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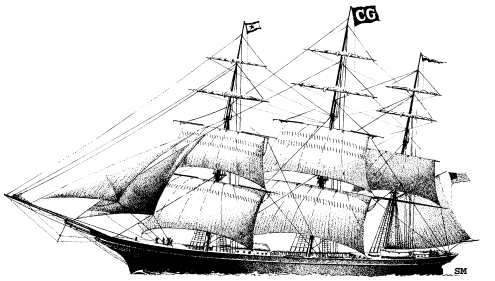

Navigating Information Technology Horizons℠

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3PAR's F-Class — A New Kind of Mid-Range Storage

Analyst: Anne MacFarland

Management Summary

With the accelerating onslaught of data and other forms of information, there are many more demands and requirements for information access and use. Many IT infrastructure inefficiencies of the past have been overcome – in a variety of ways. Bottlenecks have been addressed by adding more channels and forming non-blocking meshes that can parallelize and mitigate the clog. Hot spots have been addressed by deploying farms of independent servers and by adding a load-balancer to apportion the load appropriately. In both these cases, it is the fan-out and automated management of the resulting indirection that alleviates the problem. This is a common pattern and long has been used in storage arrays to support RAID. **However**, **RAID is just the tip of a much richer set of features that address not only the rapidity and reliability of data access but also the capacity planning and other information management tasks that have become more complex as data inputs expand and proliferate. Storage virtualization and data striping are the foundations of a new mode of storage operations and management – one that can meet the needs for performance and for the domain isolation that underlies secure multi-tenancy.**

Over the past decade, 3PAR has built on the combination of virtualization, automation, and clustering that it calls *Utility Storage* to support high storage utilization plus storage and workload consolidation that its high-performance architecture makes possible. This consolidated storage environment gives proven savings both in terms of energy use and in reduced administrative costs.

With the *F-Class*, 3PAR has brought a comprehensive set of its enterprise-class features to mid-size organizations. These features add the automation and business-side value to change storage from just being a peripheral to becoming a collaborative part of business process. 3PAR's innovative approaches deserve broad consideration, beyond the hosting companies that are the backbone of their customer base.

If, because of the economic downturn, you have been hanging on to old storage just a little bit longer than really makes good sense, now is the time to assess what the new features of the F Class array might provide to your organization. You may find you can cut the management time, energy costs, and money spent on managing storage more than expected. This will not solve all the problems facing the planet, in general, and your business, in particular, but it does create some well-needed breathing room. For more details, please read on.

Cost and Waste are the Enemy

Storage has traditionally suffered from low utilization. Now, new sources of business data, and expansion of traditional data sources with byte-gluttons like video, make storage expense a real problem, even while storage costs are going down on a per terabyte basis. Deleting data that is no longer needed and moving historical information off primary storage are classic and good strategies, but often they do not adequately address the problem.

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Automation of storage management routines is one step towards freeing up time to address the host of new tasks that underlie prompt and satisfactory information provisioning to applications and end users. However, more than simple automation is needed. Virtualization[1] – when applied to storage as a foundational strategy – supplies the redirection that allows the whole domain of storage provisioning and management to be rethought.

The abstraction of IT resources that storage virtualization provides changes assignment of storage physical capacity from a specific stripe on a specific disk to an abstract (logically-referenced) piece of a storage pool with a persistent pointer that properly satisfies requests for its contents. Like car pools, family-style meals, and laundromats, pooling is a frugal strategy. As with server virtualization, it is even more useful if the resulting storage domains come with guaranteed isolation (provided by 3PAR Virtual Domains – see more below).

As an array-based capability, it enhances the effectiveness of other array-based capabilities with a multiplier effect that can add up to real CAPEX and OPEX savings, while suiting the needs of the mid-sized enterprise for simple infrastructure. When combined with striping of data across an entire cluster of drives, it is also a very good idea. With 3PAR, each volume[2] is spread not just across disks in a cluster but also across cache and I/O. This reduces the probability of contention for these resources. This is similar to the divide-and-conquer pattern noted on the first page.

3PAR's F-Class Array

The Benefits of a Good Array Operating System – 3PAR InForm

Capacity planning is done by routines in the 3PAR's *InForm* operating system, replacing a tedious, usually manual part of storage administration. They also support high quality of service without capacity waste. InForm can be updated non-disruptively.

Mesh Controllers as another use of Virtualization

The combination of Intel processors with 3Par's custom ASIC gives F-Class a hybrid-style *best of both worlds*. You have the speed and low energy use of Intel processors for the more prosaic tasks, and the re-programmability and hardware-based acceleration[3] of an ASIC, where it is most needed. As an example, the ASIC splits control commands from data. Control commands have a 4GB cache, while 6GBs of cache are used for data. This allows performance to be unimpeded by control traffic. The ASIC also supports *cache coherence*, which is critical to supporting domain isolation, and *adaptive cache*, which adjusts to workload demands by giving credits to the write cache when appropriate.

3PAR F-Class supports up to four mesh controllers, each of which contains both the Intel Xeon processor and the ASIC. *Mesh-Active* is different from traditional Active-Active configurations, in that in mesh-active, all controllers are active on each volume. Collectively, they act as a load-balanced cluster.

Thin Provisioning

Because 3PAR virtualizes all array resources, provisioning can be done – as needed – in small chunks, spread across the cluster. 3PAR's patented process, the original that others imitate, uses smaller chunks (16KB).[4] Smaller chunks mean less waste. F-Class arrays can be installed mostly empty (starting at 2.4TB) and grow only as the capacity is actually – not just theoretically – needed. Decreasing costs of drives of all types (3PAR supports FC, SATA and, soon, SSDs) makes postponable acquisitions part of a good strategy for storage acquisition.

Thin Built In

As an amplification of 3PAR's Thin Provisioning, the F-Class also offers a feature called *Thin Built In*, where the 3PAR ASIC performs hardware-based conversion of fat volumes into thin volumes.

When a 3PAR array copies a volume from a data source that has no thin provisioning, the 3PAR ASIC will flag, deduplicate, and map the newly-acquired "thin" data. 3PAR's thin provi-

[1] A many-decades old technology that is now most familiar for consolidating servers.

[2] One should note that, while 3PAR's tools and tactics address a broad purview, the system was developed and is sustained with a block, not a file, perspective. It is this block approach that supports thinner provisioning than methods used by NAS vendors.

[3] Things "run better in hardware" because there are no communication wires and layers to traverse.

[4] Think of using gravel casting for making jewelry rather than fine sand. Fine-grained is better.

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sioning multiplies the effective thinness. This lets the array work not just as great infrastructure but also as an optimizer of a larger storage infrastructure.

Fast RAID 5

Because the data is spread across disks in a cluster behind a battery of mesh controllers, it can be retrieved in parallel. This lets 3PAR's *Fast RAID-5* achieve the performance of traditional RAID-1 mirrored storage with less dedicated capacity. By the end of 2009, 3PAR expects to support *Fast* RAID-6 (double-parity RAID), which will be called *RAID MP*[5].

Information Resilience

Striping with redundancy reduces the impact of a bad disc (including SSDs), because the array can seek an alternate source for a piece of the data, not of the whole file. Replication can be atomic and less of a batch task, lessening batch's generally greater risk of interruption.

Volume rebuild similarly leverages the indirection of virtualization. The rebuild process copies and points to spare chunklets across all the drives in the array in what 3PAR calls a *Virtual Rebuild*. Then, when the disk is replaced, the array migrates information back onto the new drive as a background process.

3PAR Remote Copy supports both asynchronous and synchronous replication over IP. There is a port on each controller dedicated to *RemoteCopy* traffic. In addition, each controller has four 4GB/s Fiber Channel ports, and two optional adapters that will provide 4 more ports with either Fiber Channel or iSCSI connectivity.

3PAR Virtual Domains

A key part of controlling storage management costs is in reassigning the parts of the challenge that are better accomplished elsewhere, 3PAR *Virtual Domains* supports the creation of thousands of virtual private domains on an array. The isolation between them ensures data isolation and makes chargeback possible. It also supports secure administration at the virtual domain level by application administrators, DBAs, or developers. This curtails storage administration costs, and shifts the controls over to those with direct knowledge of the actions that are needed.

VMWare Enhancements

In the past few years, the combination of VMware *ESX* with HP *C-class* blades and 3PAR storage has become so popular with 3PAR customers that it is called *3CV*. To encourage this situation, 3PAR has developed *3PAR Thin Copy for VMware VDI* and 3PAR *Replication Adapter for VMware SRM*, and has developed *Adaptive Queuing* jointly with VMware to support greater IO scalability. If you use VMware, these features will be attractive.

Conclusion

Frequently, economic downturns become watersheds, where old ways of doing things, tolerable in good times, are discarded and new ways of doing business set their own requirements. The future does not look to be any less competitive than the past. Considered over time, margins will be thin. Processes will be commoditized. Success will depend on the ability to provide goods or services-to-suit more quickly than others, at a competitive cost. 3PAR F-Class will support these new requirements.

[5] Supports multiple partitions.

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- ***The Clipper Group can be reached at 781-235-0085 and found on the web at www.clipper.com.***

About the Author

Anne MacFarland **is Director of Information Solutions for The Clipper Group.** Ms. MacFarland specializes in strategic business solutions offered by enterprise systems, software, and storage vendors, in trends in enterprise systems and networks, and in explaining these trends and the underlying technologies in simple business terms. She joined The Clipper Group after a long career in library systems, business archives, consulting, research, and freelance writing. Ms. MacFarland earned a Bachelor of Arts degree from Cornell University, where she was a College Scholar, and a Masters of Library Science from Southern Connecticut State University.

- ***Reach Anne MacFarland via e-mail at Anne.MacFarland@clipper.com or at 781-235-0085 Ext. 128. (Please dial "128" when you hear the automated attendant.)***

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