

Lab Report

PROMISE VTrak J5960 JBOD with 24TB SATA HDDs

Author: Rainer W. Kaese, Senior Manager
Business Development, Storage Products Division,
Toshiba Electronics Europe GmbH

Introduction

Striving for net-zero and sustainability are top priorities in modern data center operations. The goal: minimise power consumption and reduce the overall carbon footprint – while continuously processing massive volumes of data, most of which is still stored on hard disk drives (HDDs).

These green initiatives now influence every aspect of the data center – from innovations like waste heat reuse and free cooling to the adoption of sustainably produced hardware and cutting-edge HDD technologies.

This is where our lab report begins...

The PROMISE VTrak J5960 4U 60-bay top-loader JBOD is promoted as a “JBOD with green DNA,” reflecting a commitment to environmental protection and sustainable manufacturing. Previously, Toshiba Electronics Europe GmbH (“Toshiba”) evaluated this JBOD using 60 Toshiba Enterprise SAS HDDs with 18TB capacity each, totalling 1080TB in a dual I/O module (IOM) configuration (see [Lab Report TSH086](#)).

Since then, HDD capacity has increased to 24TB per unit. To optimise cost and energy efficiency, large-scale storage systems in the petabyte range are increasingly turning to SATA drives instead of SAS.



Picture 1: PROMISE VTrak J5960 JBOD in the Toshiba lab

In line with this trend, we tested a single IOM version of the VTrak J5960 (PROMISE part number J5960sS) using Toshiba 24TB SATA Enterprise drives (MG11ACA24TE).

Our focus: functionality, performance, and power consumption – specifically evaluating PROMISE’s “green JBOD” claims.

Dimensions & mechanical features

With a 4U height and a chassis length of just 666mm, the J5960 is the most compact high-density JBOD we’ve tested in the Toshiba HDD lab. It’s as short as a typical 2U server chassis and fits easily into standard racks – unlike many JBODs that exceed 1,000mm and require extended racks or complex cabling.

The hot-swappable IOMs are accessed from the front, while cabling remains connected at the rear. This design simplifies field replacements, avoiding the hassle of navigating through power and signal cables.

A standout mechanical feature is the JBOD’s lid, which remains attached to the rack when the unit is pulled out for servicing. This allows for partial extension – just enough for access to replace a drive – and makes it suitable for installation even at the top of a rack.

Each HDD is secured in a metal tray with four screws to ensure stable and reliable mounting, preventing vibration and movement that could lead to data loss or damage.

The status LEDs remain off during normal operation and only activate when the lid is opened, saving additional power.

Setup in the Toshiba lab

Model:	PROMISE VTrak J5960 4U-SAS-60-S BP / J5960sS configuration
Firmware:	1023
Host OS:	Linux (Red Hat 9.5)
Host bus adapter (HBA):	Broadcom Avago HBA 9500-16e (Host IF: 8x PCIe-Gen4)



Picture 2: J5960 with the lid open

Tests with enterprise capacity (nearline) SATA drives

Model name: Toshiba MG11ACA24TE
Block size: 512 byte emulated
Firmware: 0102

Data-rate outer diameter: 309MB/s

Power consumption

Idle_B: 3.03W
Sequential write: 7.65W
Sequential read: 7.35W
Random write: 6.21W
Random read: 8.81W

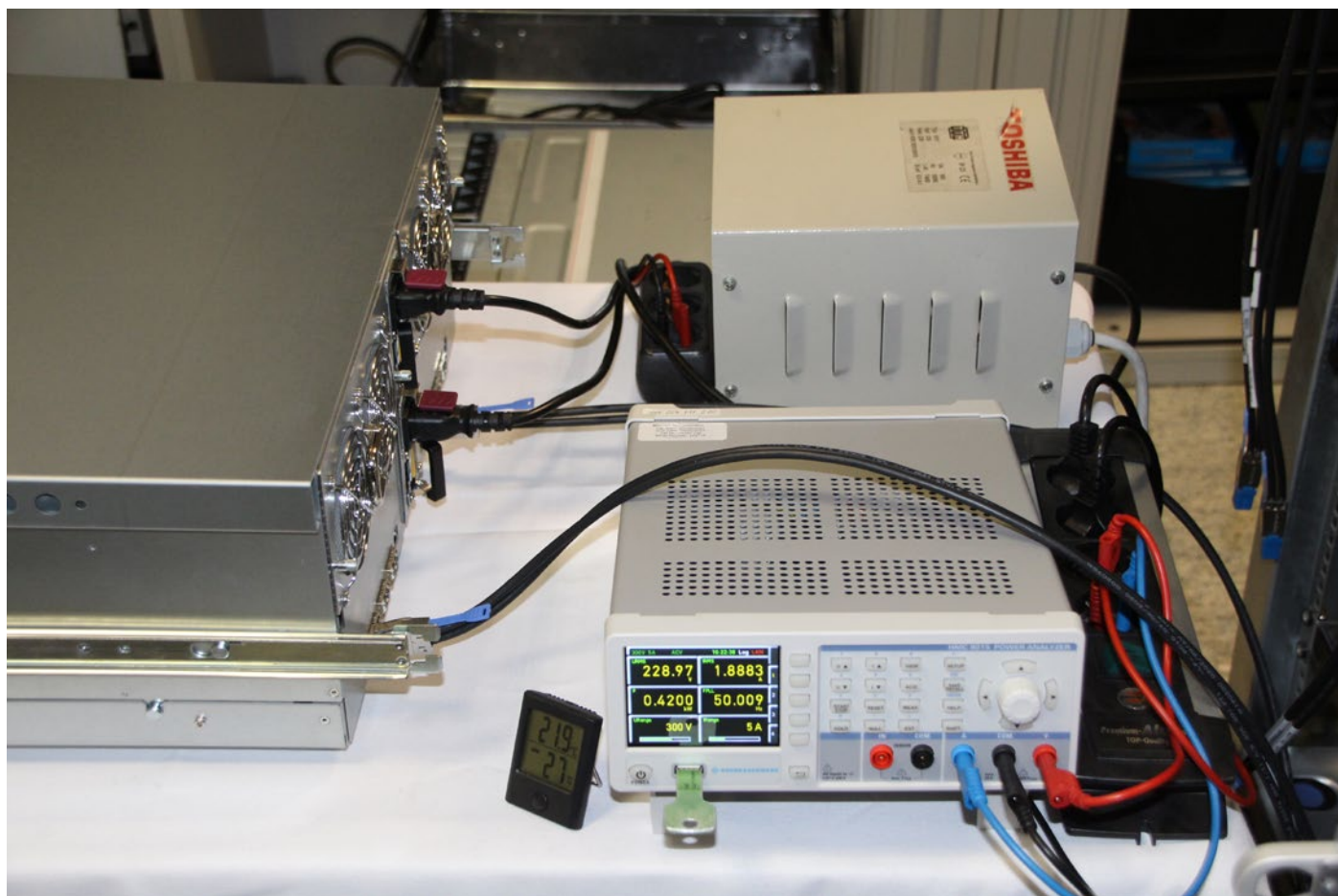
Basic JBOD functions

Basic function: ok
SAS IOM detected: ok
Hot plug /re-insert: ok
Smart reading: ok
Enclosure management: ok, tested with RJ11 serial connection



Picture 3: Toshiba HDD MG11ACA24TE in PROMISE tray

Power measurements were conducted using a high-precision Rohde & Schwarz HMC8015 power analyser.



Picture 4: Power measurement setup in the Toshiba HDD lab

Power & Environmental Metrics:

JBOD with drives, maximum start-up power over 500ms: ... 750W
JBOD with raw drives at HBA Idle_B: 286W
Lambda (ratio of active and reactive power) 0.96
Noise at 1 m distance 80dBA
Temperature ambient 23°C

An idle power draw under 300W is exceptional – most 60-bay JBODs start at 400W or more.

A high lambda factor of 0.96 means that the ratio of reactive power generated by the power supply units is extremely low (equating to 4% of the total power). The higher (i.e. better) the lambda factor, the smaller the reactive power.

Reactive power does not cost and does not create heat, but power supply rails must be dimensioned for both active and reactive power – so, for large data centers, a high lambda factor is an important factor.

Performance measurements in the Toshiba lab

The JBOD’s single IOM was connected via two mini-SAS HD cables to two mini-SAS-HD ports of the 16e Host Bus Adapter, increasing bandwidth and providing redundancy. The secondary IOM was replaced with a blind module.

This configuration gives a theoretical JBOD/HDD access-bandwidth of 2x 4.8GB/s = 9.6GB/s

Using the flexible I/O tester tool (fio tool), we tested all drives directly as /dev/sdxy, measuring both sequential and mixed workloads, as well as power consumption.

OS: Linux Red Hat 9.5
HBA/Controller: Broadcom HBA9500-16e
HDD: 60x Toshiba MG11ACA24TE
Configuration: Single IOM 2x Mini-SAS HD cables (3m in length)

Workload	Power (W)	IOPS	Bandwidth (MB/s)
Sequential write 1024k	528		6169
Sequential read 1024k	546		7395
Mixed 4k/64k/256k/2M	611	6310	1869
Temperature ambient	23°C		
Temperature HDD min.	27°C		
Temperature HDD max.	36°C		

Tabelle 1: Power and Performance Measurements

The power draw of 500 - 600W under load confirms the JBOD’s energy efficiency. A temperature spread of less than 10°C and a maximum delta of just 14°C above ambient ensures optimal cooling – key for HDD longevity and reliability.

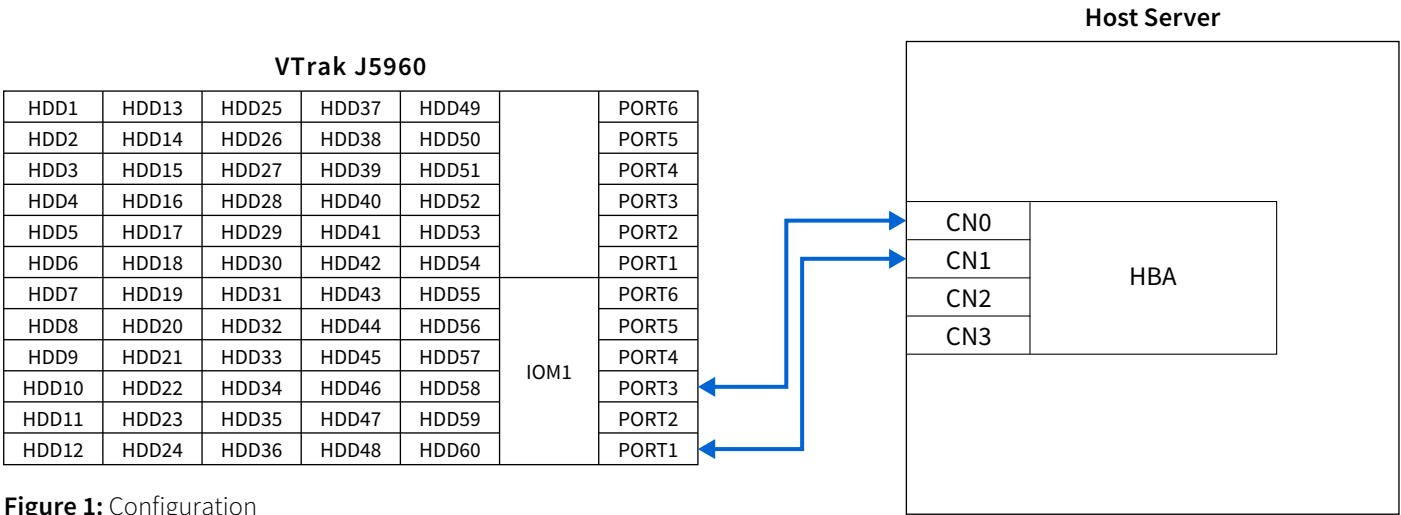


Figure 1: Configuration

Script (All drives parallel as single physical devices):

```
#!/bin/sh
fio --direct=1 --ioengine=libaio --rw=write --bs=1m --time_based --runtime=1h --group_reporting --write_bw_log=storage-expansion-write.bw.log --log_avg_msec=10000 --output=storage-expansion-write.log --name=/dev/sd{a..z} --name=/dev/sda{a..z} --name=/dev/sdb{a..h}

fio --direct=1 --ioengine=libaio --rw=read --bs=1m --time_based --runtime=1h --group_reporting --output=storage-expansion-read.log --name=/dev/sd{a..z} --name=/dev/sda{a..z} --name=/dev/sdb{a..h}

fio --direct=1 --ioengine=libaio --rw=randrw --bssplit=4k/20:64k/50:256k/20:2m/10 --time_based --runtime=1h --group_reporting --output=storage-expansion-randrw.log --name=/dev/sd{a..z} --name=/dev/sda{a..z} --name=/dev/sdb{a..h}
```

System considerations

In our earlier report (TSH086), we achieved ~12.5 GB/s bandwidth using dual IOMs, four cables, SAS drives, and a multipath setup – ideal for performance-optimised systems.

However, for applications where 6-7 GB/s is sufficient (e.g., systems connected via 10/25/40 GbE), the single IOM + SATA configuration tested here offers some savings in both cost and energy.

Summary

The PROMISE VTrak J5960 is a compact, energy-efficient, and service-friendly 60-bay top-loader JBOD. At just 666mm in length, it's the shortest in its class. Fully populated with Toshiba 24TB SATA drives, it delivers nearly 1.5PB of capacity while consuming only ~500W under load.

Despite using cost-effective SATA drives, the system still achieves 6 - 7 GB/s throughput and 6k IOPS in mixed workloads. Its efficient cooling design ensures HDD temperatures remain within 14°C of ambient, supporting long-term reliability.

Note of thanks to our partners

Critical to the success of this lab report has been the collaboration. "I would like to thank all our partners for the support on this project. PROMISE provided the green JBOD Vtrak J5960 to us and Broadcom contributed the Host-Bus-Adapter HBA 9500-16e. Together with our Toshiba Hard Disk Drives, we were able to build up a data center setting in our laboratory, showing a new level of impressive performance results."

Rainer Kaese,
Senior Manager Business Development,
Storage Products Division,
Toshiba Electronics Europe GmbH

Interested in performing a test in our lab yourself or planning a visit? We'd be happy to support you.





Toshiba Electronics Europe GmbH

Hansaallee 181
40549 Düsseldorf
Germany

info@toshiba-storage.com
toshiba-storage.com

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