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Compaq Smart Array 431 Controller Hardware Fault Tolerance vs. Software Fault Tolerance

***Abstract:** This paper focuses on the Compaq Smart Array 431 Controller in comparison with software RAID products in the market.*

In the ever-growing world of server storage, finding the right solution for low cost storage is often a difficult decision for the IT manager. No matter how big or small the company, managing and protecting data is crucial to the organization's success. Making sure users have continuous access to business critical data has become today's IT challenge shared by the entire business community.

In light of this need to protect business critical data, Compaq continues to design a variety of fault tolerant solutions with the customer in mind. One of these products is the Compaq Smart Array 431 Controller.

The Smart Array 431 Controller is a hardware-based RAID solution developed to:

- ? Reduce the storage purchase cost and total cost of ownership over the life of the server
- ? Decrease the difficulties associated with complex technology
- ? Maximize data performance

This paper will illustrate the vast differences and advantages of the Compaq hardware RAID solution as compared to competitive software products. These differences include Ease of Use, Data Performance, and Total Cost of Ownership – all of which point to the Smart Array 431 Controller as the product of choice for an entry level server storage solution.

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Various RAID implementations

Although there are numerous variations of RAID (Redundant Array of Independent Disks) systems available, there are two fundamental approaches to providing “fault-tolerant” data security. The first approach, hardware RAID, uses a dedicated hardware array controller with its own dedicated microprocessor, memory, and SCSI channel. Dating back to 1989, Compaq has pioneered the hardware approach to fault tolerance in the Wintel market. The second approach to providing fault tolerance is strictly through the use of software RAID features found in some operating systems.

Smart Array Family Advantages

All Compaq Smart Array Controllers share the Smart Array Family Advantages. These advantages include:

- ? Data compatibility between Smart Array Controllers
- ? Consistent configuration tools
- ? Consistent management tools
- ? Pre-Failure Warranty for disk drives¹
- ? Snapshot backup – with StorageWorks Virtual Replicator
- ? Design integration by Compaq on Compaq platforms

Compaq Integrated Smart Array Controller

The Compaq Integrated Smart Array Controller is an entry-level, embedded product that provides a lower cost of ownership than using software RAID. Used on the ProLiant DL380 as a standard for internal drives and the ProLiant ML370 as an option, the Compaq Integrated Smart Array Controller also features the Smart Array Family Advantages. When a customer is ready to upgrade from the Compaq Integrated Smart Array Controller to another Compaq array controller, the new array controller is simply plugged in. The new controller automatically recognizes the server array configuration previously used and begins providing RAID. There is no easier upgrade process in the industry.

¹ Certain restrictions and exclusions apply. Requires that servers use Compaq Insight Manager in order to implement Pre-Failure alerting. Call the Compaq Product Information Center at 1-800-345-1518 for more details.

Compaq Smart Array 431 Controller

One upgrade example and one of the milestones in the Compaq RAID story is the Smart Array 431 Controller. In addition to the Smart Array Family Advantages, the Smart Array 431 Controller has several key strengths that are NOT featured in software RAID implementations found in popular operating systems:

- ? Powerful yet user-friendly management software
- ? Automatic Data Recovery (ADR) – no user software interaction required to start rebuild
- ? Hot Plug Drive Support (RAID-1 and RAID-5)
- ? Support for Compaq Insight Manager
- ? Pre-Failure Notification and Warranty replacement for failed drives²
- ? Fully tested and integrated to run with Compaq ProLiant servers
- ? Full-featured RAID options including RAID levels 0, 1, 0+1, and 5
- ? SCSI channels reside on the board - efficient access to data

Software RAID Strengths

The greatest strength of software RAID is that it is considered "free" with the purchase of an operating system. However, this can be a misleading perception. The real cost of software RAID is not the cost to purchase the fault tolerance – it is the cost in performance, management, and the cost of training Information Technologists to maintain a software RAID system. In many ways, software RAID's perceived greatest strength is also its greatest weakness.

Different operating systems (OS) support various features and have different limitations; the list below illustrates the weaknesses of one specific implementation:

Microsoft Windows NT RAID Weaknesses

- ? Limited support for RAID-1 only (only supports 1+1 drive mirroring)
- ? No hot-plug drive support for RAID-5
- ? No support for on-line spares
- ? Cannot boot from RAID-5 array (must have additional drive/controller to boot)
- ? Limited performance
- ? Server CPU utilization increases (particularly in "degraded mode")
- ? Dependant upon addition of SCSI controller to obtain higher performance provided by SCSI disk drives (adds to cost of server)
- ? Requires trained IT professionals to manage (not for new or untrained professionals)
- ? Must interrupt the server CPU to service each I/O (higher CPU utilization occurs here)
- ? No support for array expansion

² Certain restrictions and exclusions apply.

IMPORTANT: Lack of knowledge and correct procedures could easily result in data loss. If a user reboots the server before a failed drive is replaced, the server may not reboot at all.

IMPORTANT: Management of the array: While everything else listed on this list could be significant to any given user, the lack of user-friendly and easy-to-use configuration utilities could be the biggest resource drain and cost of maintaining data integrity. Learning how to cope with a drive failure/replacement could cost more than a hardware array controller could.

Cost of Ownership for software RAID

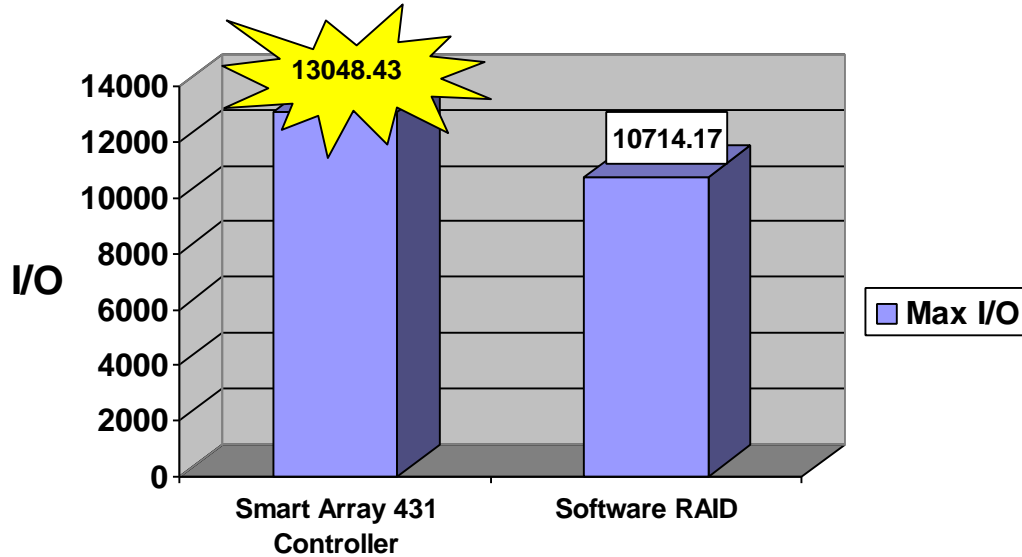
Software RAID implementations are most often found simply to be features of operating systems, such as Microsoft Windows NT and Novell NetWare. These added features in the OS, while inexpensive to “purchase,” can be very expensive to configure, manage, and actually use day to day. The total cost of ownership associated with a software RAID implementation is often found to be a much more significant investment than the cost of competitive hardware that is designed to be dedicated to the task of managing and protecting server data. A few of the areas of software RAID ownership cost includes:

- ? Experienced IT personnel time and resources to configure the array
- ? IT personnel time and resources to add storage capacity to the array
- ? Day-to-day performance characteristics
- ? Performance during a drive failure condition (significant additional burden is placed on a server operating in a degraded mode with software-based RAID products)
- ? IT personnel time and resources to replace a failed drive and rebuild data from the remaining drives
- ? Time and expense related to an unexpected drive failure with no Pre-Failure notification

Note: *Ownership costs begin at the time of purchase. According to technology industry analysts, only a small percentage of the total cost is actually related to the purchase cost, but the true cost of any implementation begins with the configuration and does not end until the system is discarded.*

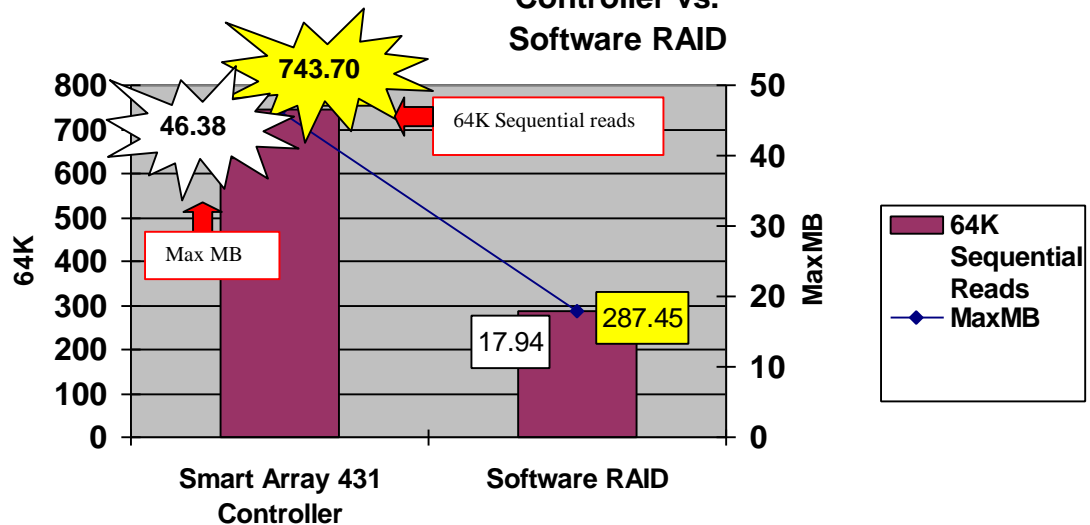
Smart Array 431 Controller vs. Software RAID Performance

Figure 1. Max I/Os of Smart Array 431 Controller vs. Software RAID



- ? Figure 1 above demonstrates that the Compaq ProLiant Smart Array 431 Controller is **21% faster** than Software RAID when measuring Max I/Os and utilizing RAID 5 with 4 hard drives and 1 logical drive.
- ? Figure 2 below demonstrates that the Smart Array 431 Controller is **158.7% faster** when measuring 64K Sequential Reads and **158.3% faster** than Software RAID when measuring Max MB and utilizing RAID 5 with 4 hard drives and 1 logical drive.

Figure 2. 64K Sequential Reads and MaxMB of Smart Array 431 Controller vs. Software RAID



Conclusion

Summing up all the pieces of the landscape that compose the Compaq hardware RAID solution, it is easy to see that if a customer's need is one of performance, cost of ownership, manageability, and data integrity, the clear choice is the Compaq Smart Array 431 Controller. Software RAID solutions can be nice features of the operating systems, but tend to be much more expensive to use, maintain, manage, and often more expensive to actually purchase.