Spectra Logic

SPECTRA

39 Years of Success – since ‘79

Privately Held

Boulder, Colorado USA HQ

Bracknell, UK

Sydney, Australia

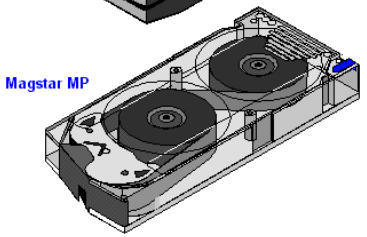
Over 400 employees in 11 countries

Managing *Exabytes* of content globally

DEEP STORAGE EXPERTS

Spectra Logic, Boulder Colorado

Drive Heritage



Released 1996

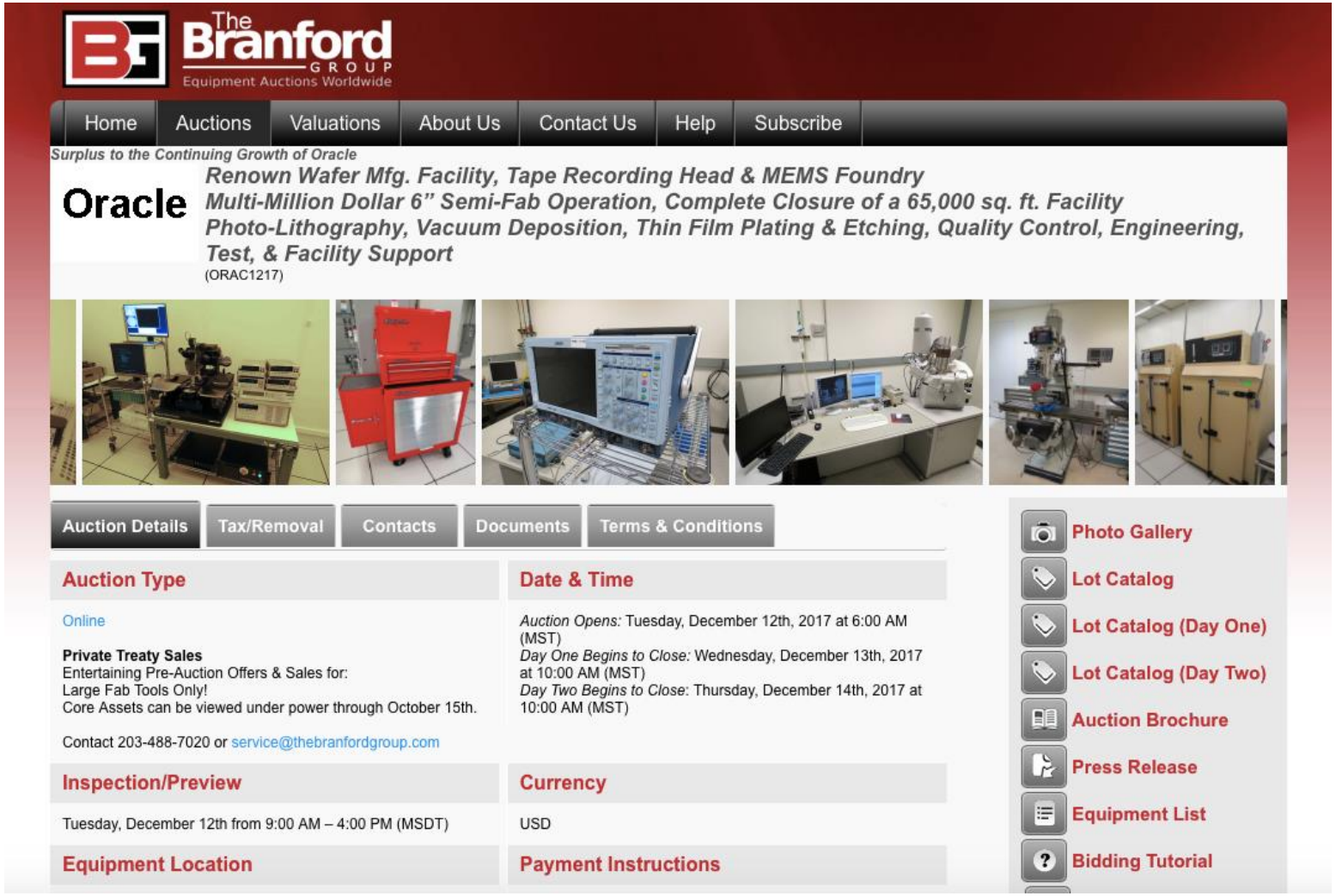
Released 2000

Released 2003

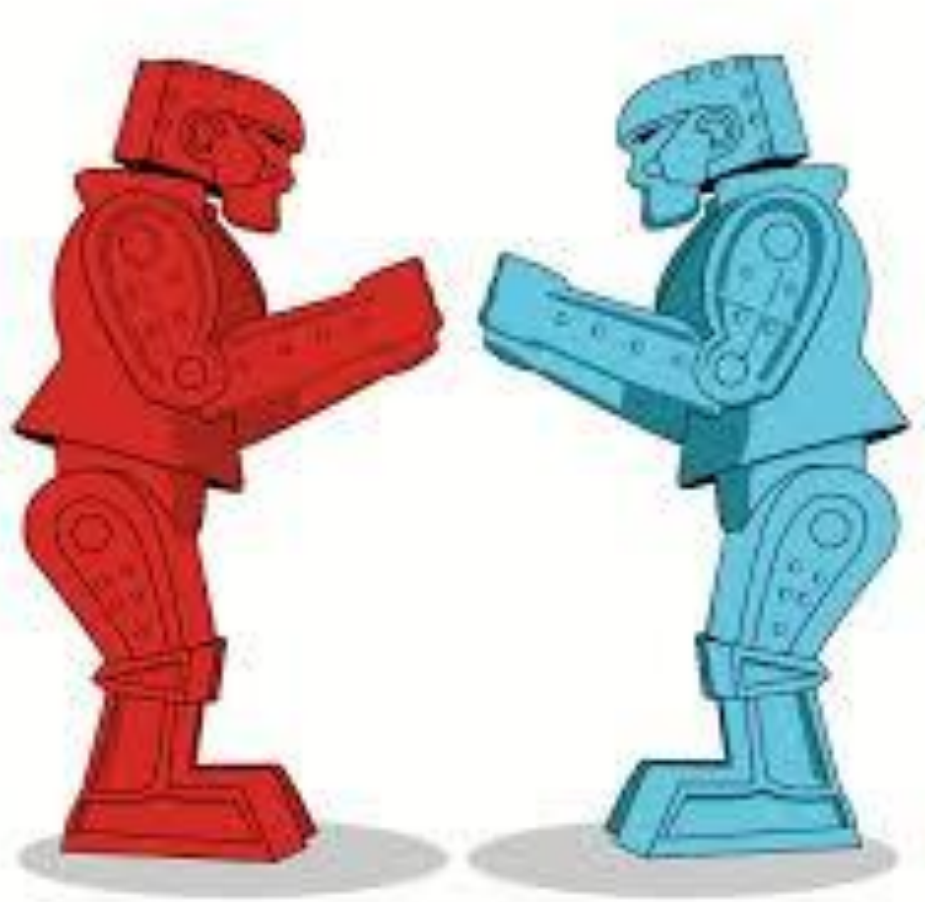
Oracle Tape (Drives, Libraries, Virtual Storage Manager)

- Started out over 500 engineers
- Layoff 1:
  - 5% cut in tape drives, 5% cut in libraries, 10% cut in VSM
- Layoff 2:
  - 90% cut in tape drives (kill E), 35% cut libraries (kept a few around to launch SL4000), 70% cut in VSM
- Layoff 3:
  - Tape drives left with 1 Manager and 4 Engineers
  - Remaining Library staff:
    - SL150: 1 Mgr, 4 SW-Eng
    - SL4000: 1 Mgr, 5 SW-Eng
    - SL8500: 1 Mgr, 3 SW-Eng
    - Group HW: 1 Mgr, 3 Eng
  - VSM and Test practically gone

Asset sell off



LTO or TS



TS vs LTO

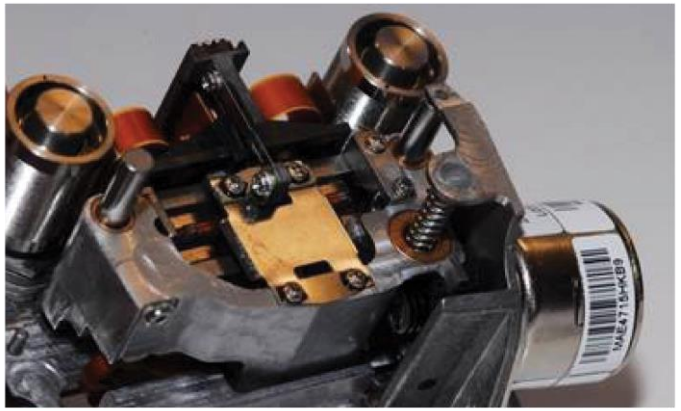
LTO Generations	LTO-6	LTO-7	LTO-8	LTO-9	LTO-10	LTO-11	LTO-12
Native Capacity	2.5 TB	6 TB	12 TB	UpTo 25 TB	UpTo 50 TB	UpTo 96 TB	UpTo 192 TB
Other Format Capacity	1.5 TB	2.5 TB	6/9 TB	UpTo 12 TB	UpTo 25 TB	UpTo 50	UpTo 96
Native Data Rate	160 MB/S	300 MB/S	UpTo 360 MB/S	UpTo 432 MB/S	TBD	TBD	TBD
TS11X0	TS1140	TS1150	TS1155	TS1160	TS1165	TS1170	
Native Capacity	4 TB	10 TB	15 TB	UpTo 20 TB	UpTo 30 TB	Upto 40 TB	
Other Format Capacity	2 TB	7 TB	7 TB	15 TB	15 TB	30 TB	
Native Data Rate	250 MB/S	360 MB/S	360 MB/S	UpTo 500 MB/s	UpTo 500 MB/S	UpTo 1000 MB/S	

Market

- T10K is EOL, Oracle is exiting the tape business
- Current drives are TS1155 and LTO8
- LTO Media shipments in 2017
  - 108,457 petabytes of media
- LTO drives ship ~20:1 to TS/Jag drives
- Over 5 million LTO drives have shipped
- Average tape generation stay active for 5-6 years
  - LTO4 just going end of Service
  - Still have customer running LTO3 for gen 1 media migrations.
- LTO roadmap out to 12 generations

Today, LTO and TS commonality

- Core Recording Technology
  - Head, data channel, media
  - Generally newest technology goes into Enterprise first
- Data Reliability
  - Both systems same high BER - identical ECC, channel,
  - dataflow
  - 1E20 spec for Enterprise
  - 1E19 spec for LTO (lower for media variances of multiple LTO vendors)
- Deck
  - Tape path (IBM Donated tape path IP to LTO)
  - Head
  - Servo tracking



TS vs LTO

LTO 8

- SAS and FC
- Up-format w/ LTO 7 M media
- Multiple Media vendors
- Open systems only
- HH and FH drives
- 40 watts per drive

TS 1155

- FC and RoCE
- Up-format of Older media
- Single vendor
- Open system / Mainframe
- FH only
- 60 watts per drive

Drive Specs

LTO 8

- TMR Head
- 360 MB/s, 700 MB/s Comp
- Error Rate 1 x 10^19
- Native 12TB, 30 TB Comp
- MSBF 100K
- R/W Cache 1024 MB
- Load time 15, Unload 20
- Rewind time 59
- 100 GB file 333 seconds
- 500 GB file 1524 seconds
- Multiple media vendors

TS1155

- TMR Head
- 360 MB/s, 700 MB/s Comp
- Error Rate 1 x 10^20 ****
- Native 15TB, 37.5 TB Comp
- MSBF 300K
- R/W Cache 2000 MB
- Load time 12, Unload 36
- Rewind time 50
- 100 GB file 342 seconds
- 500 GB file 1521 seconds
- Single media vendor

$ per GB

- Best value as $ per gig is currently LTO8 drives with 7M media
  - At ~1.5 -2.0 cents per gig at 200 PB, library, drives and media
- Libraries equipped with TS1155
  - 30% more than LTO, even w/ reformatted media
- Current LTO 8 drives with LTO 8 media
  - 29% more than the 7M media

- LTO media declines 0-30% year over year. Multi-vendor
- TS media declines less than 10% per year. Single-vendor

TS additional features

- Media reuse
- Single Vendor Media for better BER
- Backhitch
  - Virtual Backhitch
  - Recursive accumulating backhitchless flush
- Capacity scaling
- Off board data string searching
- BOP caching
- RAO
  - High Resolution Directory (HRTD)
- Ethernet attach drives

RoCE LTO support

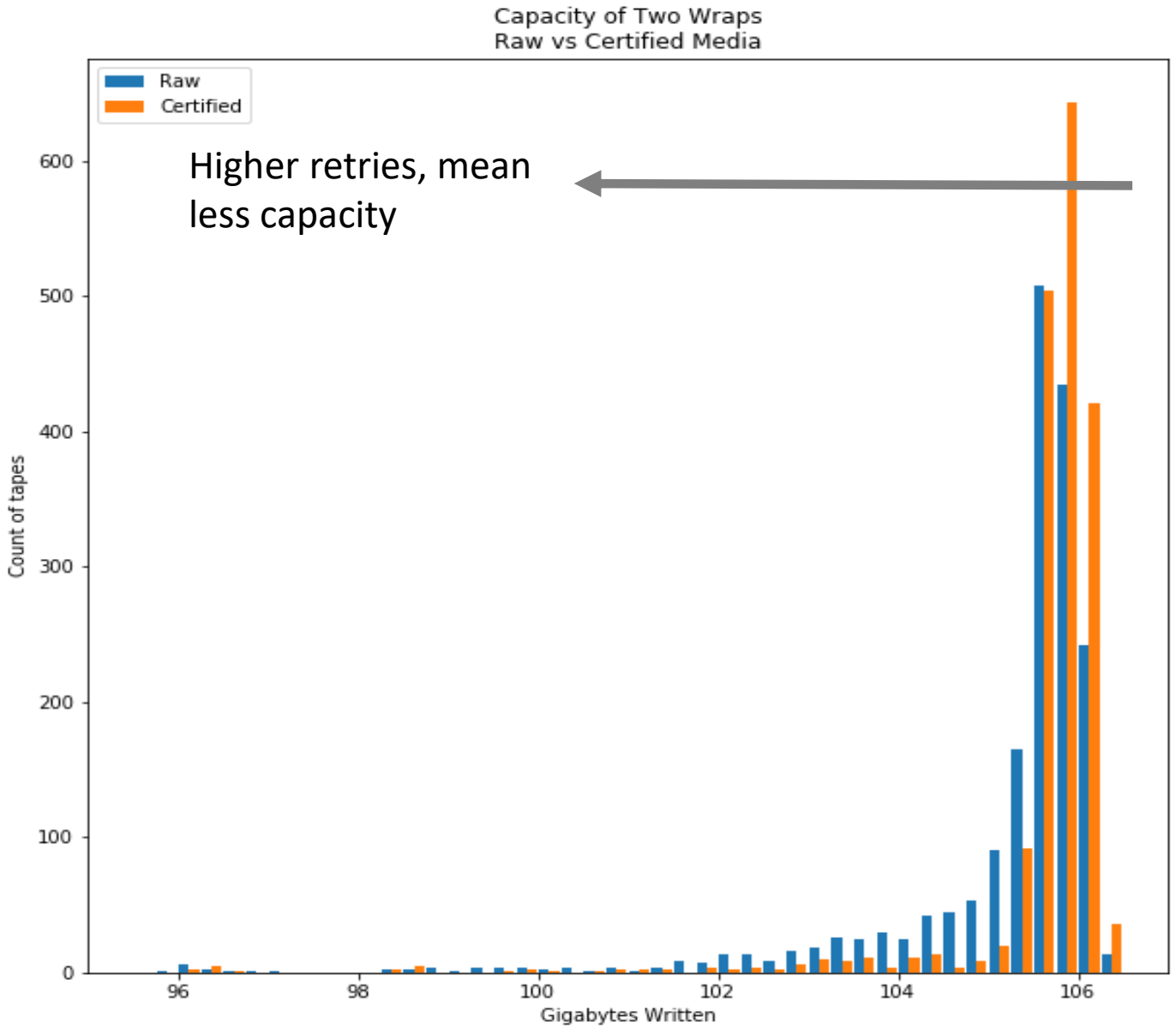
- Full RoCE v2 support through bridge to LTO SAS tape drives.
  - Up to 16 HH LTO SAS drives.
  - 2x 40GbE.
  - HH SAS drive capable of 300MB/s
  - HH drives cost roughly 2.5X less than TS1155E RoCE tape drive with same RoCE interface.
- TS1155E RoCE drive capable of 360MB/s

- For the same price you can install twice as many drives = almost 2X overall system performance and ability to read from twice as many tapes at the same time.

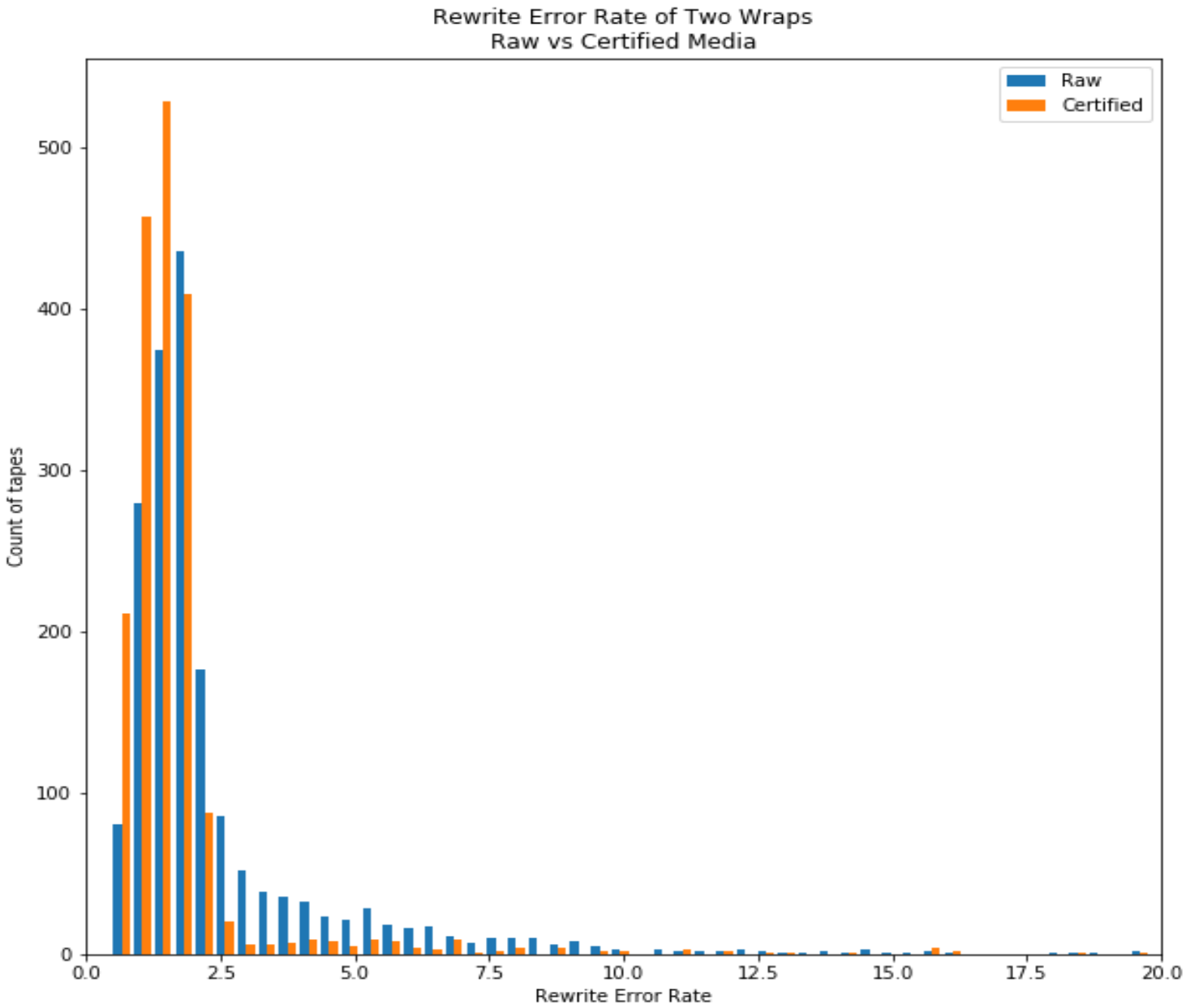
Media Cleaning

Media is [illegible] to C4
[illegible] database.
[illegible] clean
[illegible] customer from the
customer

Now cleaning and validate both TS and LTO



Capacity or amount of data written in a down and back, two wraps. Lower errors rates mean more data per wrap, less rewriting of data means better performance.



A down and back pass on the tape, two wraps. The lower the error rate the better the write performance. Too high an error and capacity starts to be impacted.

TAOS™ Program Update

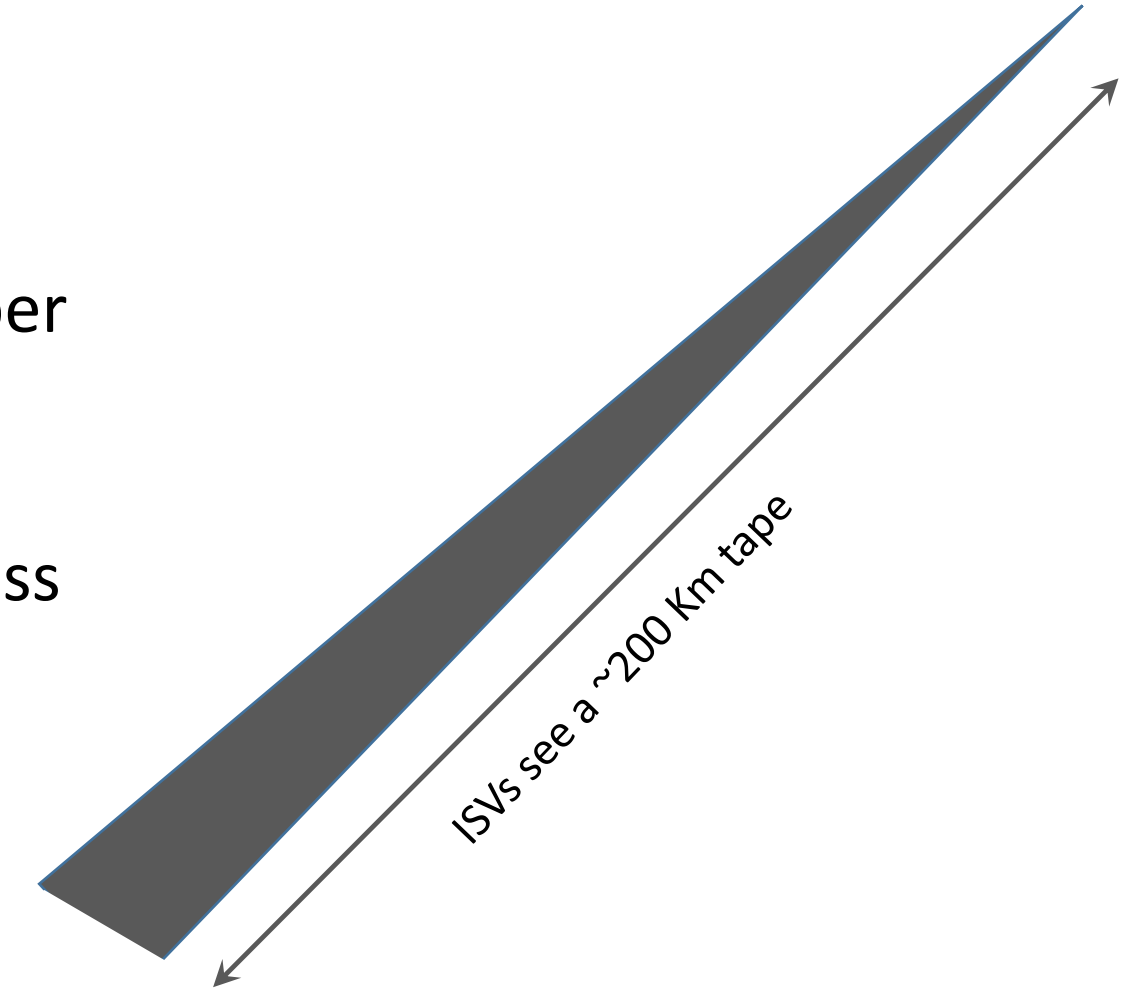
(Time-based Access Order System)

Objectives Of TAOS™

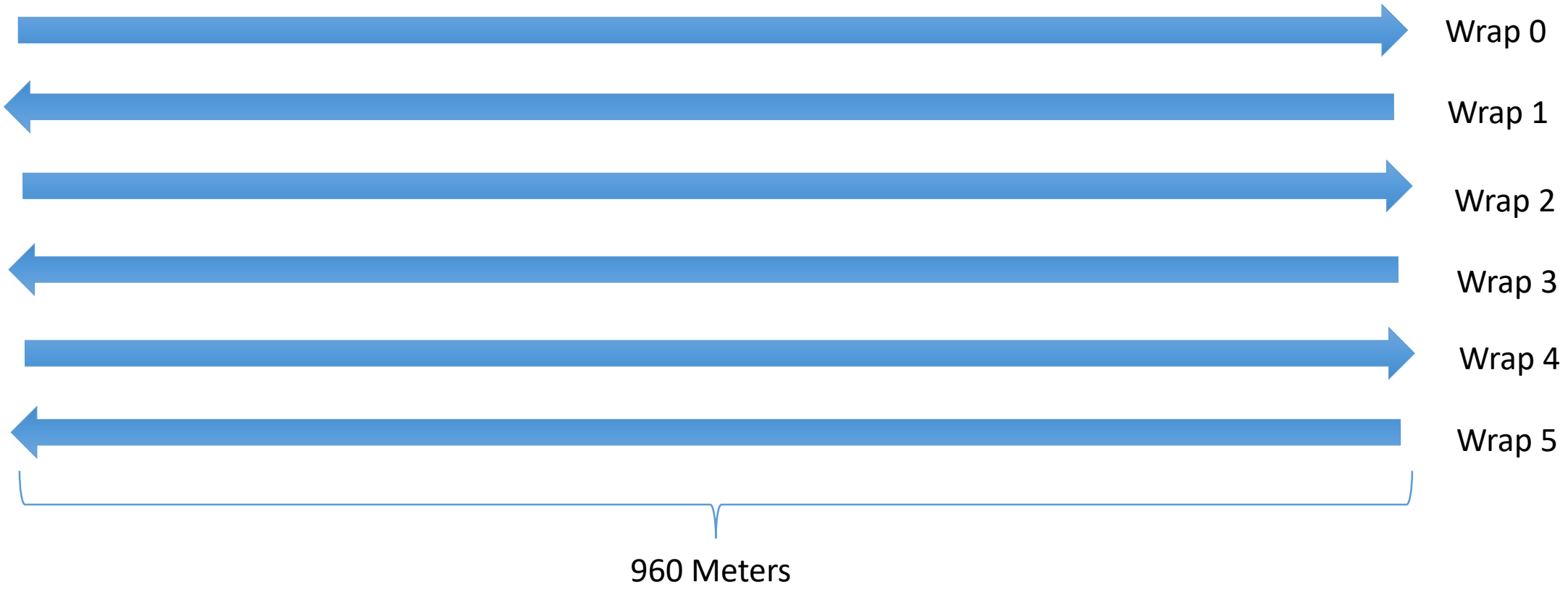
- Improve performance of restore operations
- Reduce tape media wear
- Reduce tape drive wear
- Support LTO-7, 8 and future LTO drives.
- Near identical SCSI interface to RAO SCSI commands implemented in TS115x drives
- Work in existing library at no additional cost

Why block file locate is important

- ISV software see tape as one long sequences of blocks
- Each tape generations changes number of wraps
- Track count per band also changes
- Length of tape can change by thickness of tape
- An LTO 8 tape is almost 200 km long when read end to end
- R/W speed 6 M/s, FSF 9-12 M/s

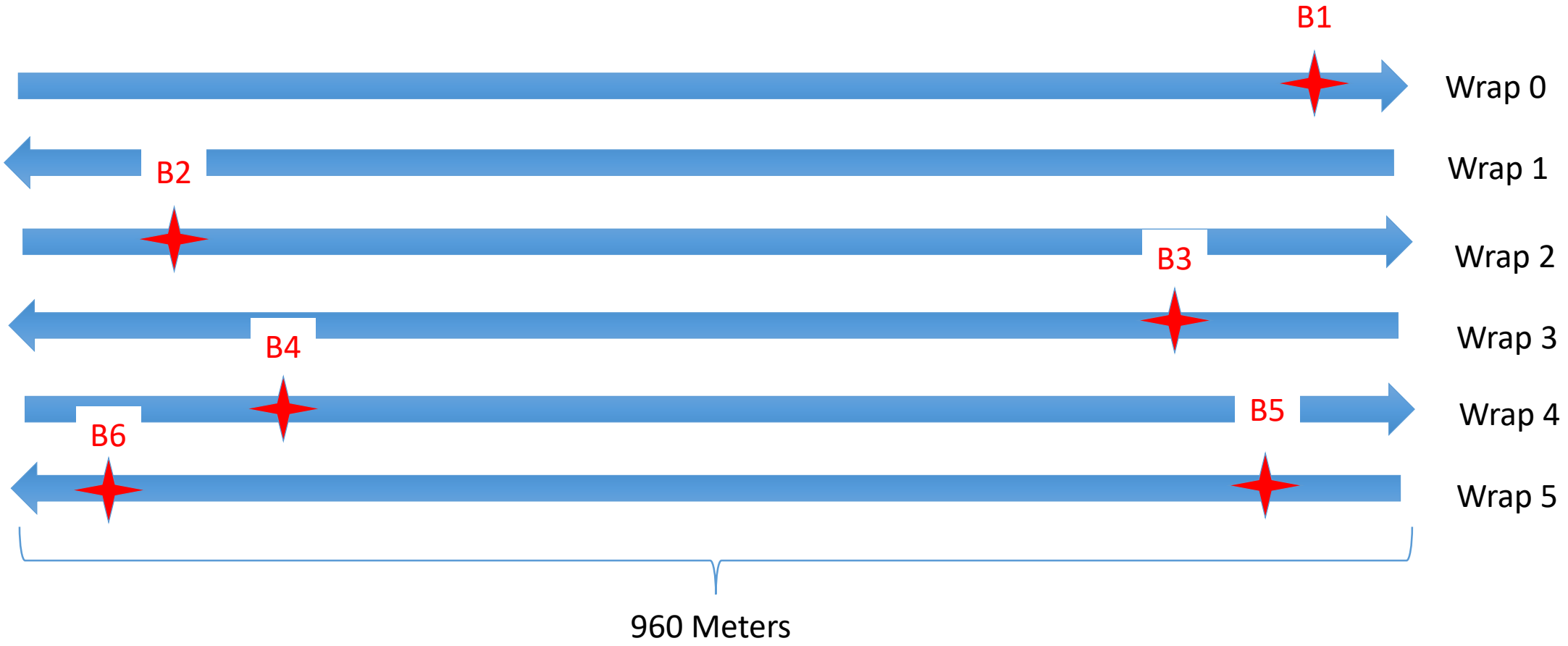


Tape has a serpentine pattern



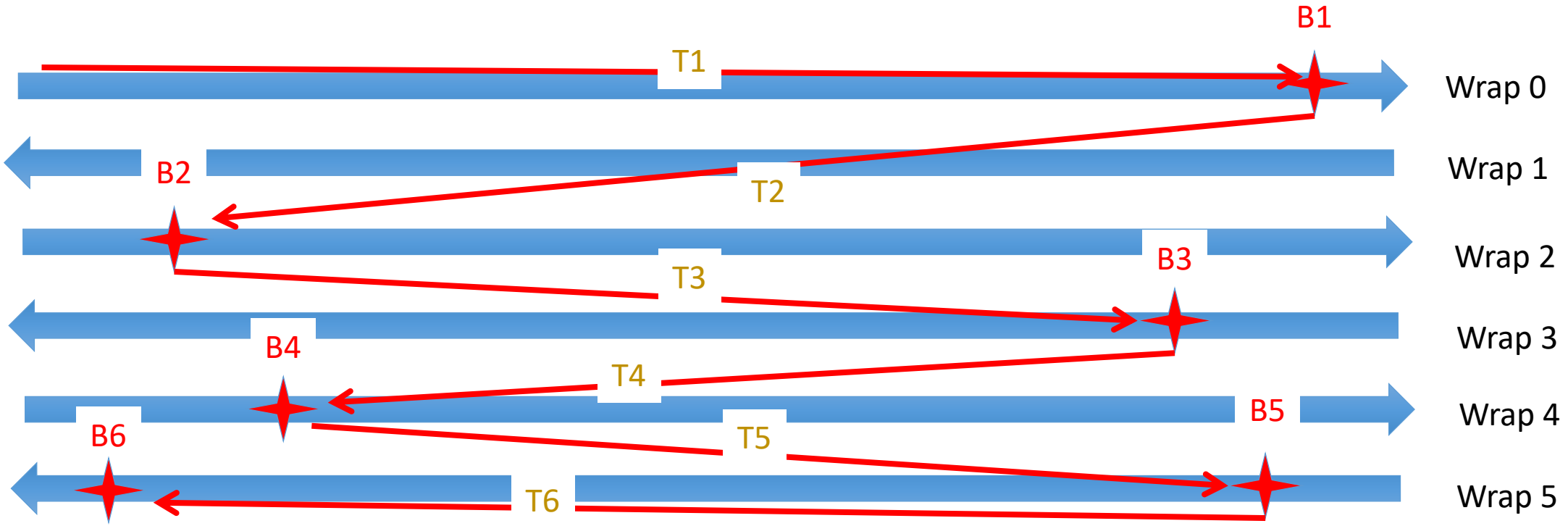
LTO7: 112 wraps
LTO8: 208 wraps

Example of 6 files recalled



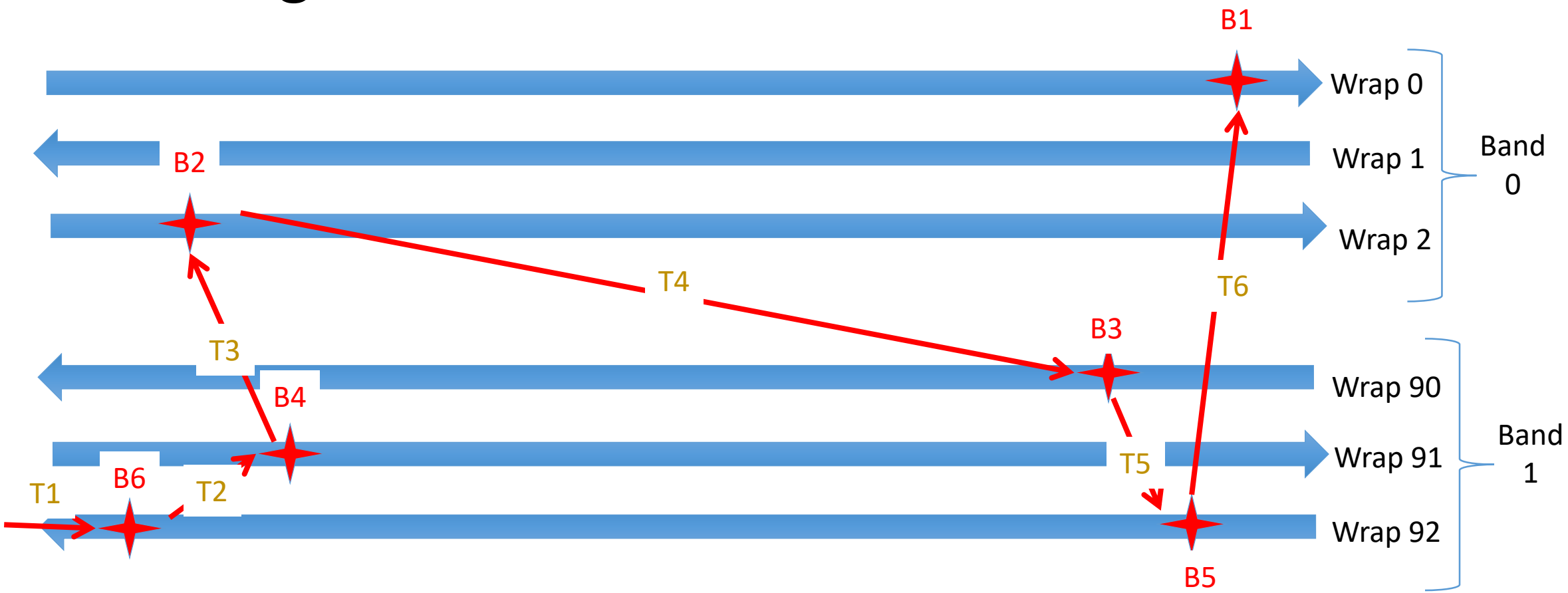
LTO7: 112 wraps, 28 Per Band
LTO8: 208 wraps, 52 Per Band

Linear recalls are very inefficient



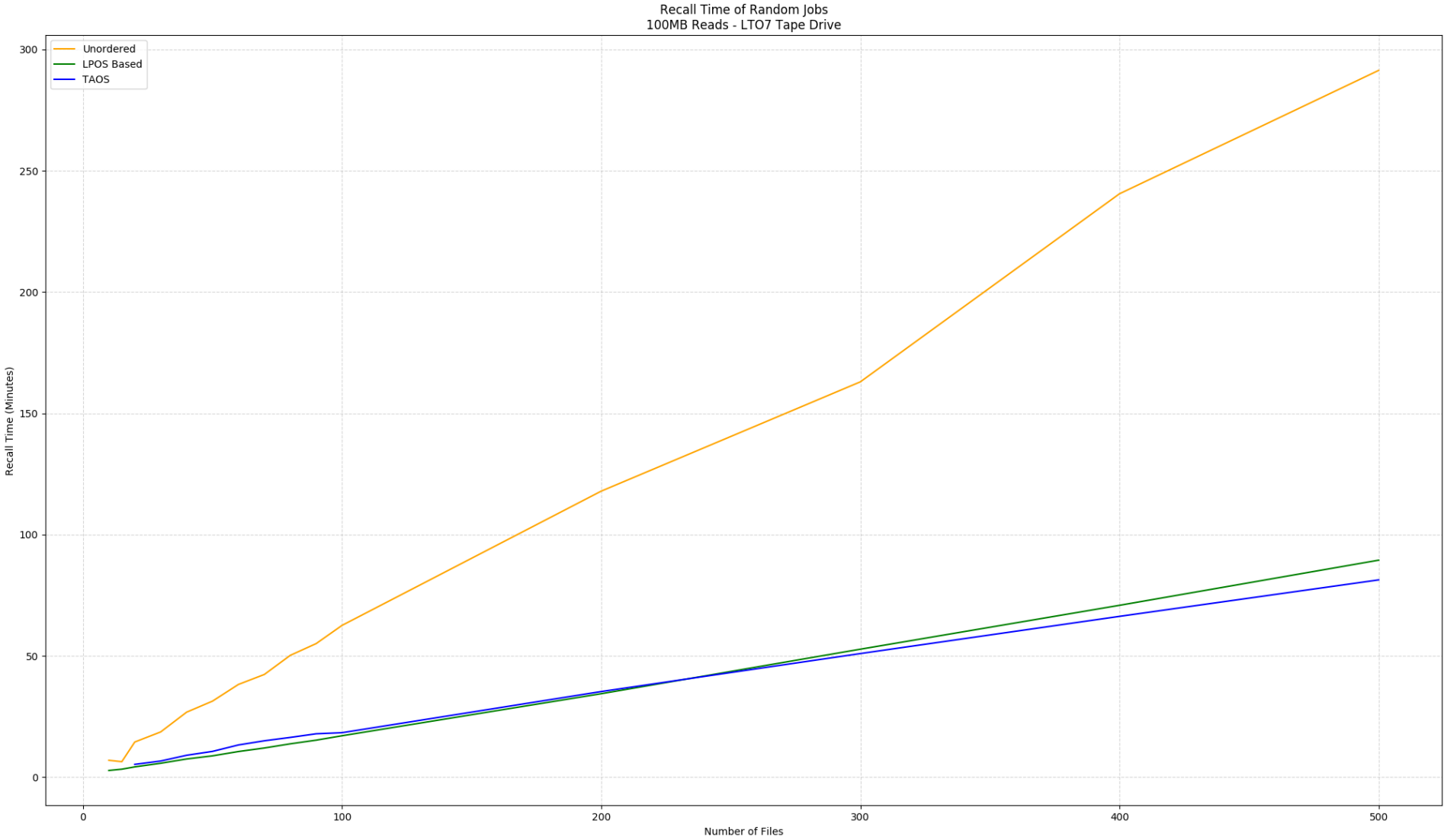
Ordered recalls based on LPOS much more efficient

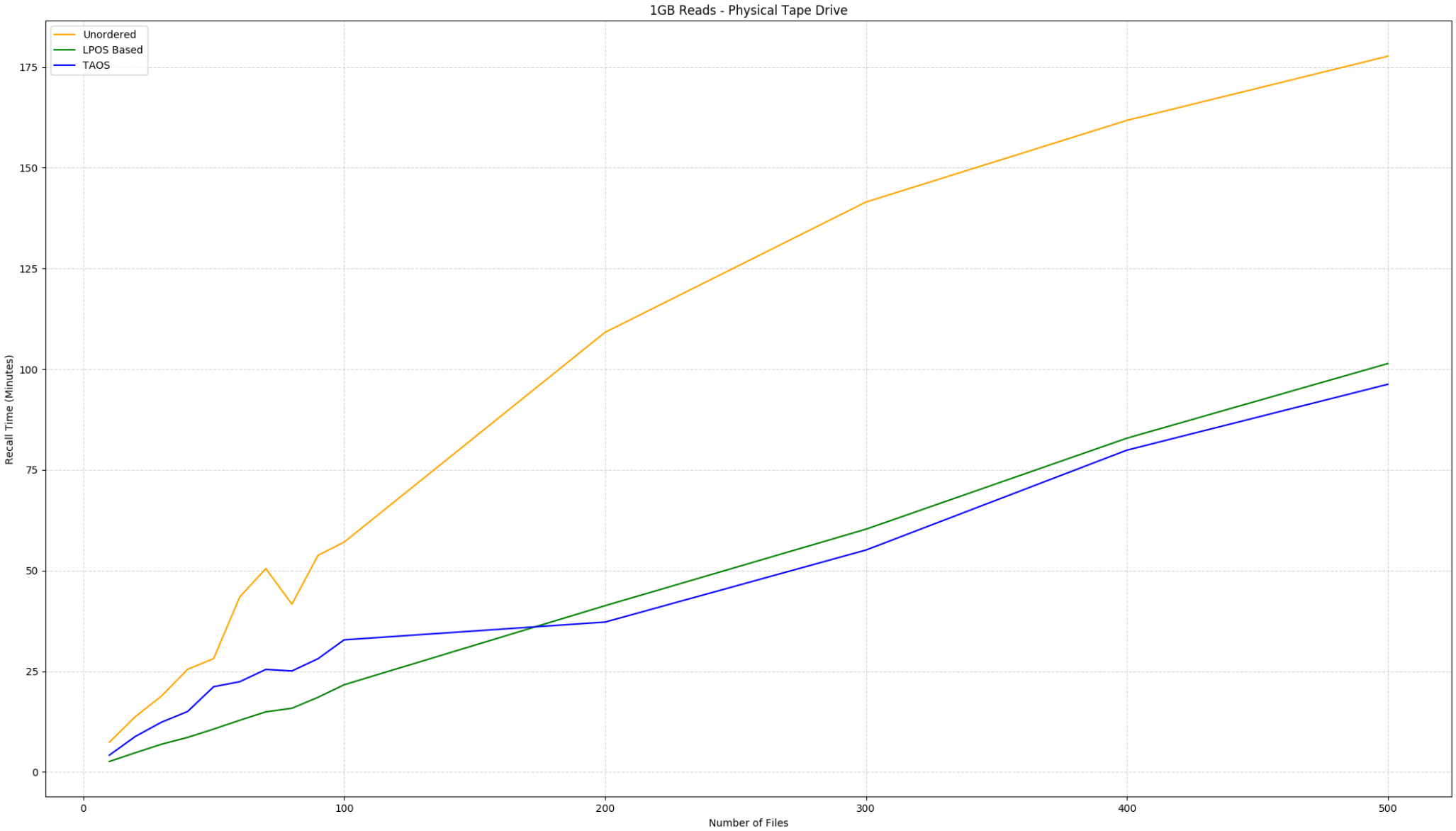
Crossing Bands Is Considered

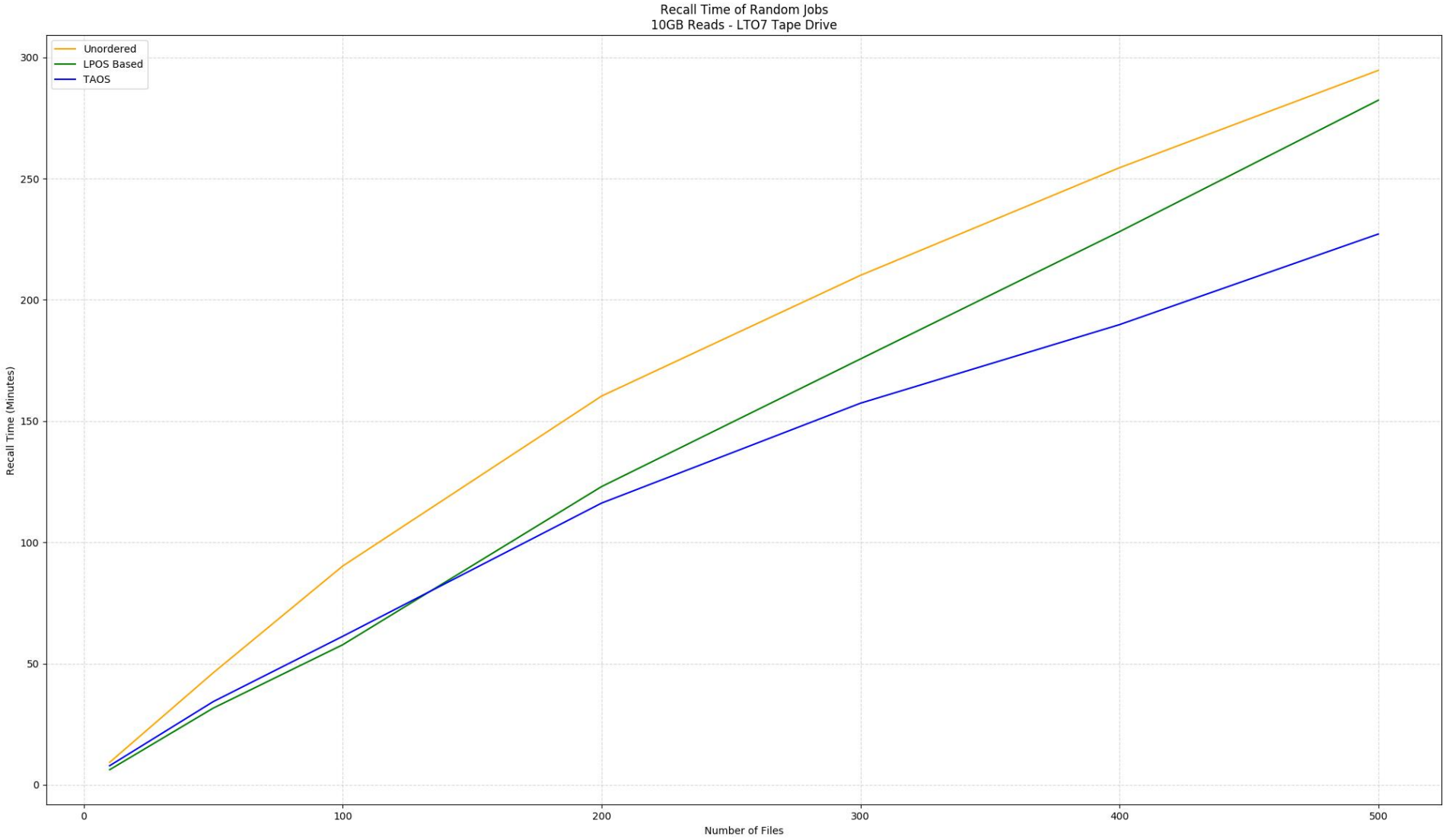


Algorithm Comparison

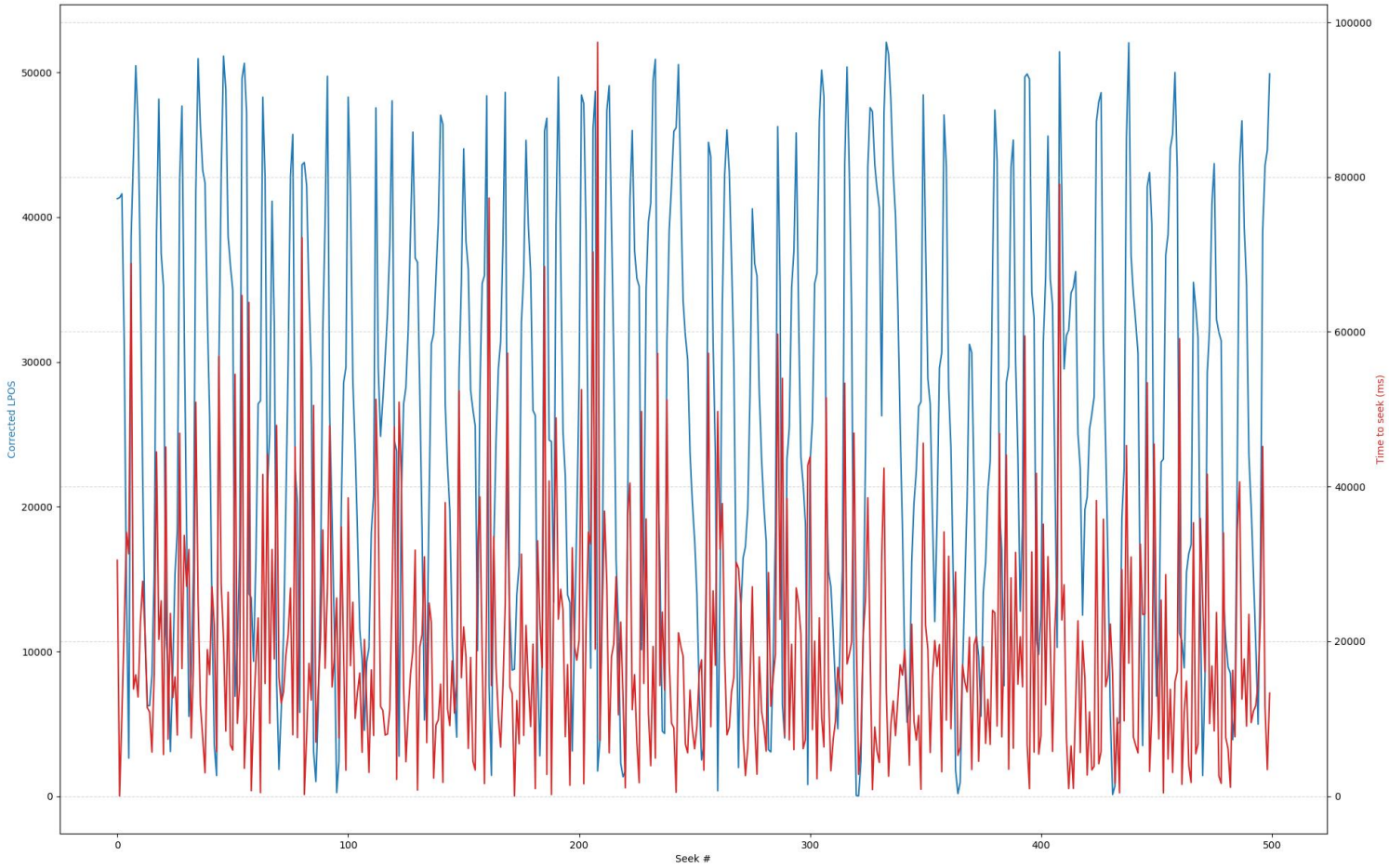
- Unordered – Do not reorder list.
- LPOS – Order block reads from start to end of tape
- TAOS - Select nearest time member to last block read.


Recall Time of Random Jobs
100MB Reads - LTO7 Tape Drive
Unordered
LPOS Based
TAOS
Recall Time (Minutes)
Number of Files
0
50
100
150
200
250
300
0
100
200
300
400
500

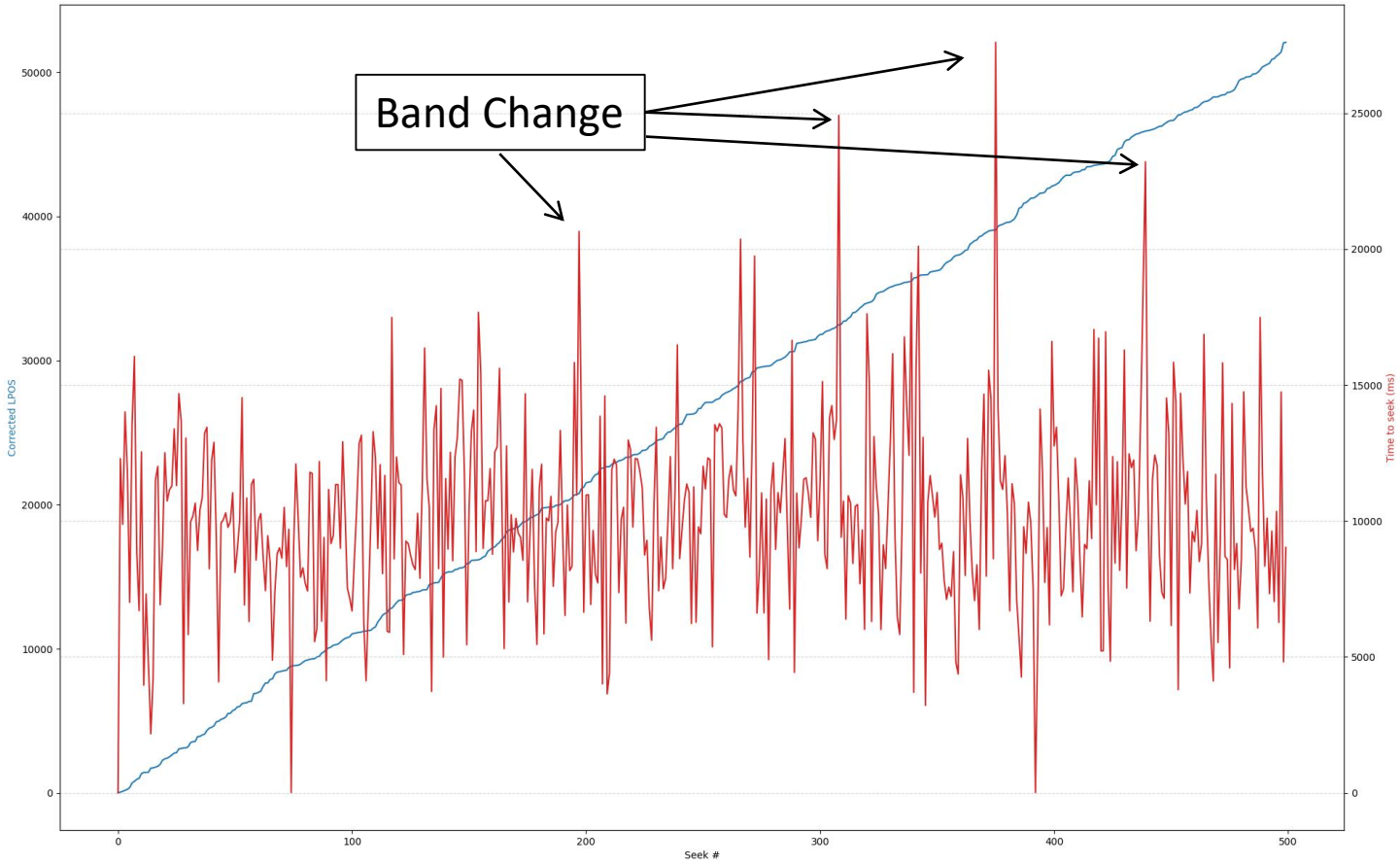

1GB Reads - Physical Tape Drive
Unordered
LPOS Based
TAOS
Recall Time (Minutes)
0
25
50
75
100
125
150
175
0
100
200
300
400
500
Number of Files


Recall Time of Random Jobs
10GB Reads - LTO7 Tape Drive
Unordered
LPOS Based
TAOS
Recall Time (Minutes)
Number of Files
0
50
100
150
200
250
300
0
100
200
300
400
500

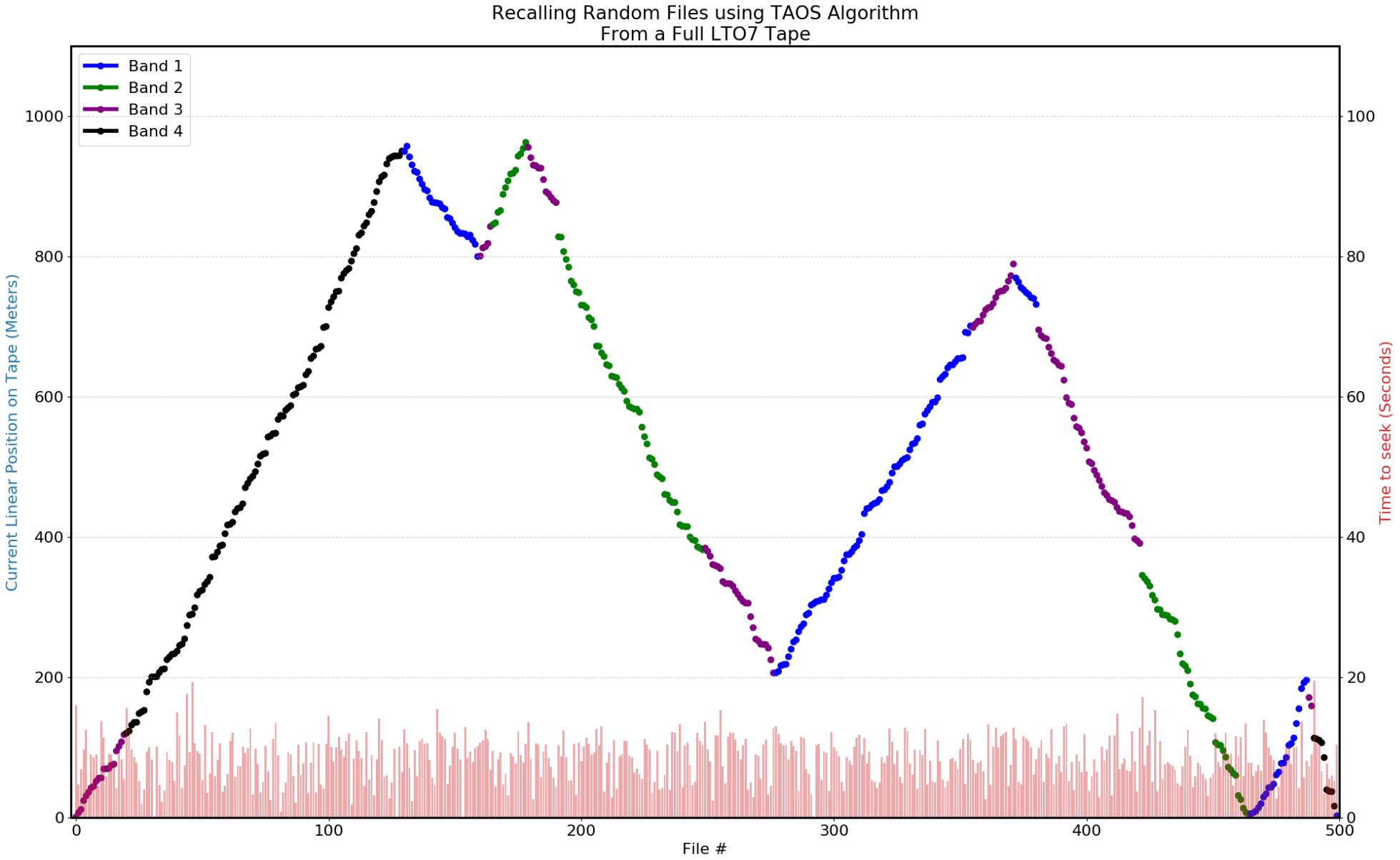
Unordered Request Causes Large Movement Across Tape



LPOS reordering does not consider band changes



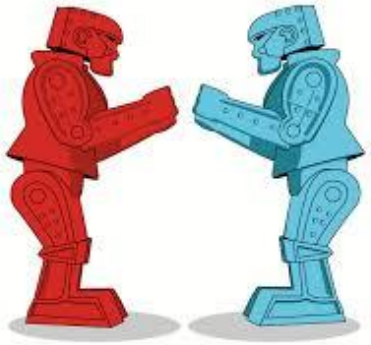
TAOS Tape Position



Media and Drive Wear Reduction Testing

- Spectra a restore tested 100 files with a file size between 1-100MB:
- TAOS Meters of Tape Across the Drive Head: 2,470
- Unordered Meters of Tape Across the Drive Head: 31,878
- That's a ~13x reduction in meters of tape. Or 8.4% of the original meters of tape.
- Spectra currently estimates that TAOS will reduce tape and drive wear by ~10X on media read operations when used in conjunction with some ISVs

Which drive right?

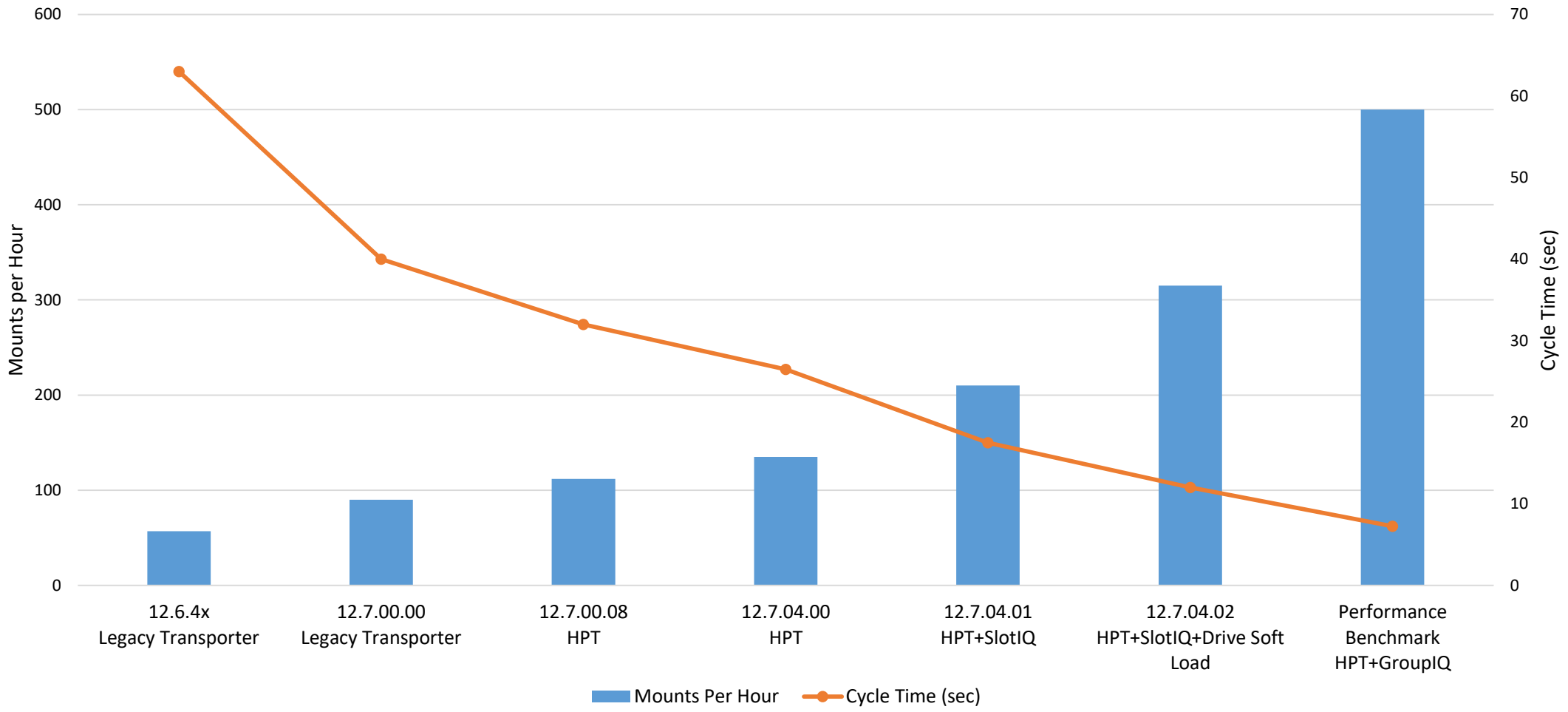


Red or Blue

- Maximum capacity -TS
- Best $ per TB -LTO
- Spec’d higher ECC on -TS
- Most used drive -LTO.
  - Firmware wrung out
  - Problems are well understood
- TS and LTO trade features over generations

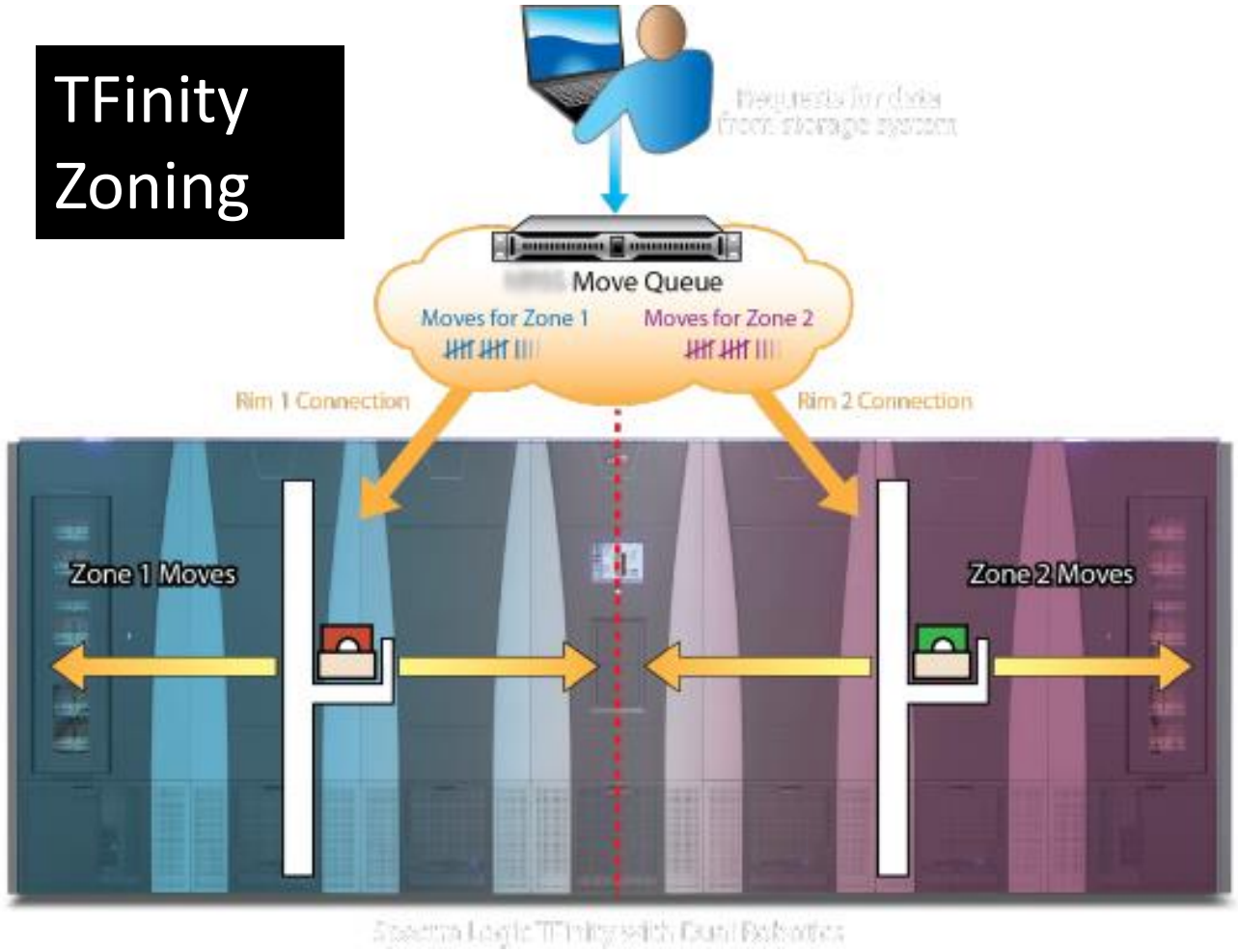
Library performance

TFinity Performance Roadmap



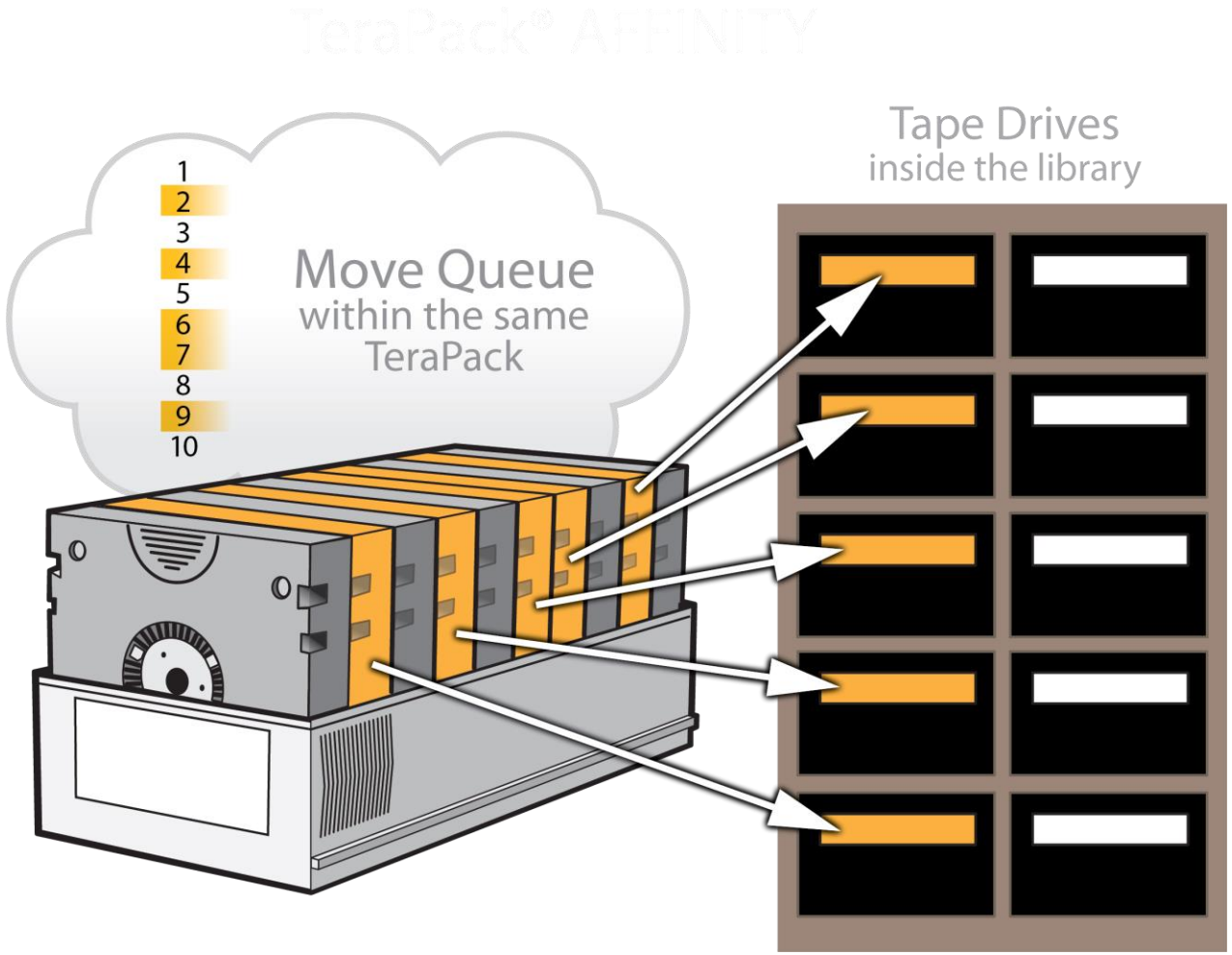
TFinity Zoning Optimizations

- The TFinity Bluescale interface has been modified to include zoning information in the Read Element Status response.
- This allows the storage software to keep both robots working optimally in their zone without any robotic contention.

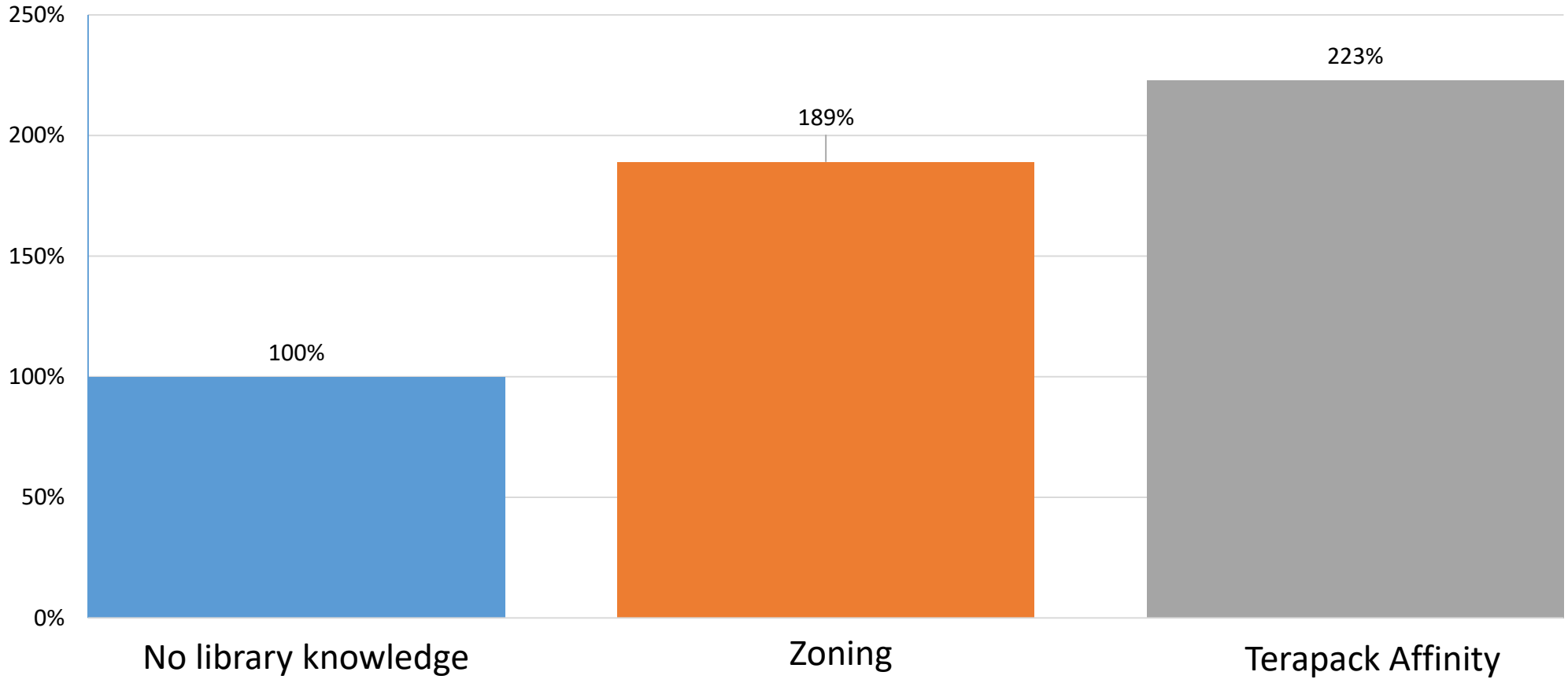


TFinity TeraPack Affinity

- Do as many tape moves as possible from the same TeraPack to increase overall robotic performance.
- By giving the storage software the TeraPack barcode associated with each tape barcode the software can sort the internal move queue to consolidate all tape moves within a given TeraPack to happen in order.



ISV + Spectra Logic Mount Rate percentage



Tri-media - Three Different Tape Technologies in the same library

- Spectra's ExaScale Edition tri-media feature now allows migrating or integrating your existing T10K media & drives.
- The ExaScale Edition TFinity supports mixed media environments with LTO, TS, and T10K.
- Spectra Logic offers a migration program where your existing T10K drives can be resledded into TFinity drive sleds and then used for recalling data from existing T10K media, reducing initial migration costs.


SPECTRA