BROADCOM®

White Paper

Is Hardware RAID Still Relevant?

The Benefits of Hardware RAID

With so many high-availability, fault-tolerant storage options to choose from, including clusters, distributed and scale-out file systems, converged infrastructures, and software-based and hardware-based RAID, one might question the need for RAID-based storage protection, especially hardware-accelerated RAID solutions. However, hardware RAID continues to provide cost-effective, in-the-box protection from data loss and downtime without the expense and overhead of other distributed and software-driven methods. In addition, the newest family of Broadcom® MegaRAID™ 9600 adapters provides unprecedented performance that can fully utilize even very high-performing SSD-based storage, allowing RAID to be used in solutions previously considered too demanding for traditional RAID adapters.

The acronym RAID stands for redundant array of independent drives, and the general definition of RAID is the placement of data across multiple drives to allow either improved performance and/or fault tolerance. The drives are presented to the operating system as a single volume. By copying data across multiple drives, performance can be significantly improved with multiple parallel accesses. There are multiple RAID types which involve different data storage techniques: mirroring, in which data is copied to two or more disks; striping, which involves segmenting data across multiple drives; or striping with parity.

Broadcom hardware RAID solutions offload all RAID operations from the system with dedicated hardware, similar to the offload GPUs and network controllers provide. Software RAID, on the other hand, utilizes server resources to handle all input/output (I/O) accesses, redundancy, parity, rebuild, and regeneration operations needed to maintain a RAID array. This overhead can generate a lot of system interrupts, context switching, memory utilization, PCIe traffic and CPU overhead, which can impact application performance. Alternatively, cluster-based, high-availability operations require high network bandwidth that causes congestion, additional costs, and high latencies. The newest Broadcom MegaRAID 9600 adapters accelerate and offload every aspect of RAID operations, consuming a fraction of system resources while providing revolutionarily fast performance.

Broadcom MegaRAID 9600 Series Benefits

RAID provides data protection for servers that store valuable data. Maintaining server uptime and reliability is crucial to ensure business operations run smoothly. Without RAID, a failed drive can result in lost revenue and productivity while maintenance and recovery operations are implemented. RAID ensures business continuity while the volume heals under the covers. While failure rates vary by drive type model and capacity, drive failures are a reality for all data centers.

Broadcom RAID proactively prevents data errors. Research shows that between 30% and 80% of flash drives develop uncorrectable errors, and 3.5% of hard drives develop bad sectors within a four-year period. Unrecoverable Read Errors (UREs) can render parts of the drives permanently unreadable. Broadcom MegaRAID adapters feature patrol reads which proactively check all the data on each drive to detect and correct errors. When required, the data on these bad blocks can be recovered using redundancy, or the affected disk sectors can be remapped internally.

In addition to providing fault tolerance and high availability, RAID can deliver significantly higher performance by combining the individual performance of each drive within the RAID volumes. This performance gain can be significant, producing millions of disk I/O operations and multiple gigabytes of bandwidth, all while safeguarding against data loss and downtime.

RAID helps utilize a storage investment more efficiently. Rather than accessing individual silos of drives, RAID leverages striping data across multiple drives, which ensures the capacity and performance of each drive is more uniformly consumed. Broadcom MegaRAID 9600 adapters are part of an end-to-end connectivity ecosystem consisting of PCIe switch and SAS expanders. With the ability to attach as many as 240 devices, you can continue to scale up your capacity and performance as needed.

MegaRAID solutions allow a mixture of drive types to support specific needs. This allows the creation of tiers of storage types, from slower but less expensive SATA or nearline SAS, to more expensive but faster NVMe and enterprise SAS drives.

With the MegaRAID 9600 adapters, the intelligent RAID cache has been optimized with hardware engines that allow consistent, low-jitter write latencies: as low as 6 µs to 8 µs. In addition, very high levels of I/O performance will experience low latency; loads of up to 3 million operations per second can be sustained at these very low latencies. This level of low latency and high performance can exceed even the best enterprise SSDs. In addition, the RAID cache can be used to quickly retrieve recently accessed data, greatly improving read performance. When combined with MegaRAID elevator sorting, write performance to hard drives can be improved by as much as 3X.

Finally, there's the question of raw I/O performance. Can hardware RAID keep up with today's enterprise SSDs and server applications? Absolutely yes. MegaRAID 9600 adapters can provide up to 28GB/s in read and write bandwidth and 7 million I/O operations each second of raw performance. MegaRAID 9600 adapters can even maintain over 13GB/s and 1 million write I/O operations per second with RAID5-based and RAID6-based configurations, the most storage-efficient and cost-effective high-availability RAID type available.

Not only do MegaRAID 9600 adapters provide high levels of performance during optimal configurations, but they can also provide over 3 million host I/O operations per second of performance while rebuilding a volume that has experienced a drive failure. These levels of performance during rebuild can keep even the most demanding applications running with no noticeable drop in overall system performance. MegaRAID 9600 adapters greatly accelerate array rebuild times with SSD-based solutions, ensuring data is optimally protected over its lifetime.

Conclusion

The advantages of Broadcom robust and reliable hardware RAID are numerous. Broadcom solutions provide premier features and software tools to help manage data. The latest MegaRAID 9600 adapters offer the highest performance, both for optimal and rebuilding volumes.

The benefits of Broadcom hardware RAID are numerous:

1. High availability and fault tolerance in-the-box, without clustering overhead or the resource consumption of software RAID.
2. Hardware offload handles all I/O operations, allowing server resources to be used for applications and not storage operations.
3. Preventive maintenance with patrol reads and consistency checks to proactively detect and correct drive errors.
4. Higher performance through the combination of multiple drives into a single volume.
5. Better utilization of storage investment by uniformly consuming drives.
6. Expandability of up to 240 devices.
7. A mixture of SAS, SATA, and NVMe drive types to meet cost, capacity, and performance requirements.
8. A RAID cache that delivers extremely low and deterministic write latency over the entire range of controller IOPS performance.
9. High-performing hardware RAID with up to 28GB/s of bandwidth and up to 7 million I/O operations per second.
10. Unprecedented storage performance during array rebuilds: over 3 million I/O operations per second, along with lightning fast rebuild times.

Whether you are deploying a database server, virtual desktops or a machine learning cluster; whether your server is in a large data center, a small or medium business office, or sitting at the edge; Broadcom MegaRAID 9600 adapters continue to be one of the most cost-effective and highest performing means to ensure your data is protected and always available.