Removable Media Trends
MSST 2025

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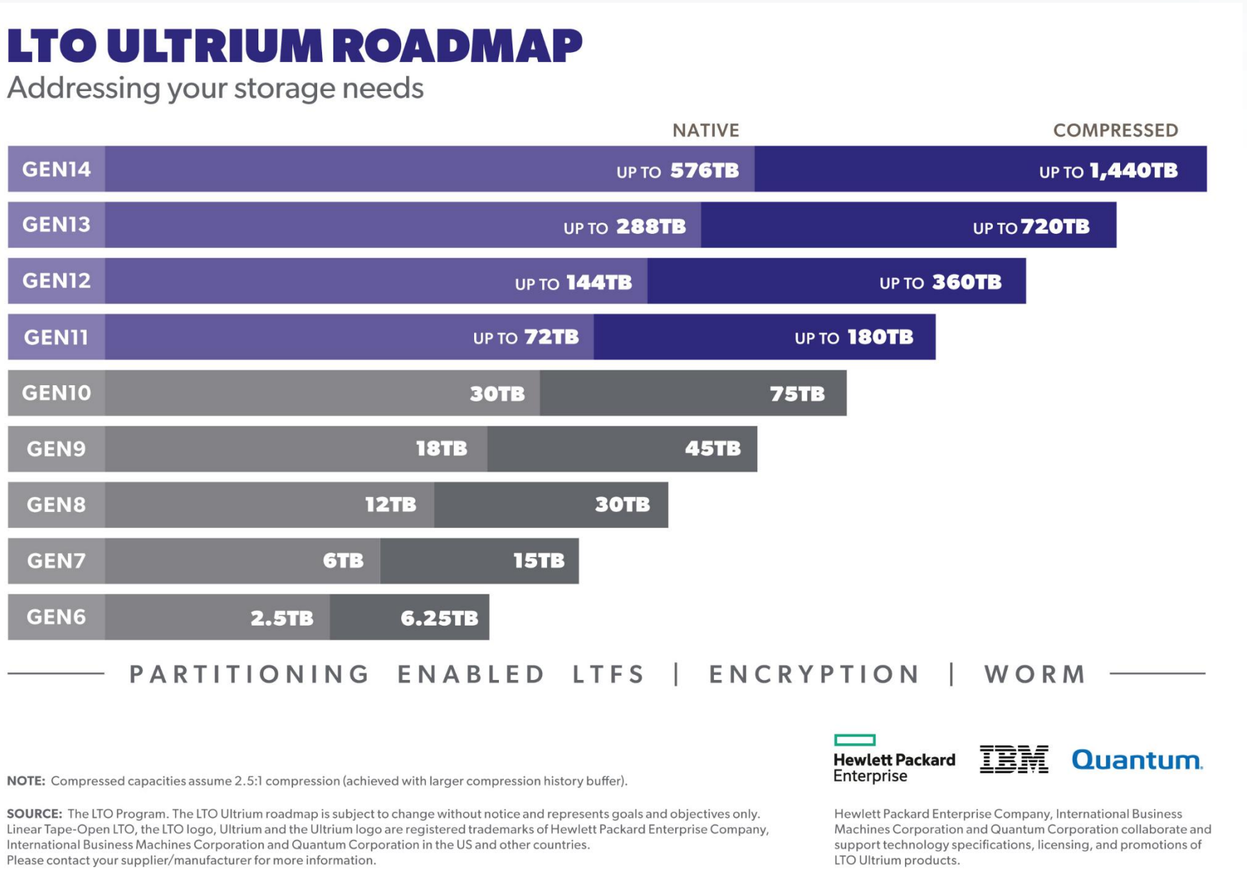
25 Years of LTO

25 years of LTO Dominance

- LTO-1 released in 2000
  - 100 GB per tape
  - 20 MB/s
- LTO-10 now available
  - 30 TB per tape
  - 400 MB/s
  - Designed for future generations



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First a Look Back

TS1170

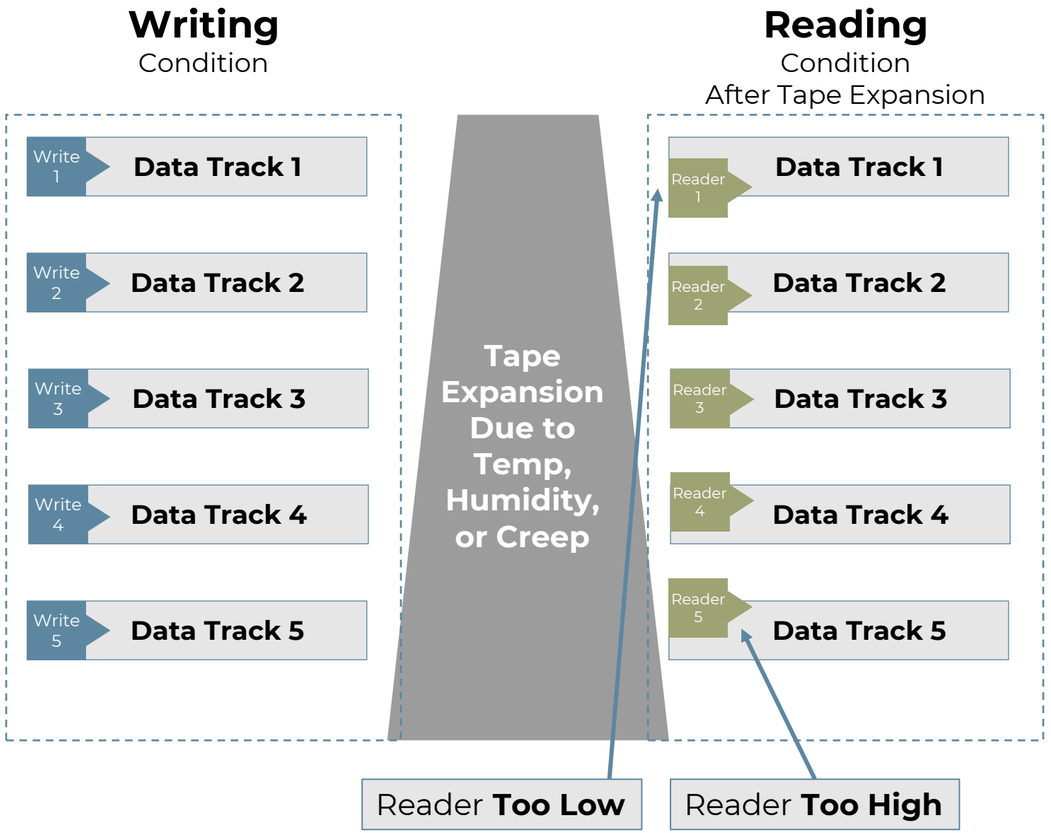
- Released August 2023
- 50TB native capacity, JF media
- 400 MB/s native throughput
- 16G fibre channel
- 12G SAS TS1170 also available

LTO-9

- Released September 2021
- 18 TB native capacity
- 400 MB/s native throughput (FH)
- 8GB fibre channel
- 12Gb SAS FH now available
- Now with oRAO for similar read to TS11XX

Challenge after LTO-9 Tape Dimensional Stability (TDS)

- Next challenge—but has solution
- Data is written on tape in a parallel fashion with 32 **writers**
- All 32 **readers** have to stay on their respective written tracks
- Variation in dimensions can occur in both the media and heads due to:
  - Temperature changes
  - Humidity changes
  - Tape tension variation
  - Tape aging/creep
  - Head wear/aging
  - Head manufacturing variation
  - Tape tension
- Any mismatch of track centerlines results in increased error rates for that channel



TDS in an Example 5-Track System

Introducing LTO-10

A Revolutionary Tape Platform

- 30 TB Uncompressed Capacity
- 400 MB/s Throughput
- 32G FC or 12G SAS Copper or Active Optical
- New Strontium Ferrite Media
- No Backward compatibility
- Entirely New Platform
- Available now

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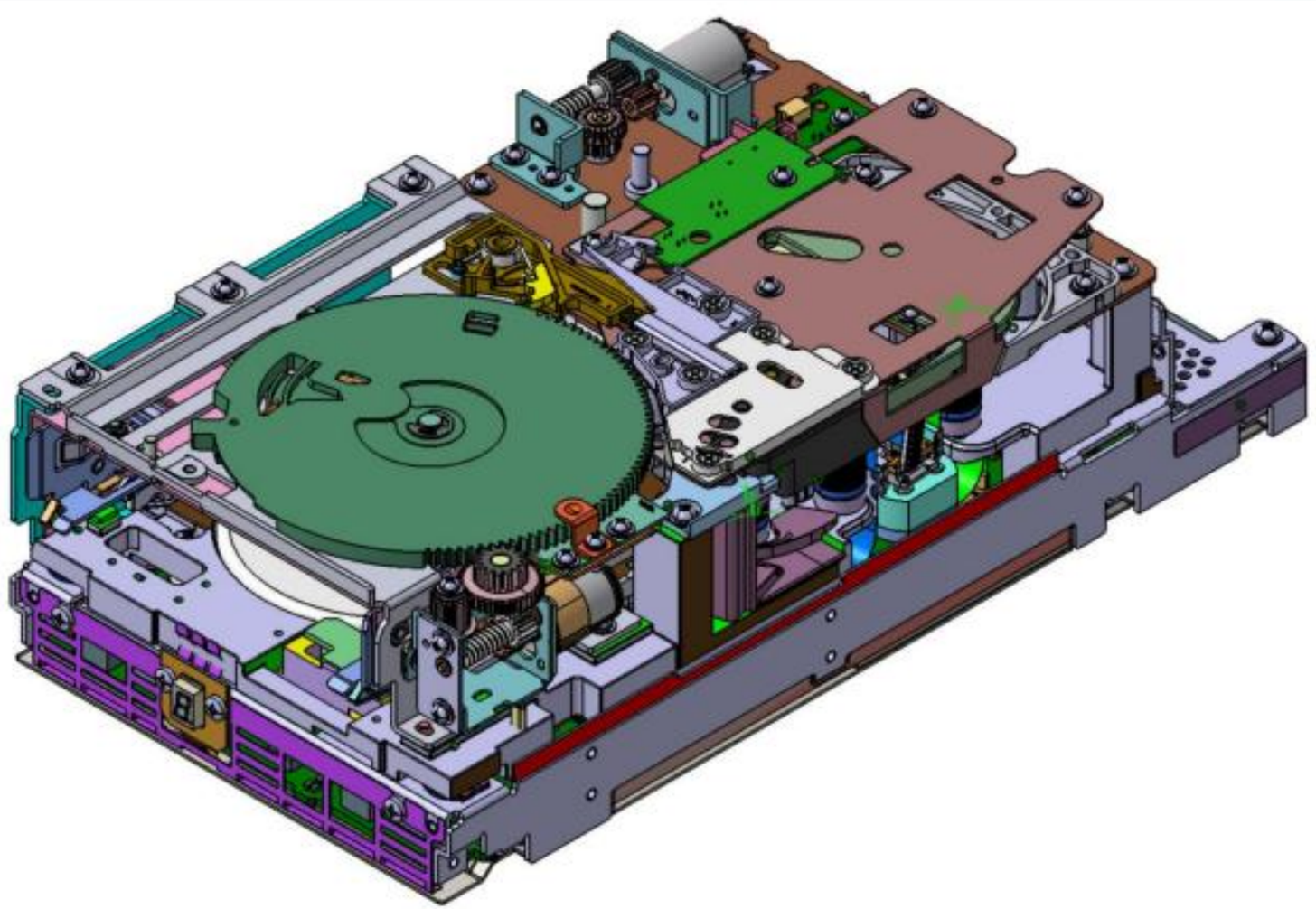
Breakthrough Technologies

New Platform enables LTO-10, LTO-11, LTO-12 and beyond…

- Deeper Deck/Actuator
- Data Flow ASIC
- Writer ASIC
- Analog ASIC
- Internal cabling

Data Flow ASIC*

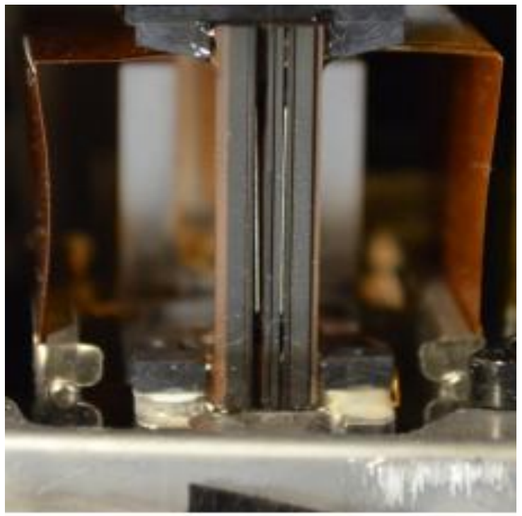


Operational Simplification

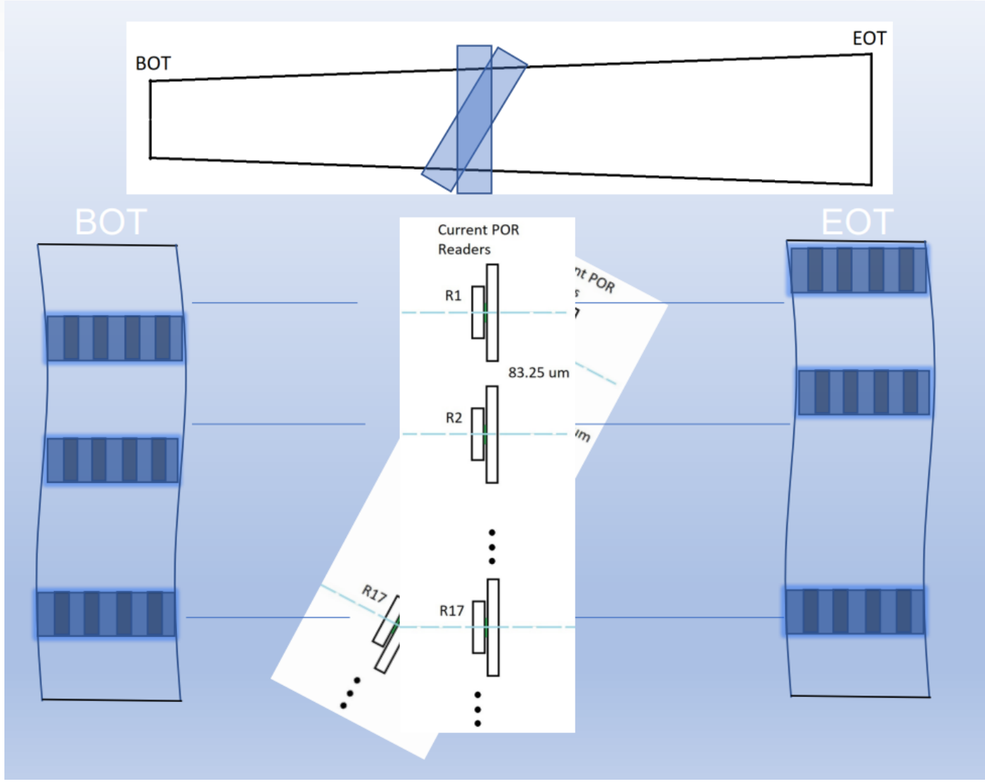
Reimagined Read/Write Head & Tape Path

Pivoting 32-channel “Pisa” Head

- Improves Tape Dimensional Stability
- Eliminates Media Initialization
- Eliminates Archive Low Tension Unload
- Increases Environmental Design Margin



Pisa Read/Write Head*



Pisa Head Geometry*

Spectra Tape Library Portfolio

Spectra® Stack

Spectra Cube™

Spectra® T950

TFinity® Plus

Library	Max. Media/Slot Count[1]	Max. Native Capacity[1]	Max. Compressed Capacity[1]	Max. Drives[2]	Max. Native Throughput (TB/hr.)	Tape Drives Supported	Dual Robotics	Dimensions H x W x D (Inches) Rack Units
Spectra Stack	560	**16.8PB**	42.0PB	42 Half Height 21 Full Height	45.4 HH 30.2 FH	LTO	N/A	78.7 x 19 x 47 42U (Standard 19-inch rack)
Spectra Cube	1,670	**50.1PB**	125.3PB	30 Half Height 16 Full Height	32.4HH 23.0 FH	LTO	N/A	79.4 x 35.9 x 45.4 42U (Standalone frame)
Spectra T950	10,020 (LTO) (8-frames)	**300.6PB**	751.5PB	120	172.8	LTO	N/A	79.12 x 29 x 39.4 (45U) (Individual frame)
TFinity Plus	56,400 (LTO) (45-frames)	**1.7EB**	4.2EB	168	241.9	LTO, IBM® TS11XX and Oracle® T10000	Yes	79.12-82 x 29 x 43.25 45U (Individual frame)
	42,930 (TS1170) (45-frames)	**2.2EB**	6.4EB	168	241.9			

1. Capacities and throughputs are based on LT0-10 and IBM TS1170 tape technology.
2. Drive types are full height unless noted.

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SAS vs Fibre channel

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Data Center Pain

- **Fibre Channel** is the traditional connection
  - Switches with complex Zoning
- Most Fibre has phased out for SAN in favor of Ethernet
- Expense continues to grow
  - 64G switches $30-90K - plus HBAs, cabling, maintenance, expertise, etc
- Tape underutilizes Fibre bandwidth per drive
- Spectra customers openly vocal about wanting an alternative to Fibre Channel

- **SAS** is also available for Tape Drive connectivity
  - SAS is the highest ship by volume ~70% of the market
  - LTO-9 introduced FH-SAS , same with LTO-10 and beyond
- SAS is cheaper by ~$1000 per Tape drive and direct connect so no switch needed or hassle
- **But**… SAS is 3-4 meter max so the server has to be on top or RIGHT next to the library.

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We sometimes put the Host server on top of the library and direct connect SAS

- Lowest cost
  - ~$1000/Tape drive savings to go SAS
  - 1:4 Fanout cables are low cost so one HBA runs 16 drives
- Logistics are sometimes an issue
  - Rack height
  - Serviceability
  - 4:1 SAS breakouts have length limitations
  - Not all libraries have well placed top mounts
- Expansion Limitations
  - What happens if you want multiple shelves of Disk storage
  - What happens if one host needs to run 2-3 libraries

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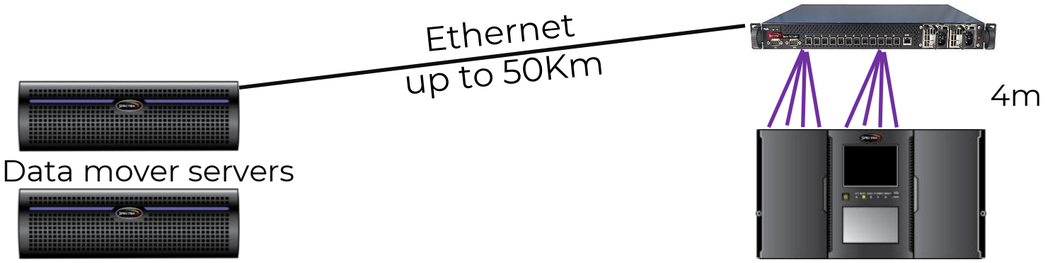
There are good alternatives

Released 2019

Ethernet Backbone, Local SAS breakout

- Ethernet to SAS bridge - midrange cost
- - up to 50Km Host to Switch
- - up to 8 tape drives iSCSI or 12 iSER/RoCE



Bridge on the library

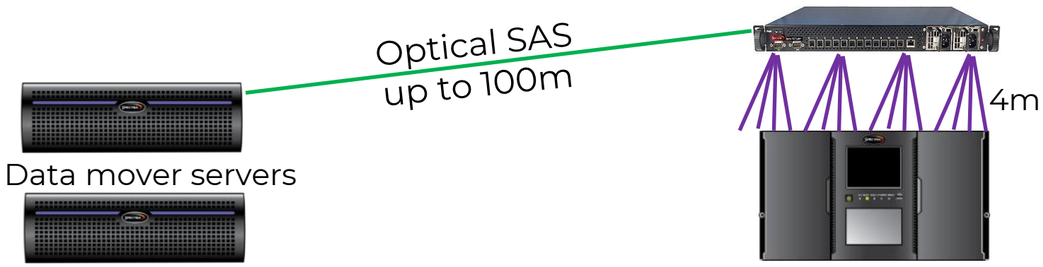
SAS 4:1 fanout down to tape drives

NEW – Announced 2025

AOC SAS Backbone, Local SAS breakout

SAS switch - very low cost

- up to 100m Host to Switch – Active Optical SAS
- up to 36 tape drives at 400MB/s each
- connectivity multiplier if limited slots on host



SAS Switch on library

SAS 4:1 fanout down to tape drives

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Optimize Tape Connectivity!

Simplicity

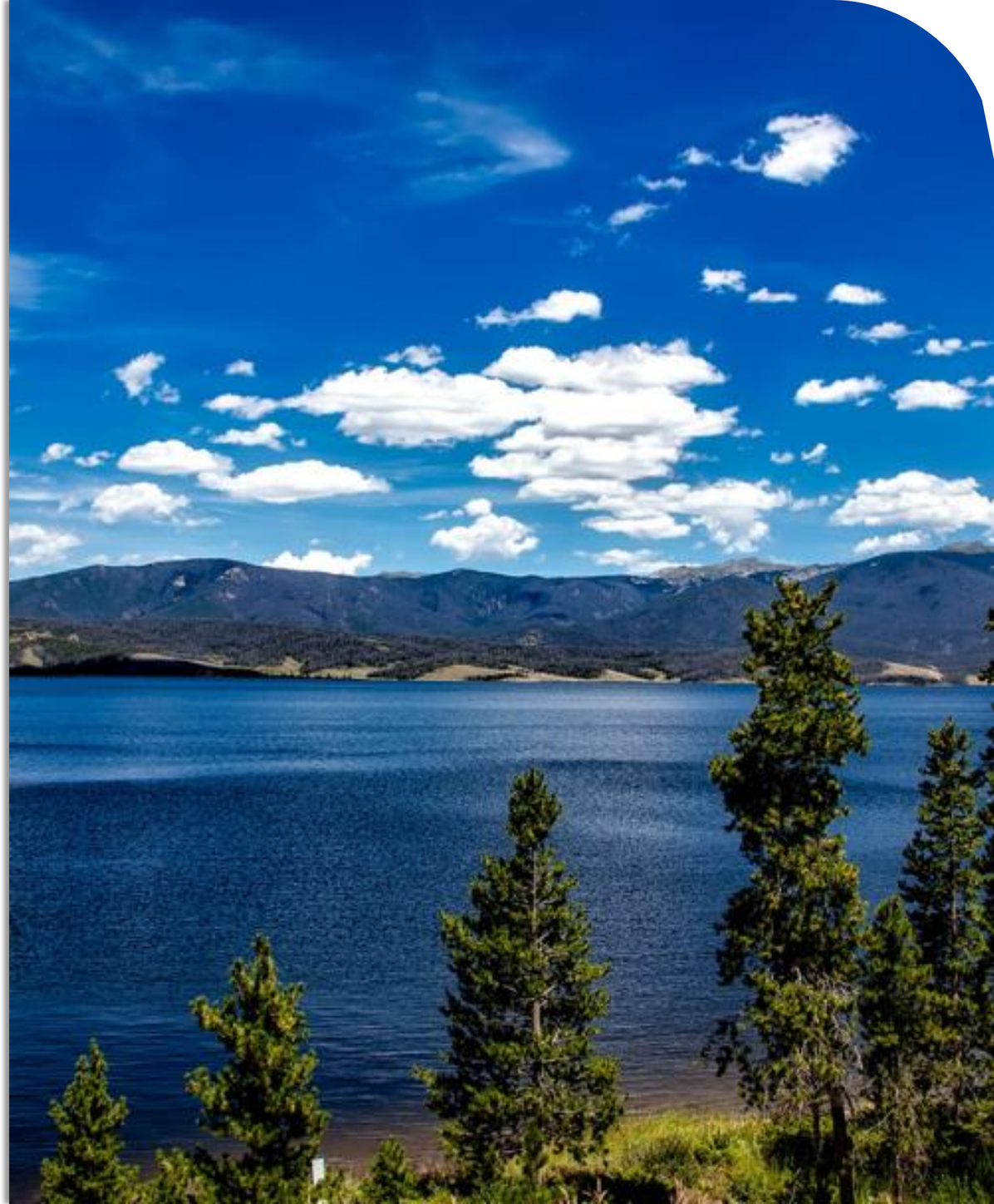
- Modernize legacy storage networking
- Easy to setup, manage and maintain

Flexibility

- SAS and FC Tape Libraries
- Optical SAS switch networking
- Greater distances between servers and storage

TCO

- Up to 60% lower cost per port
- Maximize tape library ROI

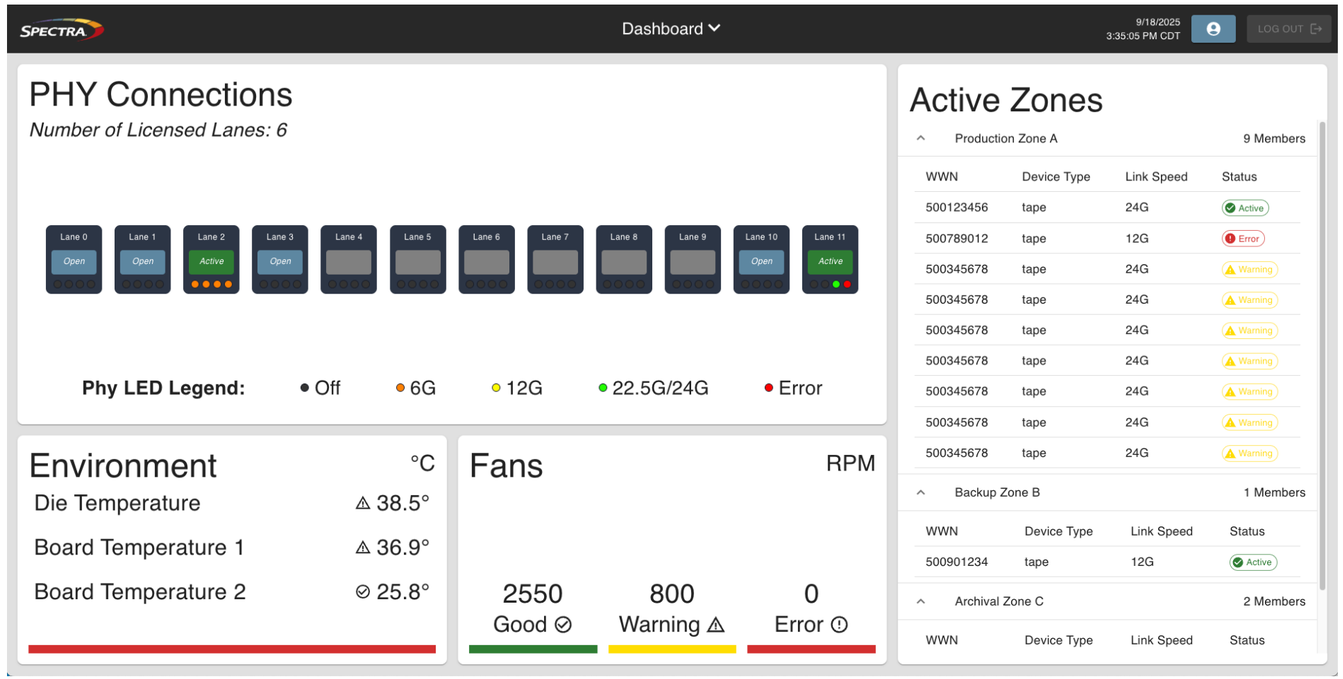


Spectra OSW-2400 Optical SAS Switch

Transforming Tape Connectivity

- **Industry's only 24Gb/s SAS-4 switch**
- **Up to 100m w/ Active Optical Cables**
- **Fast! 12-48 Lanes @ 22.5Gb/s**
- **Lowest per-port cost vs FC & Ethernet**
- **Reduces or eliminates FC dependency**
- **Modernizes and standardizes tape connectivity without special skills**
- **Maximizes flexibility, enables switched topologies**
  - Resource sharing | performance aggregation | HA
- **Supports all Spectra Tape Libraries & Object-Based Tape solutions**
- **Plug-and-Play Simplicity**

Easy to Setup & Manage



- Plug and Play compatibility
- Complete, easy-to-use User-Interface
- Ethernet
- The Optical SAS Switch monitors the status of every port/Phy
  - Physical Phy number
  - Protocol
  - Line speed
  - Connection status
  - Zoning
- Built in DataBolt technology
  - End Device Frame Buffering (EDFB)
  - Allows a fast backbone to efficiently share many slower Tape Drive links by buffering

Questions?