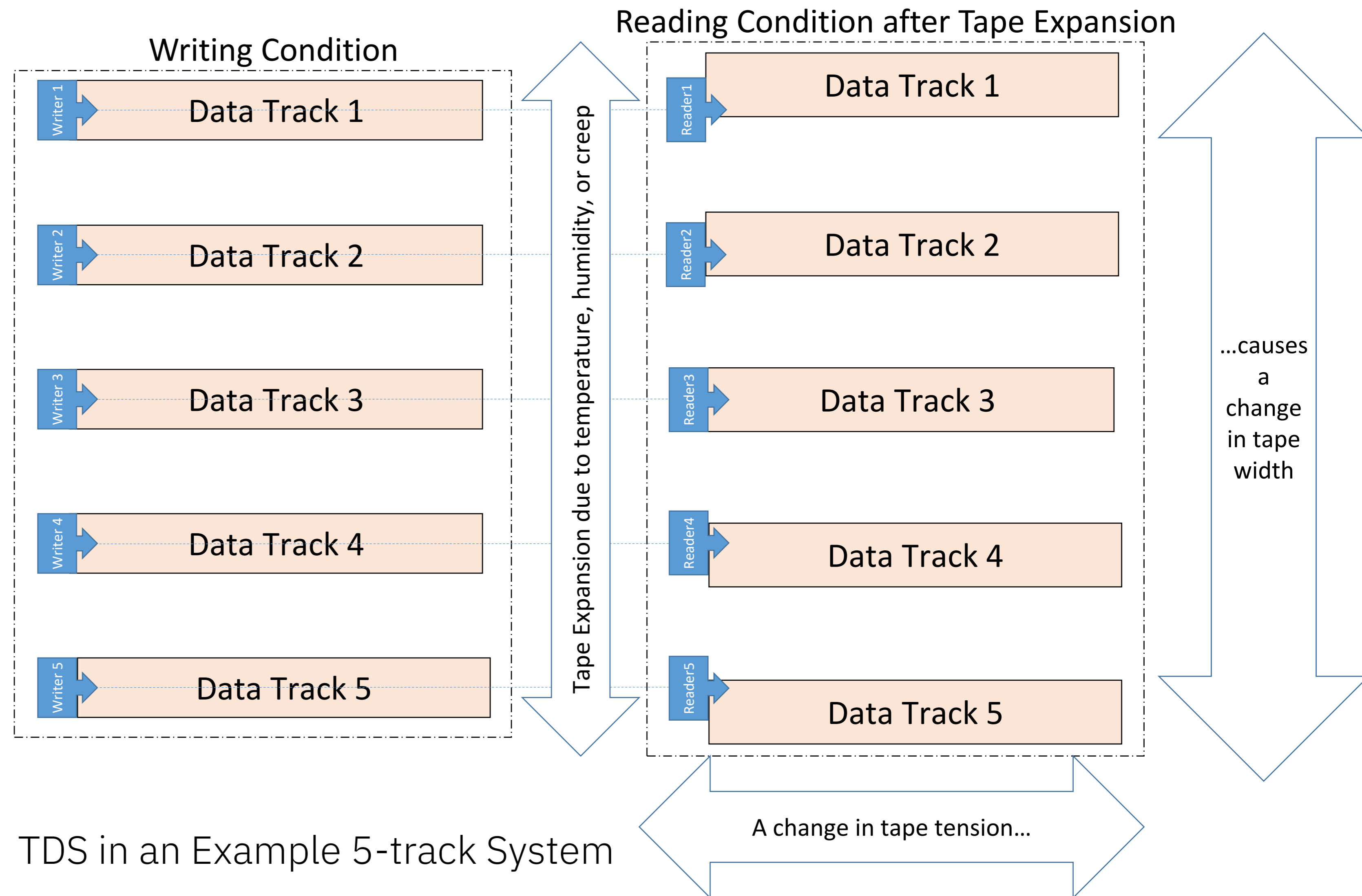
- Data is written on tape in a parallel fashion with 32 writers. All 32 readers must stay on their respective written tracks
- Any mismatch of track centerlines results in increased error rates for that channel



TDS in an Example 5-track System

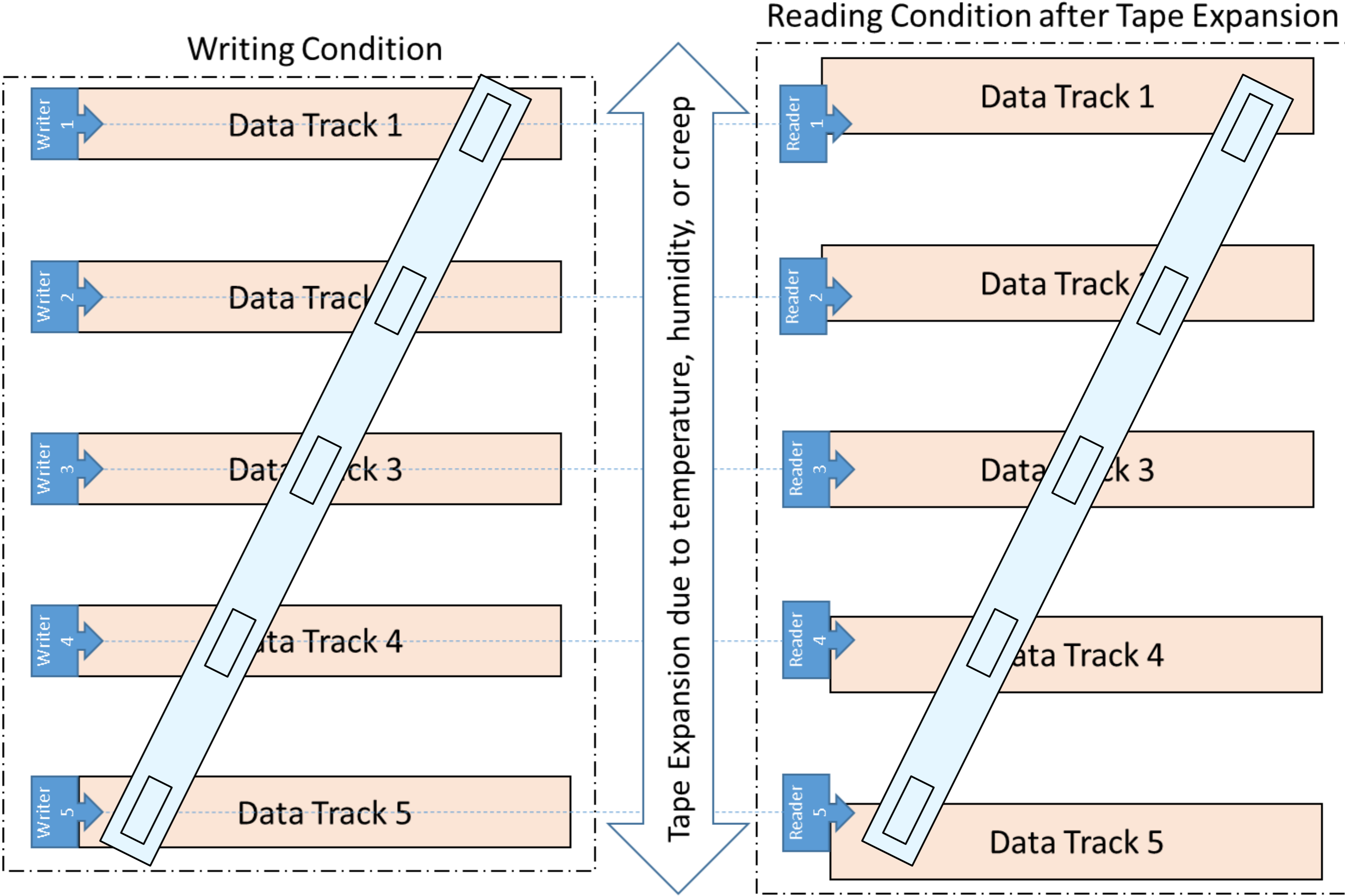
Tension Control of TDS

- The drive continually monitors the condition of the tape
- As mismatches are observed the tension is changed
- Poisson effect converts longitudinal tension changes to lateral expansion or contraction
- Constrained operating point



LTO-10: TDS Compensation by Head Tilt

- The drive continually monitors the condition of the tape
- As mismatches are observed the head tilt is changed
- By increasing or decreasing the angle of the head, the drive can follow expansion or contraction of the tape
- More flexibility to choose operating point

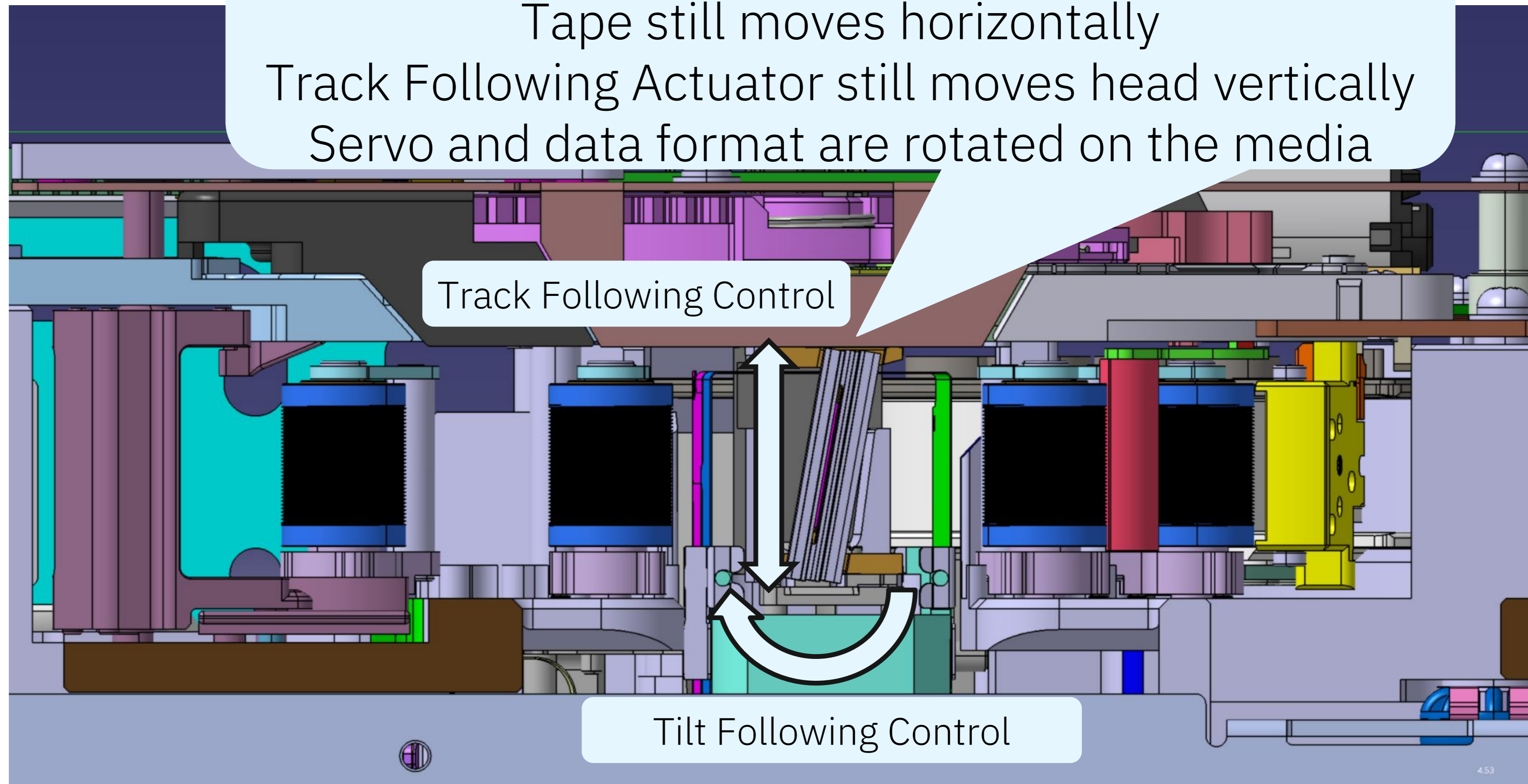


LTO-10: TDS Compensation by Head Tilt

Because the servo and data format are now rotated on the media, this prevents older generations from being written or read on LTO-10

Head Tilt for TDS control

Tape still moves horizontally
Track Following Actuator still moves head vertically
Servo and data format are rotated on the media



LTO-10: TDS Compensation by Head Tilt

LTO-10 drives compensate for TDS changes by changing the angle of the write/read heads

No cartridge calibration required for LTO-10 (saves 500+ hours per Diamondback)

No archive unload required for LTO-10 (saves 500+ hours per Diamondback)



Takeaways

- 25 Years of LTO Innovation
- LTO-10 is the largest technology leap since LTO-1
- Investments pave the road for future generations
- The future of tape is bright

IBM