White Paper

Embedded RAID 1 Solution

It is difficult for embedded system integrators to find viable solutions to their storage expansion projects. This is where Redundant Array of Independent Disks (RAID), specifically RAID level 1, comes in as a simple and proven method to keep data safe in case of disk failure. Innodisk offers compact, cost efficient hardware RAID solutions that are designed for the embedded market.

Introduction

As opposed to traditional enterprise applications, there are several unique challenges facing the embedded system integrator when deciding on a RAID solution: limited space, system constraints, data integrity issues, harsh operating conditions. These conditions render standard RAID rather impractical for most embedded applications.

With embedded systems there is no one-size-fits-all solution, so the system integrator has to find a customized solution while at the same time keeping costs low. And if failure were to occur, it is imperative that the operator is notified and that the system can be fixed without compromising data integrity.

This paper aims to take a closer look at what constitutes the above mentioned difficulties, and then present the reader with a viable and cost effective solution.

Background

The embedded industry is diverse and encompasses widely different areas. Yet, there are certain common themes that are shared across the industries. With the ubiquity of IoT (Internet of Things) there is an ever growing demand for increased connectivity and modernization. Whether it is defense, automation, aerospace or in-vehicle, every operator faces similar difficulties when it comes to storage expansion. Space onboard the vehicle or platform is already fully utilized, and there is little to no room for new systems. Any expansion or upgrade might thus turn into a very costly affair.

However, every operator still faces unique challenges, whether it is robustness, data security, accessibility et cetera. As such there is a need for customization that might not be offered by the larger embedded vendors.

With a tailor-made solution, the operator can ensure there is only negligible interference with already onboard systems, the data is safe and the environmental footprint is small; all the while having a low impact on the bottom line.

Challenges

Data Integrity

Data Integrity is essential in the embedded industry as a sudden failure can mean costly down time and even pose a risk to operation and personnel. In the event of disk failure, there has to be a system of notification as well as easy accessibility for disk replacement.

Size Constraints

A standard enterprise RAID setup would normally include high capacity storage in a more expensive and bulky package. For embedded system integrators capacity requirements often come secondary to space-limitation concerns.

Software RAID vs Hardware RAID

Standard RAID is also normally built through software, which means that the RAID building process is handled by the CPU. However, in embedded systems CPUs are primarily chosen for their energy efficiency and small footprint – RAID building can as such severely impact processing speeds.

Harsh Environments

Industrial systems see operation in remote and inhospitable environments. To ensure data integrity, the components need to withstand large temperature variations, electromagnetic interference, and shock and vibration.

Solutions

RAID 1

One of the embedded market's main concerns is data integrity. To address this, RAID 1 works by simply mirroring two SSDs, so in the event of one disk failing (degraded mode), all data is still intact and accessible (see figure 1). While writing speed remains the same as a single disk setup, RAID1 increases reading speed by having the same set of data available on both disks.

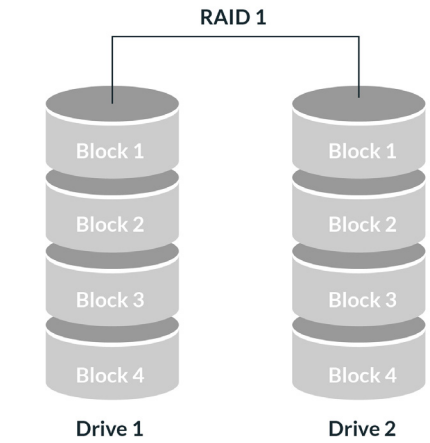


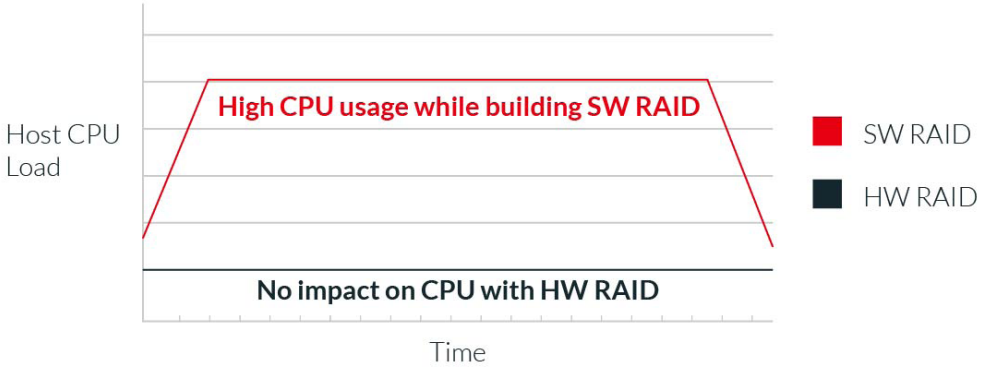
Figure 1:RAID 1 mirrored disks

Compactness

Space limitations are easiest solved by utilizing compact form factors. The smallest RAID setup simply requires an array module with two attached SSDs – allowing for a much easier integration.

Hardware RAID

Innodisk offers hardware RAID where RAID is built by an integrated controller on the module. This means that disk mirroring happens without relying on the host CPU – ensuring that there is no interference with ongoing CPU operations (see graph 1). The process is fully automated and will kick in as soon as a new SSD module is installed.



Graph 1: Difference in CPU usage for hardware and software RAID

Monitoring Software

With an efficient monitoring system, the user can access SSD SMART info at any time. A notification system will alert the user if anything out of the ordinary were to occur – which in turn allows the user to fix the problem before data is lost.

Innodisk's iRAID software offers these features, while also allowing for separate control of up to five array modules.

Robustness

For operation in extreme environments, Innodisk modules are tested and proven for use in industrial temperatures ranges from -40°C to 85°C, and in vibrations up to 5G@7~2000Hz and shock up to 50G@0.5ms.

Conclusion

Every embedded application is unique and requires a unique solution, yet there are certain challenges that are commonly shared such as limited space, system restraints and harsh conditions. With a compact embedded RAID 1 setup, these challenges can largely be mitigated. Hardware RAID ensures little to no impact on system performance; monitoring software will alert users and keep them up to date; and industrial robustness ensures reliability.

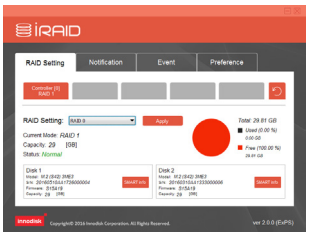
Innodisk's RAID 1 Solution

Innodisk provides flexible form factor and interface alternatives:

Form Factor	mPCIe/mSATA	M.2	2.5"	Standard PCIe x 4
Input Interface	PCI Express 2.0 SATA III	SATA III	SATA III	PCI Express 2.0
Output Interface	SATA III	SATA III	SATA III	SATA III
Output Connector	7 Pin SATA	7 Pin SATA	M.2 2242/2260/2280 mSATA	M.2 2242/2260/ 2280/22110

iRAID

iRAID is Innodisk's in-house designed RAID and SSD monitoring software.

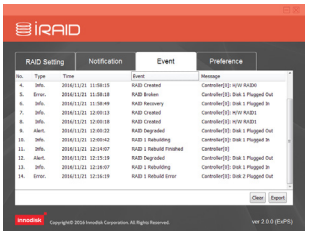


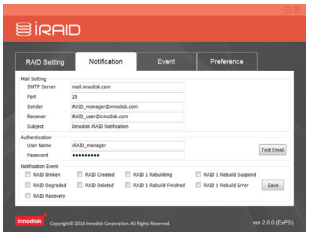
Monitor

Allows you to quickly asses the status of your RAID setup

Records

Access detailed records of your devices



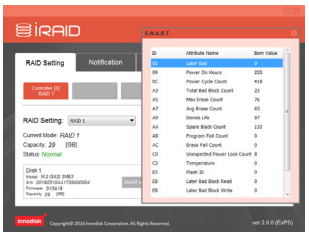


Notifications

Tweak settings to notify operator when certain parameters are met

SMART

Easily access the SMART information of your storage devices



Innodisk Corporation

5F., NO.237, Sec. 1, Datong Rd., Xizhi Dist., New Tapei City, 221, Taiwan
Tel : +886-2-7703-3000
Fax : +886-2-7703-3555
E-Mail : sales@innodisk.com

innodisk