15 January 2026

IBM LTO 10 Tape Drive Full Height Model Performance Position Paper LA media vs. PA media

Authors:
Tsuyoshi Miyamura (miyamuu@jp.ibm.com)
Tape Storage Development
Tokyo, Japan

Table of Contents

Introduction

This position paper aims to evaluate and compare the performance of the IBM LTO 10 Tape Drive (LTO 10 tape drive) Full Height Model when operating with PA media versus LA media in an open systems environment.

This document is provided for informational purposes to describe the mitigation of repositioning performance degradation caused by the approximately 30 % longer tape length of PA media compared to LA media, through the implementation of High Resolution Tape Directory (HRTD).

LTO 10 Tape Drive Overview

The tenth generation IBM LTO 10 tape drive offers a great storage capacity and an excellent performance using technology designed for the mid-range open systems environment that include IBM Power Systems™; selected Oracle and Hewlett Packard servers and Intel servers running supported versions of Microsoft Windows or Linux.

The IBM LTO 10 tape drive supports LTO 10 Cartridge Data Media (LA media) at GA. In addition to the LA media support, LTO 10 Cartridge Premium Media (PA media) is supported by the LTO 10 tape drive from PGA1 release. LA media offers a native capacity of 30 TB (75 TB with 2.5:1 compression) and PA media offers a native capacity of 40 TB (100 TB with 2.5:1 compression).

The IBM LTO 10 tape drive full height model offers a native data rate of up to 400 MB/s.

Performance Overview

Many features of the IBM LTO 10 tape drive full height mode using PA media are common compared to the one using LA media, some of the highlights are:

- Native data rate of up to 400 MB/s
- Support for 32 Gb FC and 12 Gb SAS connectivity
- SkipSync Function to provide small file backhitchless flush capability
- Cache buffer: 4096 MB

The key features of the IBM LTO 10 tape drive full height mode using PA media are designed to improve performance and capabilities when compared to IBM LTO 10 tape drive full height model using LA media, some of the highlights are:

- Native data physical capacity of 40 TB – 1.33x from the LA media
- High Resolution Tape Directory to improve locate/space performance

The LTO 10 tape drive supports High Resolution Tape Directory (HRTD) when operating with PA media. HRTD provides enhanced repositioning performance after it has been retrieved from the End of Data (EOD) data set. To ensure optimal performance when access to multiple locations will be performed, it is recommended that the host issue a SPACE EOD command immediately after loading PA media. This should be done prior to executing GRAO, LOCATE, or SPACE commands for navigation to the target location.

This position paper examines the performance benchmarks of the IBM LTO 10 tape drive full height model and associated features, especially comparing performance between LA media and PA media.

Performance Evaluation

All the performance benchmarks were run on one or more of the following systems:

- Dell PowerEdge R750 servers running RHEL 9.7 with QLogic 2772 Dual Port 32Gb Fibre Channel HBA.

The performance benchmarks used for the tests are a toolbox of in-house C-based performance measurement tools designed to fully exercise the host interface and tape drive with the least amount of overhead. As such, the primary goal of the benchmarks was to provide a picture of the maximum capabilities of the LTO 10 tape drive. All data rates/capacity reflect a decimal basis where KB = 1,000 bytes, MB = 1,000 KB, GB=1,000 MB and TB=1,000 GB. Actual tape drive data rate and cartridge capacity might vary depending on factors such as data compression, server and disk performance variables.

There are several factors that impact performance, especially data rate at high compression ratios and large block sizes. Server hardware performance, server slot and operating system/device driver performance are important factors. Another source of variability in the data rate performance tests could be due to the firmware used for the Fibre Channel and SAS connections.

Items Excluded from Measurement

The following performances of the IBM LTO 10 full height tape drive are common between LA media and PA media. Please refer to the reference document, IBM LTO 10 Tape Drive Full Height Model – Performance Position Paper.

- Fibre Channel / SAS Data Rate Performance
- Power on to ready time
- Speed Matching Performance

  The tape running speed of the LTO 10 tape drive is adjusted for both LA and PA media to maintain the same data rate. Therefore, although the tape running speeds differ, there is no difference in speed matching performance.

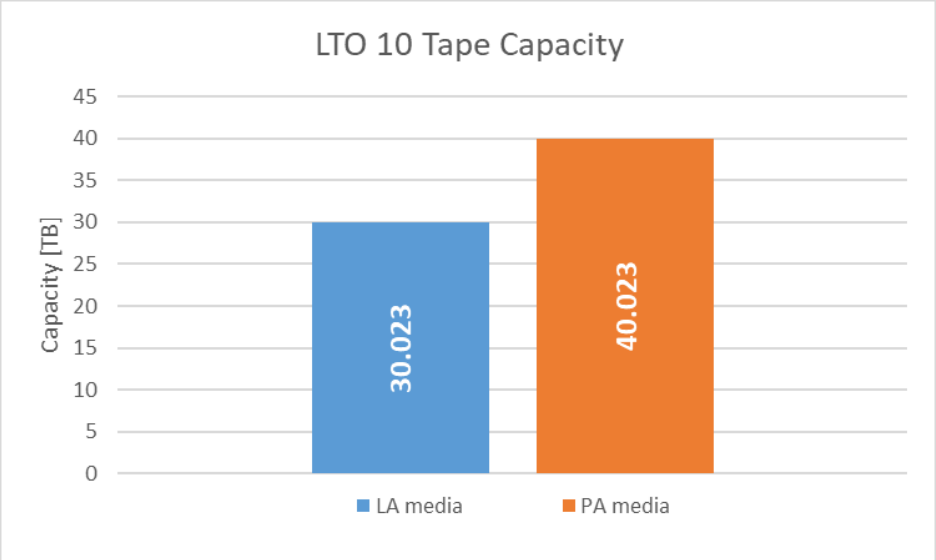
Reference

IBM has already measured the LTO 10 Tape Drive's performance using LA media. This position paper aims to compare the performance between LA media and PA media. Please refer to the former document for common items between them.

- IBM LTO 10 Tape Drive Full Height Model – Performance Position Paper

Tape Capacity

The following chart shows the capacity for PA media measured with the LTO 10 tape drive. Tape capacity is obtained by writing 512 KB blocks of uncompressible data until an error code is returned when EOT (End of Tape) is reached. The LTO 10 tape drive with PA media increases about 33% over LA media capacity offering a native physical capacity of 40 TB.

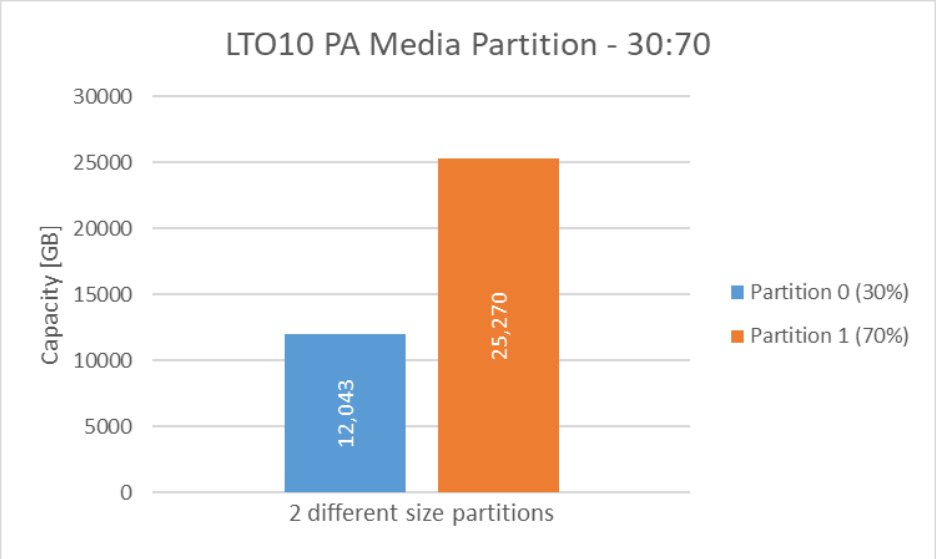


The LTO 10 tape drive with PA media offers a significant capacity increase over LA media. The main reason for the increase is the length of PA media which is approximately 30% longer than LA media.

Tape Capacity when partitioned

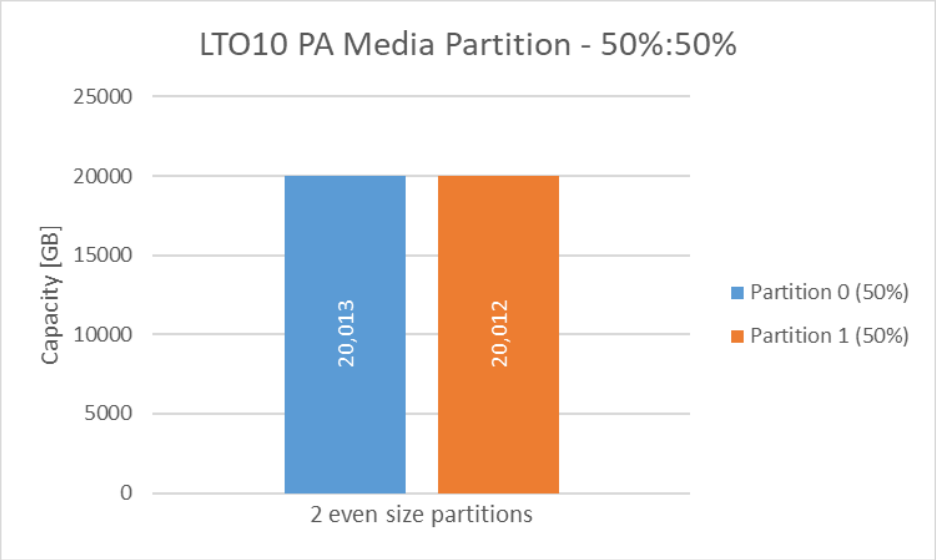
The following chart shows the capacity for PA media measured with the LTO 10 tape drive when partitioned. The tape is partitioned into 2 partitions at a rate of 30%:70%. Tape capacity is obtained by writing 512 KB blocks of uncompressible data until an error code is returned when EOT (End of Tape) is reached. The capacity of the final partition will be less than the residual tape capacity after allocation of the preceding partitions as the size of guard wraps between partitions is consumed.

PA media with the LTO 10 tape drive requires 32 wraps for the guard wraps between partitions, which correspond to around 2.7 TB. The more the number of partitions increases, the less the size of the last partition. The user must take the capacity loss into account when the tape is partitioned.



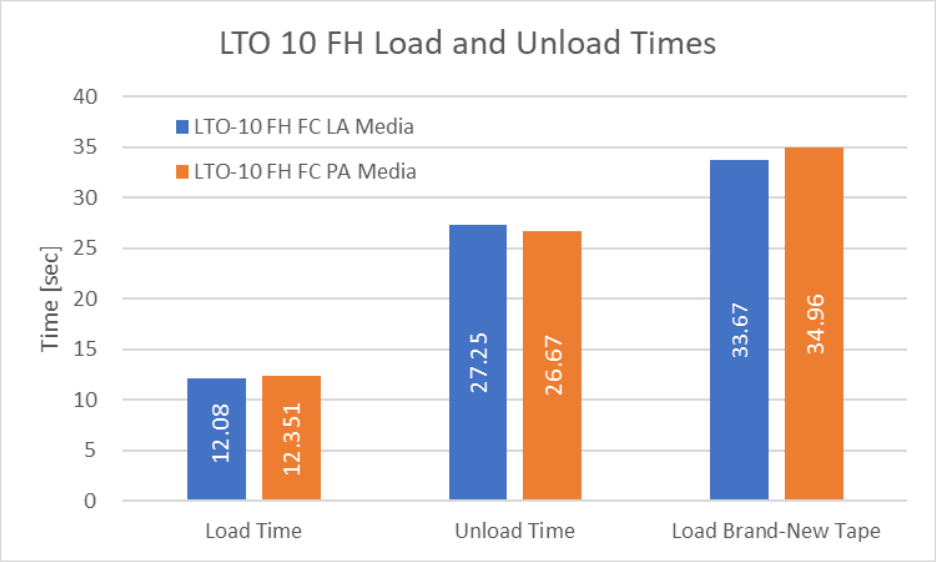
The capacity of each partition is lost by the guard wraps between partitions. New partitioning features have been supported since LTO 9 when the tape is partitioned into 2 or 4 partitions at the same capacity. The features allow the tape to be partitioned in 2 partitions at a rate of 50%:50% or in 4 partitions at a rate of 25%:25%:25%:25% without capacity loss.

The figure below shows the measured capacity of each partition when a PA media is partitioned with a 50%:50% capacity ratio.



Cartridge Load and Unload Performance

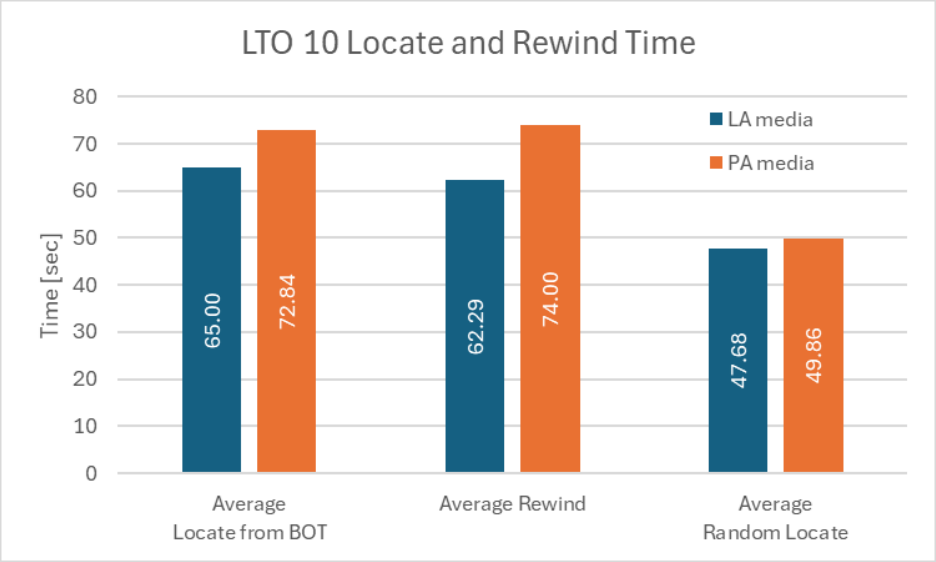
The following chart shows the tape cartridge load and unload times for the LTO 10 tape drive with LTO gen 10. The chart also shows the brand-new LTO gen 10 tape cartridge load time for the LTO 10 tape drive.
There is no significant difference regarding the interface type used. It takes three times longer than used tape cartridges load time because the tape drive initializes the contents of the cartridge memory and writes a Format Identification Dataset (FID) to the tape.



The IBM LTO 10 tape drive has good load performance for both interface types.

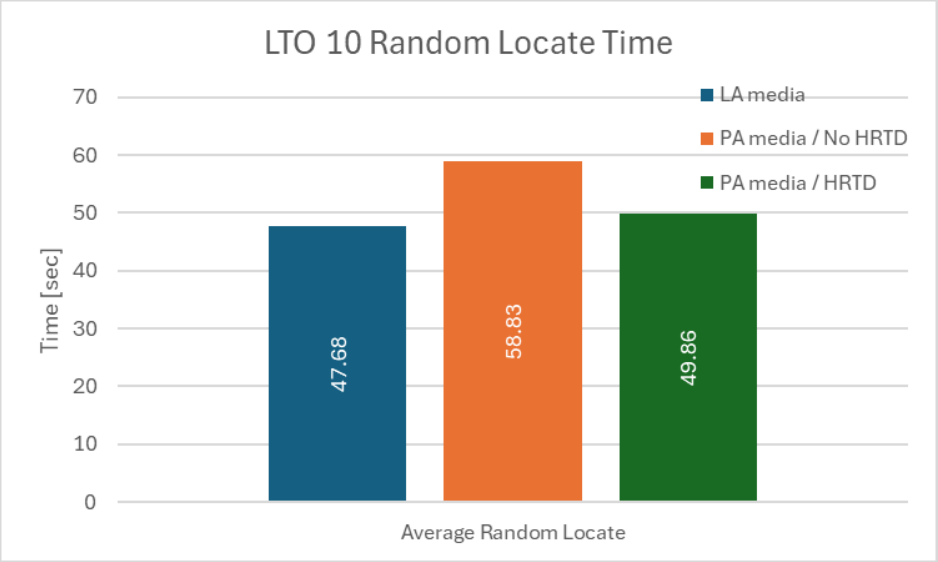
Locate and Rewind Performance

The following charts show the average time for the LTO 10 drive to locate a random block on the tape starting at BOT (Beginning of Tape), the average time to locate a random block starting at some random location on the tape, the average rewind time as well as maximum times measured for the three operations. To determine the average and the maximum times, many locate commands and rewind commands were performed on a filled tape.



The LTO 10 tape drive using PA media delivers slower performance than LA media for Locate and Rewind operations. The primary reason is the difference in tape length, with PA media being approximately 30% longer than LA media. On average, Locate time from BOT with PA media is 12.06% longer compared to LA media. Rewind time is 18.80% longer, and Random Locate time is 4.57% longer when using PA media.
The reason why the performance difference is small regardless of tape length is that PA media starts measurement after obtaining HRTD from EOD.

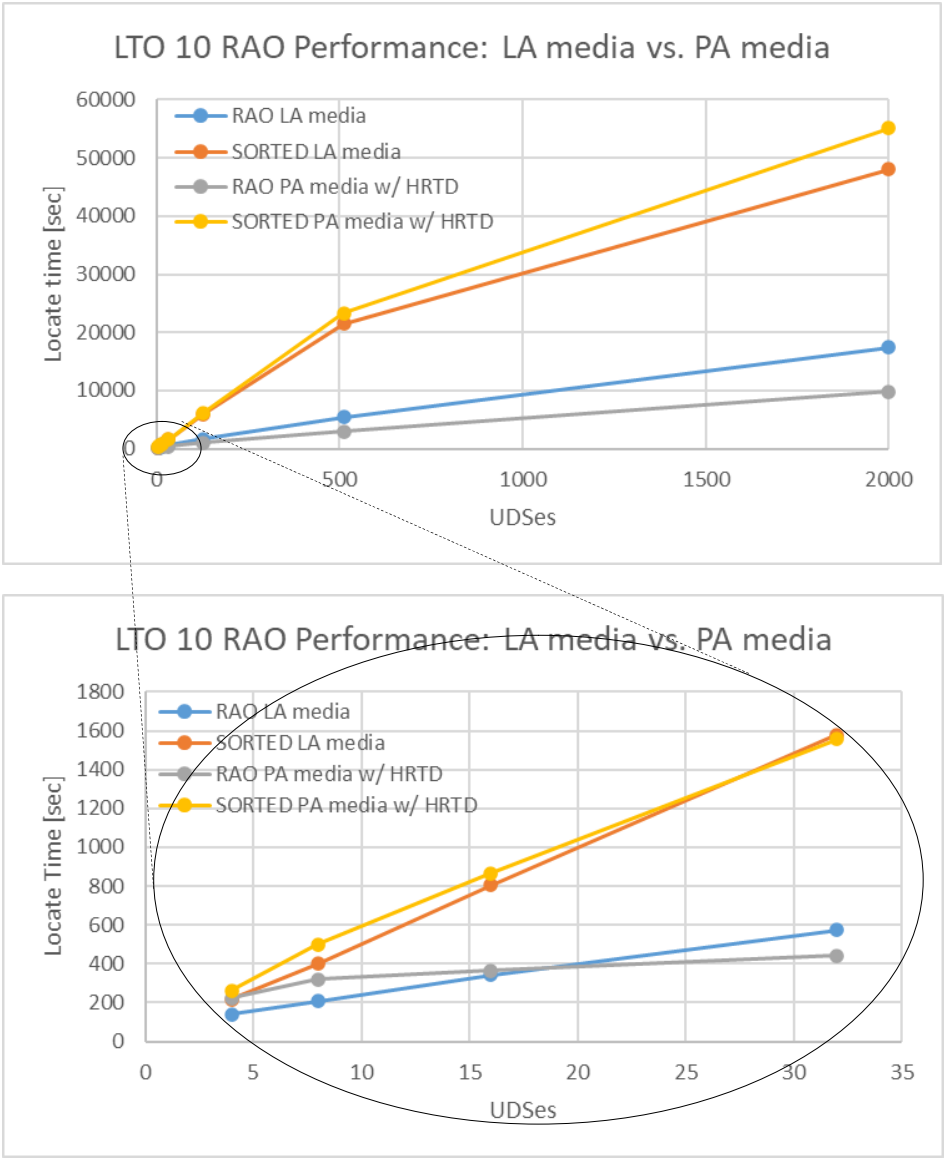
The following shows a comparison of the average random locate time using LA media, PA media with HRTD disabled, and PA media after retrieving HRTD. When HRTD is disabled, the average random locate time for PA media is approximately 23.38% longer than for LA media. This difference corresponds to the variation in tape length, as PA media is about 30% longer than LA media. By utilizing HRTD for PA media, the average random locate time improves by about 8.97 seconds (15.25%).



Based on these discussions, it is recommended to pre-acquire HRTD when using PA media.

RAO Performance

The Locate performance comparison between LA media and PA media on LTO 10 tape drive is described by the following set of charts that show how the drive behaves when locating or locating data in the access order determined by RAO and Sorted by record numbers using differing numbers of 200 MiB UDSes (4, 8, 16, 32, 128, 512, and 2000). Here, MiB=2^20.
HRTD is supported by PA media initially which improves the locate performance. To utilize the feature, it is highly recommended that SPACE EOD command is issued before GRAO command. The performance of PA media was measured after retrieving the HRTD by SPACE EOD command.



It took less time to locate when the order of access was determined by RAO compared to when the order of access was determined by sorting by record number.

The time to locate using the order of access determined by sorting by record number is mainly determined by the length of the media. Despite PA media being approximately 30% longer than LA media, Locate operations are faster when the record order is optimized using RAO. In RAO, there is a tendency to move to physically nearby positions on the media, so the more locations that need to be located, the locate time is affected by HRTD.

Conclusions

Since the introduction of the first LTO tape drive, every following generation has incorporated new features and performance improvements to respond to storage needs. Now the IBM LTO 10 tape drives in conjunction with the new LTO Gen 10 Premium media represents an efficient solution for today's growing storage demands.

Native capacity increases from 30 TB (gen 10 data media) to 40 TB (gen 10 premium media) and even more with data that is compressible (100 TB with 2.5:1 compression).

HRTD support with PA media mitigates repositioning performance degradation caused by the approximately 30 % longer tape length compared to LA media.

The IBM LTO 10 tape drive is a smart storage solution for businesses requiring backup and archival storage of their data.

Printed in the United States of America
December 2025

Product data has been reviewed for accuracy as of the date of initial publication. Product data is subject to change without notice. This information could include technical inaccuracies and/or typographical errors. IBM may make improvements and/or changes in the product(s) and/or programs(s) at any time without notice.

References in this document to IBM products, programs, or services do not imply that IBM intends to make such products, programs or services available in all countries in which IBM operates or does business. Any reference to an IBM Program Product in this document is not intended to state or imply that only that program product may be used. Any functionally equivalent program that does not infringe IBM's intellectually property rights, may be used instead. It is the user's responsibility to evaluate and verify the operation of any non-IBM product, program or service.

The performance data contained herein was obtained in a controlled, isolated environment. Actual results that may be obtained in other operating environments may vary significantly. While IBM has reviewed each item for accuracy in a specific situation, there is no guarantee that the same or similar results will be obtained elsewhere.

THE INFORMATION PROVIDED IN THIS DOCUMENT IS DISTRIBUTED "AS IS" WITHOUT ANY WARRANTY, EITHER EXPRESS OR IMPLIED. IBM EXPRESSLY DISCLAIMS ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT. IBM shall have no responsibility to update this information. IBM products are warranted according to the terms and conditions of the agreements (e.g., IBM Customer Agreement, Statement of Limited Warranty, International Program License Agreement, etc.) under which they are provided. IBM is not responsible for the performance or interoperability of any non-IBM products discussed herein.

The provision of the information contained herein is not intended to, and does not
grant any right or license under any IBM patents or copyrights. Inquiries regarding patent or copyright licenses should be made, in writing, to:

IBM Director of Licensing
IBM Corporation
North Castle Drive
Armonk, NY 10504-1785
U.S.A.