

# Read Intensive Flash Drives

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Storage



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## Introduction

This IBM® Redpaper™ publication describes the configuration guidelines for using Read Intensive Flash Drives available from IBM with the IBM Spectrum Virtualize™ and IBM Storwize® family systems.

The Read Intensive (RI) solid state drives (SSDs) that are available on Storwize V7000 Gen2, Storwize V5000 Gen2, and IBM SAN Volume Controller 2145-DH8/24F are one Drive Write Per Day (DWPD) Read Intensive drives.

To deploy Read Intensive SSDs, your system must have Storwize code levels 7.6.1.4 or 7.7.0 installed.

RI SSDs are available to purchase as an add-on to an existing Storwize system, or they can be bought with a new system that contains RI SSDs. Due to the Read Intensive nature of these drives, they must be treated differently from regular or 10 DWPD SSD drives. We advise that the user follow the configuration guidelines that are detailed in the following document to be able to make the best use of RI SSDs.

## Drive identification

RI SSDs on a system can be identified by searching for the `vendor_id` assigned to these drives. Depending on the Storwize model, the RI SSD will use one of the following `vendor_ids`:

- ▶ Storwize V7000 (Gen2): **IBM-D051**
- ▶ Storwize V5000 (Gen2): **IBM-E051**
- ▶ IBM SAN Volume Controller 2145-DH8/24F: **IBM-C051**

For example, on a Storwize V7000 Gen2 system, the RI SSD drives can be identified by using the `lsdrive` command, as shown in Example 1.

*Example 1 The `lsdrive` command*

---

```
IBM_Storwize:cluster_name:admin>lsdrive -gui |grep -i d051
15 onlinecandidate 50000396ec8bbb91 sas_hdd1.7TB512IBM-D051 PX04SRB19201EJ595
11S00VN228YXXSVQARGWJ 10000 540D27onlineonlineno12Gbinactive 129
23 onlinecandidate 50000396ec8bbbe5 sas_hdd1.7TB512IBM-D051 PX04SRB19201EJ595
11S00VN228YXXSVQARGZ6 10000 540D26onlineonlineno12Gbinactive 129
```

---

Using the Storwize graphical user interface (GUI), you can also view the RI SSD pools by navigating to **Pools** → **Internal Storage**, as shown in Figure 1.



Figure 1 RI SSD pools

Note that RI SSDs will have the following attributes when listed by using `lsdrive <drive_id>` or `lsdrive -gui` or in the Properties view using the GUI, as shown in Example 2.

#### Example 2 RI SSD attributes

```
product_id: PX04SRB192
vendor_id: IBM-D051/IBM-E051/IBM-C051 (depending on Storwize product)
tech_type: sas_hdd
RPM: 10000
FRU_part_number: 01EJ601
```

For example, a 2 terabyte (TB) RI SSD on a Storwize V7000 Gen2 system will display the information shown in Example 3.

#### Example 3 The `lsdrive <drive_id>` command

```
IBM_Storwize:cluster_name:admin>lsdrive 99
id 99
status online
error_sequence_number
use candidate
UID 50000396ec8bbbbd
tech_type sas_hdd
capacity 1.7TB
block_size 512
vendor_id IBM-D051
product_id PX04SRB192
FRU_part_number 01EJ595
FRU_identity 11S00VN228YXXSVQARGXW
RPM 10000
firmware_level 540D
FPGA_level
mdisk_id
```



mdisk\_name  
member\_id  
enclosure\_id 6  
slot\_id 24  
node\_id  
node\_name  
quorum\_id  
port\_1\_status online  
port\_2\_status online  
interface\_speed 12Gb  
protection\_enabled yes  
auto\_manage inactive  
drive\_class\_id 129

---

Figure 2 shows the display that uses the GUI Properties view for the drive, and the Vendor ID indicates an RI SSD.

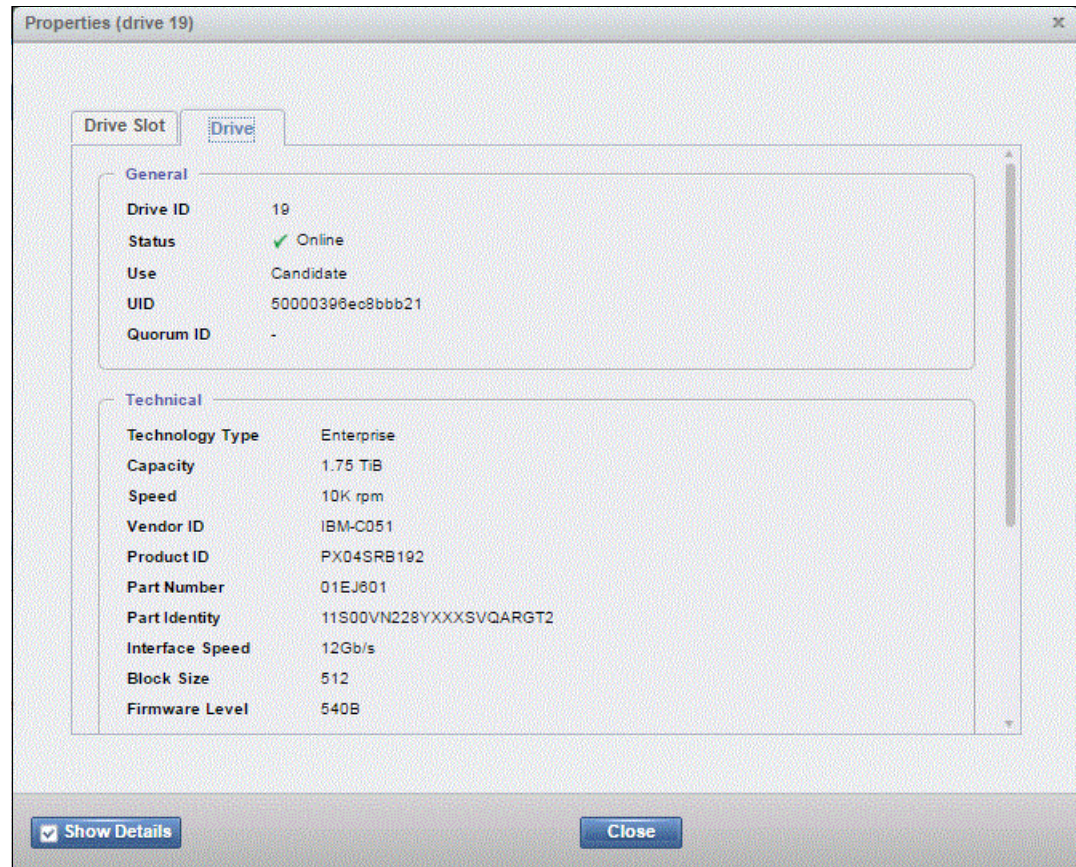


Figure 2 Vendor ID indicates RI SSD

## RAID considerations

In this current (at the time of writing) release of Storwize code (version 7.7.0/7.6.1.4), RI SSDs are assigned a `tech_type` of `sas_hdd` at 10,000 revolutions per minute (RPM). Due to this fact and the limitations on the write capability of these SSDs, the following leading practices apply when you create Redundant Array of Independent Disks (RAID) configurations:

- ▶ It is required that Read Intensive SSDs RAID and managed disk (MDisk) pools are created manually.
- ▶ If you are configuring a new system, create RI SSD RAIDs and pools before you configure other drives (other SSDs, Enterprise and Nearline serial-attached SCSI (SAS) drives).
- ▶ If you are adding RI SSDs into an existing system, create RAID and storage pools manually. Do not mix RI SSD and any other drive type in the same pool.
- ▶ Given that RI SSDs are assigned a `tech_type` of `sas_hdd` and 10,000 RPM, it is possible that automatic configuration tools might mix these SSDs with other 10,000 RPM hard disk drives (HDDs). This can affect RI SSD array performance. It is strongly advised that automatic storage configuration tools are *not* used for these SSDs.

It is imperative that enough spare RI SSDs are made available for RI SSD arrays. If a drive in an RI SSD array fails and a matching RI SSD is not available as a spare, the system picks up a HDD of matching or higher capacity and incorporates it into the RI SSD array. This impairs the performance of the entire RI SSD array. It is essential that sufficient spare RI SSDs are available to maintain exclusivity of RI SSD arrays.



Figure 3 and Figure 4 illustrate leaving sufficient null members of spares for RI arrays.

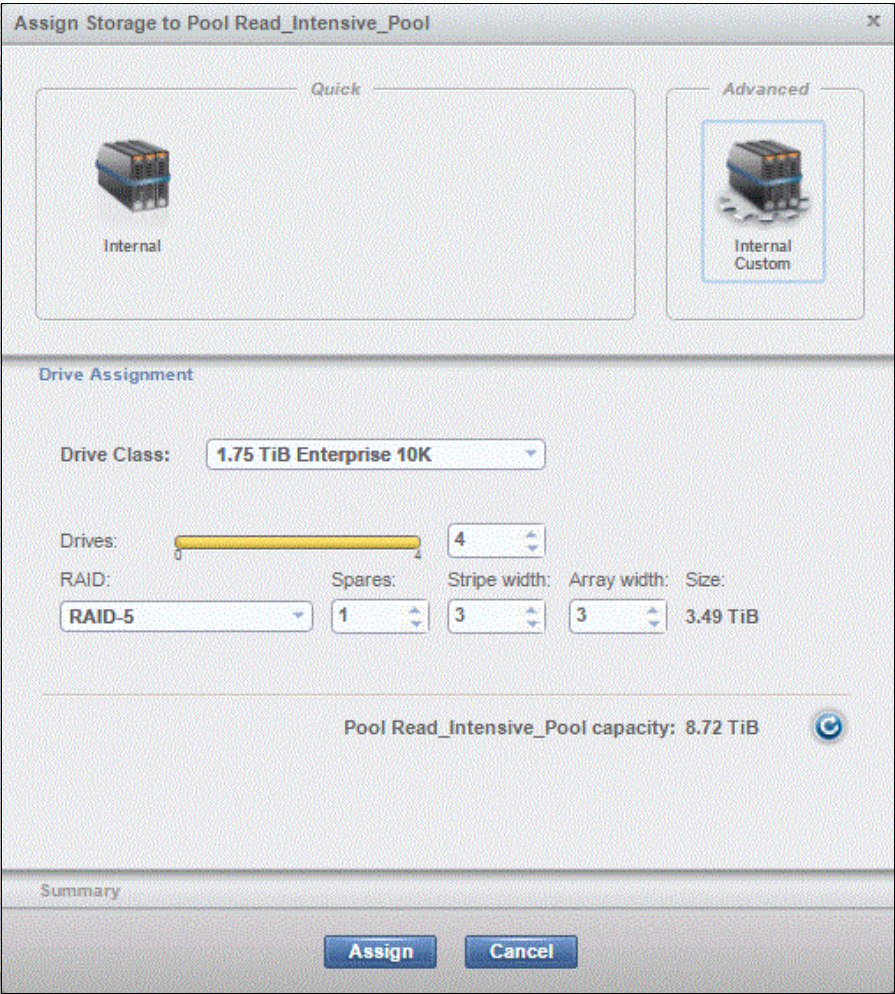


Figure 3 Spares

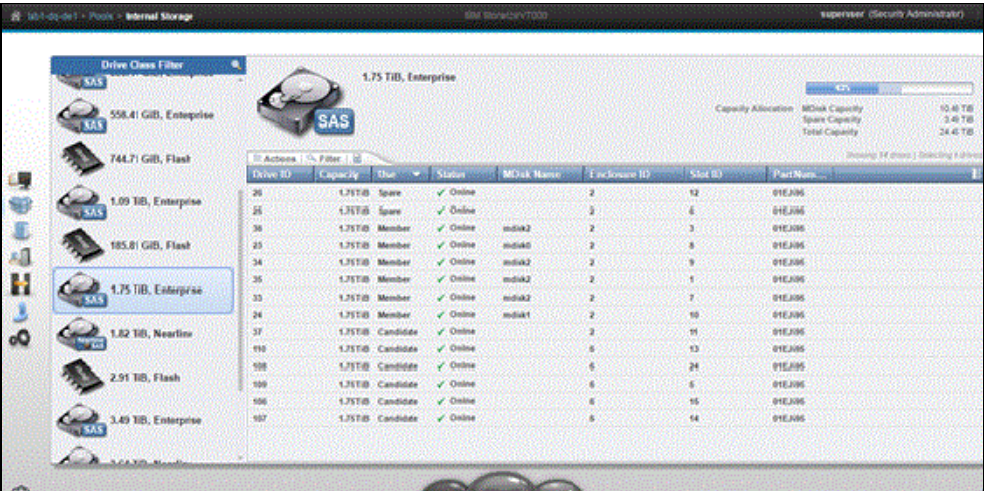


Figure 4 Spares (2)

It is necessary to ensure that RAID arrays formed of HDDs are assigned enough spare HDDs. In the absence of this configuration, an RI SSD could get incorporated into an HDD RAID array, severely under-utilizing the RI SSD.

RI SSD MDisks should not be mixed with other HDD MDisks in the same pool. If incorporated into a hybrid pool, IBM Easy Tier® management could subject the RI SSDs to unsustainable workloads.

## Read Intensive SSD considerations

RI drives have sufficient endurance to permit an average of one DWPD, and clients should choose applications for RI SSDs that have a greater read versus write workload.

When an RI SSD is used up to 95% of its endurance, an alert is logged in the system event log. If the SSD is a redundant drive in a RAID array, it will be taken offline. If it is non-redundant (taking this SSD offline will result in an array going offline), the SSD continues to be available. It is advised that you arrange a replacement as soon as possible after receiving this alert.

The eventlog entry has an event ID of 010073 and a description of Drive reporting PFA Errors, as shown in Example 4 and Figure 5 on page 7.

*Example 4 PFA errors (lines removed for brevity)*

---

```
IBM_Storwize:cluster_name:admin>|seventlog 161
sequence_number 161
notification_type error
event_id 010073
event_id_text Drive reporting PFA Errors
error_code 1680
error_code_text Drive fault type 1
```

---



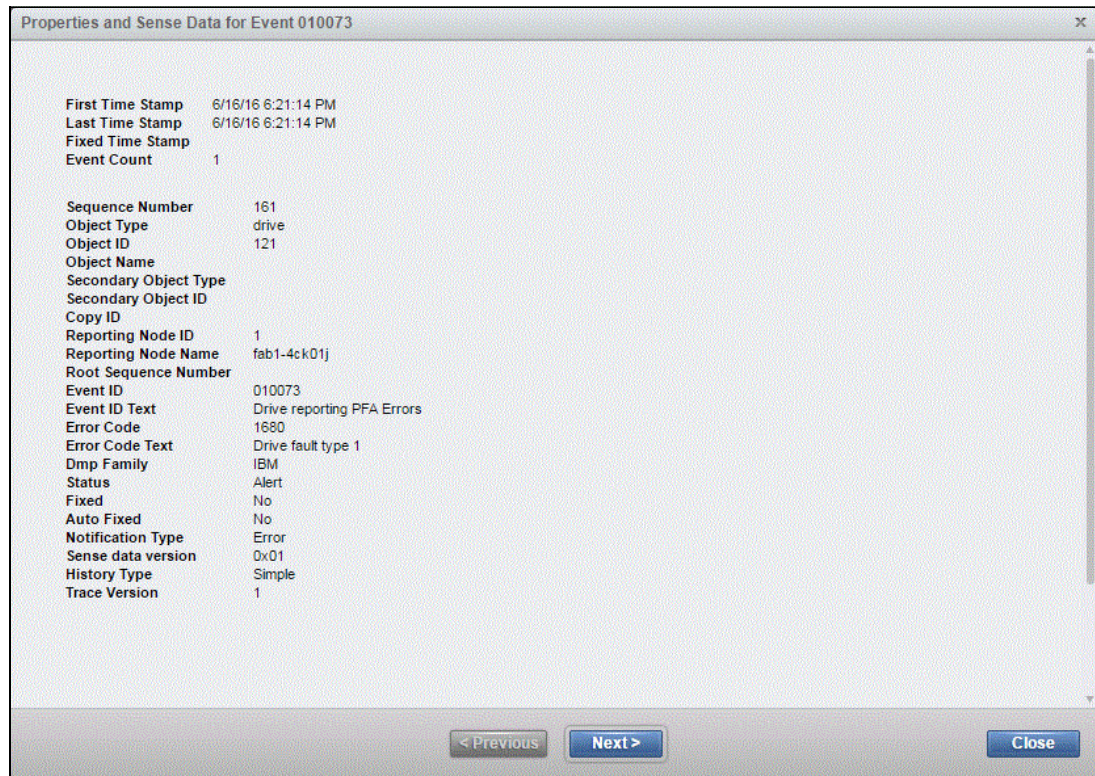


Figure 5 PFA errors

## System resource use impact on endurance

Keep in mind that there will also be some system resources expended using RI SSD. For example, array initialization will write zeros to all drives in the RAID array. If the drives are used as quorum disks, system data is written to a portion of the disks in addition to user data. The impact on endurance from these operations is considered minimal.

When volumes (VDisks) are created, disk space occupied by the VDisks are initialized with zeros. Again, although impact to endurance is minimal, it is advised that you create all volumes by using the **mkvdisk -nofmtdisk** command, as shown in Example 5.

*Example 5 The mkvdisk command*

---

```
IBM_Storwize:cluster_name:admin>mkvdisk -nofmtdisk <other options>
```

---

## Authors

This paper was produced at IBM Hursley UK labs.

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Thanks to the following people for their contributions to this project:

Sukhi Sohal

Suri Polisetti

John Fairhurst

**IBM Hursley**

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REDP-5380-00

ISBN 073845544X

Printed in U.S.A.

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