



HP LeftHand P4000 SANs

Enabling a flexible, easy and cost-effective storage strategy

Data grows exponentially every day, technology evolves, and budgets shrink – all placing a huge strain on IT departments in their efforts to determine the most effective storage strategy. They must accommodate change and growth, protect data and meet the availability needs of today's business environment as they strive to reduce their storage management costs. In addition, IT organisations struggle to implement affordable off-site disaster recovery solutions, create easily scalable storage for new projects, provide a diverse range of users and applications with access to their information, and re-allocate or provision storage quickly as business needs change.

All of these storage-related concerns are amplified in a virtual server environment. Flexibility is a key element of virtual environments, requiring the storage system to be adaptable as well as easy to manage. Legacy SAN arrays are extremely difficult to change or 're-provision' once they have been set up, and provisioning is often cited as the primary storage management pain point. This inflexibility offsets the hard-won benefits of a virtual server infrastructure.

What is needed is a storage environment that is simple to learn as well as easy to manage and change, scalable up to any size without creating bottlenecks or downtime, and highly available – all without costing a great deal of money. The good news is that these requirements are met with every HP LeftHand SAN.

Solution overview

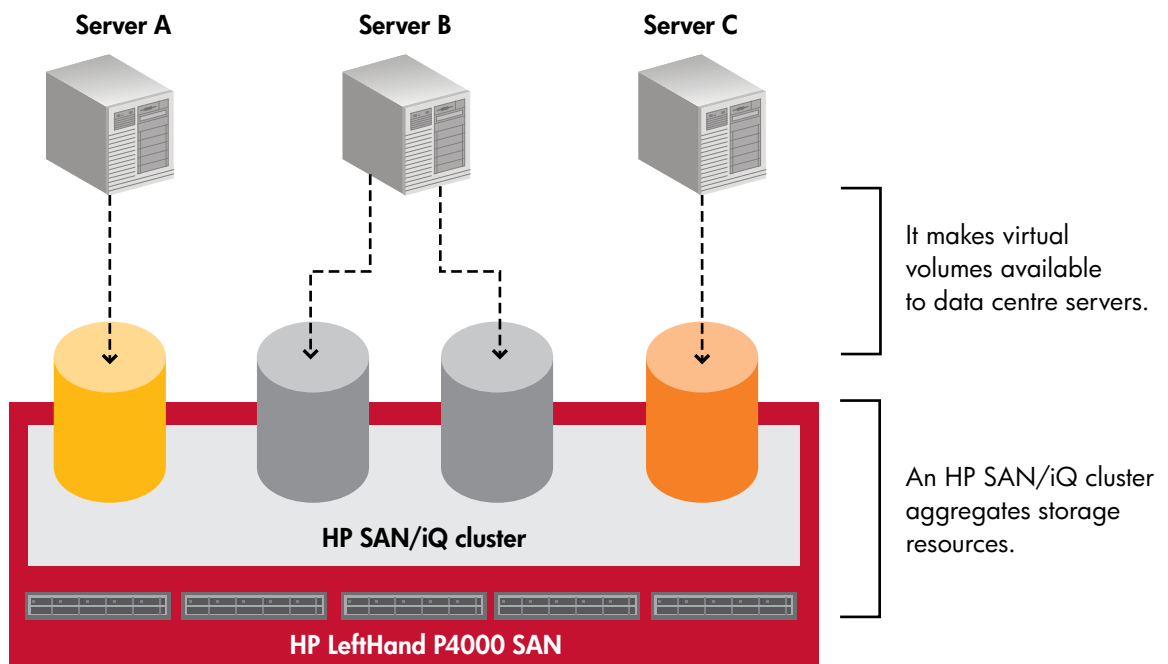
An HP LeftHand P4000 SAN's architecture is different to that of traditional SANs. Traditional SANs are composed of two separate hardware units – a controller for performance and disk shelves for capacity. Our systems combine these two units in what we call a storage system. A storage system is composed of an x86 processor, a storage controller, disk drives, network ports, RAM and cache – basically everything you need for storage in a single 'building block'. Completing the package is HP SAN/iQ® Software, which clusters multiple systems together into a single pool of storage.



When you need to increase performance or capacity, HP SAN/iQ Software allows you to attach another storage system with no disruption to your applications. Our ability to cluster provides some interesting advantages over traditional architectures.

1. **Cost and simplicity.** Buy only what you need today and grow your storage non-disruptively in the future. Most storage vendors make money by encouraging you to plan for growth and over-purchase today. With HP LeftHand SANs, you can start with a single system and scale to petabytes of data over time – managing it all with an intuitive, single user interface.
2. **Scalable performance.** With HP LeftHand SANs, performance scales along with capacity. Because all of your resources are clustered – not just capacity – the overall performance of the SAN increases each time a storage system is added; this helps you avoid controller bottlenecks and the costly, complicated upgrades that follow.
3. **Availability.** Our biggest advantage is data availability. Our systems can sustain multiple system failures and still keep data on line and accessible. Most storage vendors use dual controllers for high availability, but they do not protect against dual disk failures, power failures, air conditioning failures, or any type of 'outside of the box' failure. Our systems provide levels of data availability beyond what dual controllers and hardware RAID can provide.

Figure 1. HP SAN/iQ Software storage clustering creates a pool of storage resources from a set of HP LeftHand P4000 SANs and delivers them in the form of virtual volumes to application servers.



The other thing to note is that storage management functionality is included with every HP LeftHand SAN; we do not charge extra for add-on software capabilities.

Storage clustering – scale your storage with ease

HP SAN/iQ Software storage clustering allows you to create pools of storage by consolidating storage nodes on the network into clusters. Storage clustering provides on-line scalability, both within a volume and across the storage pool. All available physical capacity is aggregated and available to the volumes created on the SAN.

In order to scale capacity and/or performance, simply add nodes to the storage cluster. HP SAN/iQ Software redistributes the data automatically for optimal data availability and performance. All the capacity, processing power and bandwidth included in each node are aggregated into the whole SAN, helping to ensure an increase in performance as the SAN grows. To make the process still easier, HP LeftHand SANs let you expand volumes and add storage nodes on line, without taking the volumes off line or causing application downtime.

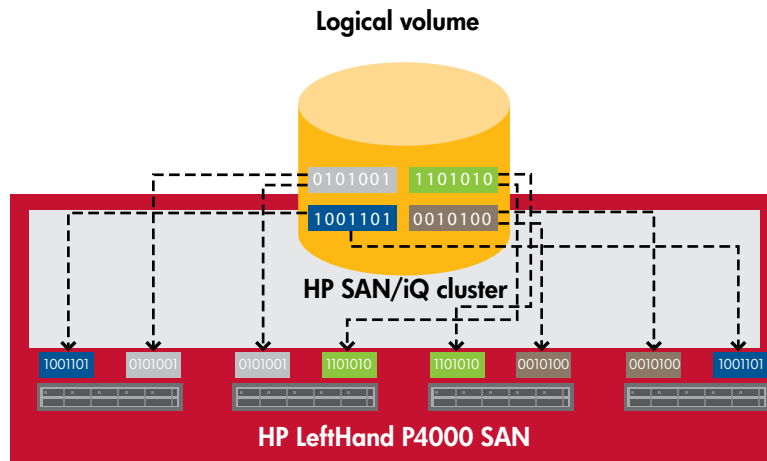
For increased access to hardware, customers can install storage nodes anywhere on the IP network. Within a facility, storage nodes in a cluster can be spread out between the server room and a network closet. A single cluster can also be spread across physical sites or data centres to eliminate the risk of data loss from a site or data centre failure.

Customers can use HP SAN/iQ Software storage clustering to implement different tiers of storage in their SANs. For instance, a storage cluster of SAS-based storage nodes can be implemented in a SAN for performance and a storage cluster of SATA-based storage nodes implemented for higher density – with both managed from a single interface.

Scalable performance

In a true cluster, every component contributes to performance. The cluster balances its own workload, distributing connections across all of the nodes. More nodes not only means more storage; it also means more network bandwidth, more RAID controllers, more cache and more CPUs – all of which contribute to performance.

Figure 2. HP SAN/iQ Software network RAID stripes and replicates up to four copies of each data block across an HP SAN/iQ cluster. A logical volume's block replication with network RAID level 2 is illustrated.



Network RAID – delivering unprecedented availability

HP SAN/iQ Software network RAID (nRAID) stripes and mirrors multiple copies of data across a cluster of storage nodes, eliminating any single point of failure in the SAN. Applications have continuous data availability in the event of a power failure or a failed network, disk, controller, or storage node.

SAN administrators can manage redundancy on a per-volume basis to optimise storage utilisation and match the data protection of the volume to the application data on that volume. Customers choose one, two, three, or four copies of data across the storage nodes, allocating additional storage space only for data that warrants additional protection. For increased protection, nRAID can also be integrated into environments where application servers are clustered, enabling true, seamless, geo-cluster solutions that provide both application and storage clustering across geographies.

Using built-in self-healing technology, nRAID repairs bad blocks on the SAN in a proactive manner before applications encounter them. In addition, nRAID automatically optimises the data layout of a volume over time, keeping performance optimal no matter how old or full the volume becomes.

Better than traditional SANs

Traditional SANs require you to define RAID groups ahead of time by allocating each disk to a particular RAID group. Changing a volume's RAID level means taking its RAID group down for restriping or moving the volume to a different RAID group – and either way, all the applications that depend on it suffer downtime during the move. Moreover, to support

different RAID levels for different types of data, you must purchase and allocate physical disks for each, which leads to underutilisation, creates storage islands and forces application downtime for copying. With HP SAN/iQ clusters, nRAID is an attribute of each logical volume and can be changed on the fly, which allows you to match your storage characteristics closely to your ongoing business requirements.

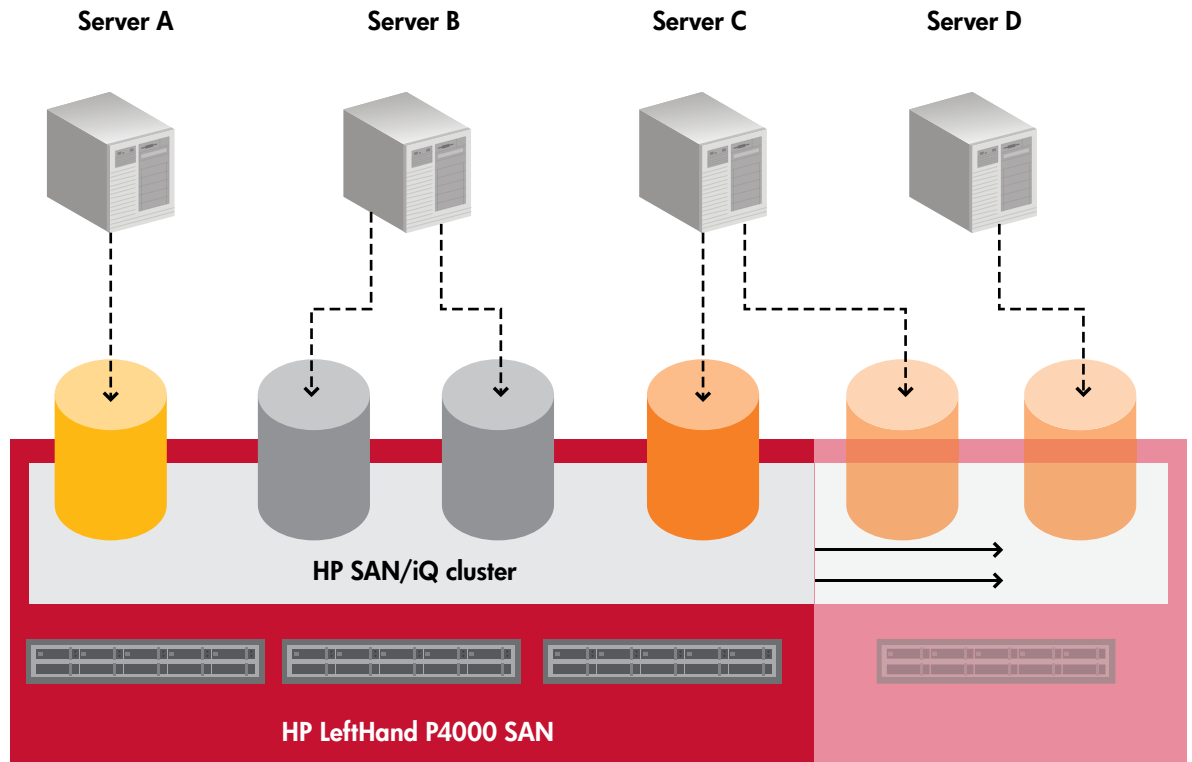
Better for business

The bottom line is that nRAID and synchronous replication help you better utilise your storage. Instead of having to maintain a different storage system for each storage policy, you can support multiple policies in a single HP SAN/iQ cluster. Because all of your storage is pooled, you reduce fragmentation and the wasted space that multiple, isolated storage systems bring. With the HP SAN/iQ grow-on-demand model, you can expand each cluster dynamically as you need the storage. When you add nodes to the cluster, nRAID re-stripes data and re-balances its workload internally, all with no application downtime.

Thin provisioning – provision actual storage only as you need it

Most SAN vendors place the provisioning burden on SAN administrators, asking them to predict how much space will be needed for volumes, snapshots and remote copies as well as the expected growth rate – all because most storage provisioning models call for storage space to be pre-allocated on the SAN. Worse yet, once storage has been over-allocated, it is nearly impossible to reclaim that unused space.

Figure 3. HP SAN/iQ Software thin provisioning and non-disruptive scaling let you create larger volumes than you need today, and let them fill with blocks as your application data grows.



HP LeftHand SANs do not require pre-allocation of storage space. HP SAN/iQ Software manages all the storage allocations underneath a given volume, and the thin provisioning feature allocates space only as data is actually written to that volume. Thin provisioning lets you purchase only the storage you need today and then add more storage to the clusters later, as application data grows; this raises the SAN's overall utilisation and efficiency and ultimately increases the ROI associated with the SAN.

Give your volumes room to grow

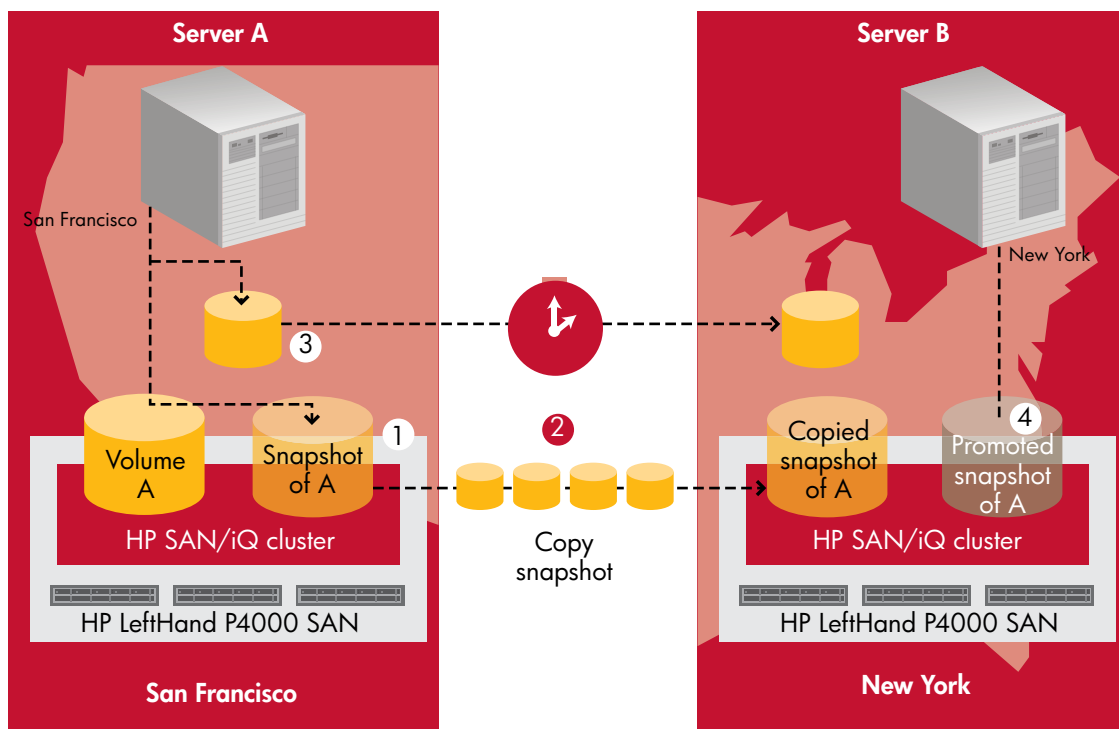
HP SAN/iQ Software's thin provisioning functionality lets you size your volumes with room to grow. You can create a volume with the size you expect it to be in the future, create a file system in it and then allow your application data to grow to fill the volume over time. HP SAN/iQ Software incorporates advanced monitoring and alerting mechanisms that make over-provisioning safe for day-to-day use. Because thin provisioning is an attribute of each volume, you can switch back and forth between thin and full provisioning as you wish – as easily as clicking the mouse. This promotes greater flexibility, efficiency and lower cost.

Snapshots – instant, point-in-time backups

Snapshots create instant point-in-time copies of data on a per-volume basis. They can be created in a number of ways to meet business or application requirements. Administrators can create snapshots manually ad hoc, on a scheduled or scripted basis, or via the Microsoft® VSS framework; these point-in-time snapshots can then be used to recover individual files or folders from the volume – or to roll back a whole volume. Unlike most vendors' SANs, which require a snapshot reserve, HP SAN/iQ Software creates snapshots that are always thin-provisioned for efficiency, consuming storage space on the SAN only for the data written to the snapshot. Thin provisioning also eliminates any upfront space reservation or guesswork that could lead to snapshot and backup job failures. HP SAN/iQ Software snapshots open up a range of new possibilities for the IT organisation:

- Almost any backup software can access the snapshots, including products that update backup times in the volume itself.
- Snapshots can be mounted read/write – and you can change the snapshot without affecting the live volume.

Figure 4. HP SAN/iQ Software's remote copy functionality uses space-efficient snapshots to create consistent, point-in-time remote copies for backup and disaster recovery.



1. HP SAN/iQ Software creates a snapshot of the volume.
2. The snapshot is copied to the remote cluster either physically or via the network. Watermarks prevent confusion between local and remote volumes.
3. Asynchronous replication schedules send only the changed blocks to the remote site. Different retention policies enable you to save recent copies or a history of copies for recovery.
4. Remote volumes can be promoted for disaster recovery or simple backup.

- Use HP SAN/iQ Software snapshots as backups: retrieve a previous version of a file, or recover a whole volume instantly.

A failover/failback wizard is also included with remote copy for step-by-step, easy-to-execute disaster recovery procedures when they are needed most.

Remote copy – recover your data with minimal disruption

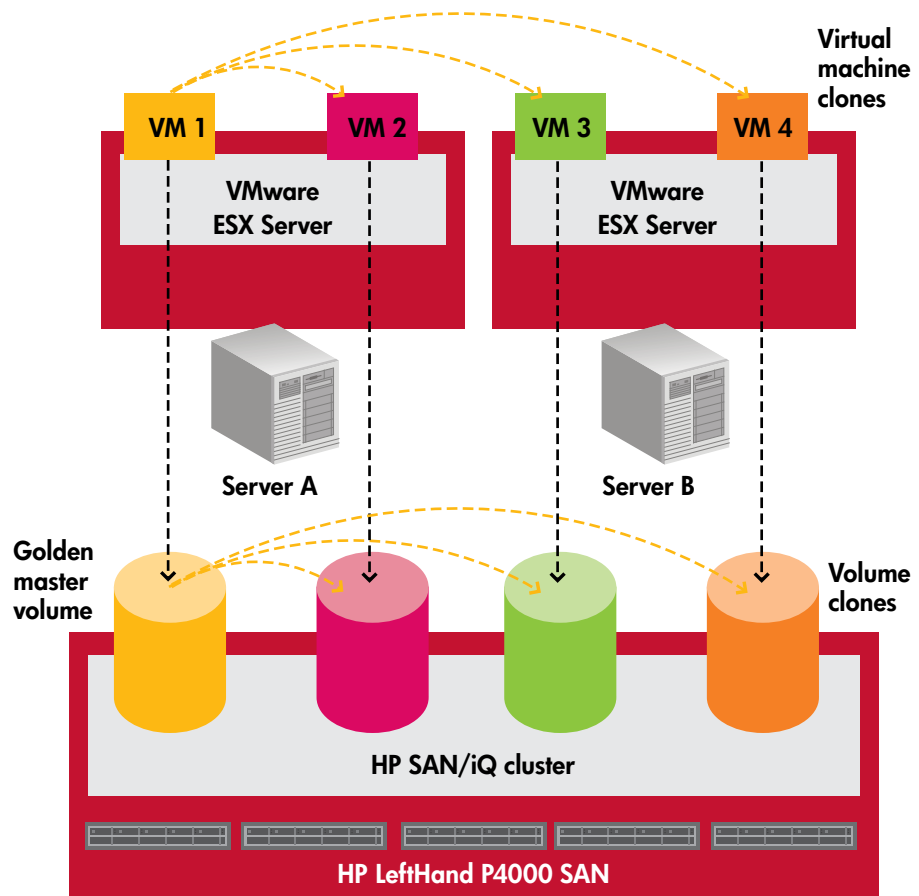
HP SAN/iQ Software's remote copy functionality lets you replicate thin-provisioned snapshots between primary and remote locations. Because the remote copies are thin-provisioned, no space reservation is required at the remote location. Remote copy is used for centralised backup and disaster recovery, and it can be set up on a per-volume basis. Placing your remote copies on a recurring schedule lets you achieve point-in-time asynchronous replication of the data between locations, sites, or data centres.

Asynchronous replication

Asynchronous replication is implemented as a series of scheduled remote copies. An HP SAN/iQ cluster understands the relationship of any given snapshot to the sync point, so all the HP SAN/iQ Software has to do to accomplish asynchronous replication is to copy the blocks that have changed since the last copy. Asynchronous replication is integrated with the

HP SAN/iQ Software's snapshot mechanism, which means there is no need to worry about write-ordering should a failure occur while a remote copy is in progress. Each remote copy is exactly the same as its source snapshot.

Figure 5. HP SAN/iQ Software with SmartClone Technology makes space-efficient volume copies instantly for use by virtual machines and physical servers.



Intelligent bandwidth management

Because you are not likely to have infinite bandwidth between your sites, HP SAN/iQ Software remote copy functionality helps you to manage and share your network resources intelligently so that you can support asynchronous replication while still maintaining quality-of-service levels for the rest of your network traffic. The PrimeSync feature lets you physically move your initial volume copy to your remote location, which saves you from transferring potentially terabytes of data over the network.

HP SAN/iQ Software also monitors and adapts to changing network conditions for bandwidth and latency, throttling the data transfer accordingly.

HP SmartClone Technology – instant, space-efficient volume clones

HP SmartClone™ Technology replicates data volumes and data sets instantly without requiring additional storage space. Each volume clone is a virtual copy that enables you to save time and space in various environments and applications, including server and desktop provisioning, boot-from-SAN provisioning, and rapid copy of production data into test and development environments.

HP SAN/iQ Software with SmartClone Technology essentially breaks down the cost and technology barriers to using virtualisation. For example, copies of existing virtual machines can be used to scale existing applications by adding identical server

instances, to create virtual desktop systems based on 'golden master' images and to create test and development environments based on existing production systems. Making new virtual server instances is easy, but most traditional SANs then require the time- and storage-space-consuming process of copying existing logical volumes for use by the new virtual machines. HP SAN/iQ Software with SmartClone Technology changes that, letting you make as many volume copies as you need – all in an instant and with minimal use of storage. This is possible because:

- Volume clones are based on an original source volume, so they are space-efficient and instantaneous
- Clones can be accessed from physical servers, virtual servers and virtual desktops
- HP SAN/iQ Software with SmartClone Technology is de-duplication technology for server and desktop images – so there is only one copy of operating system files on the SAN, which helps raise storage utilisation and increases the return on storage investments
- Cloned volumes are thin-provisioned, allocating only the storage you actually use, when you use it, increasing your storage ROI

Everyday SAN operations are simple and worry-free

The whole HP LeftHand SAN is managed from the HP SAN/iQ centralised management console (CMC). An administrator simply connects via the IP network to the storage nodes. Multiple data centres and sites of storage can be managed from a 'single pane of glass' no matter where the nodes are located physically. The CMC also includes an integrated performance management system, providing you with detailed, real-time metrics and the ability to export statistics. All HP SAN/iQ Software features are managed from the CMC.

A single point of management

The HP SAN/iQ CMC lets you configure, manage and monitor your SAN easily, making everyday operations simple and worry-free. Part of what makes managing HP LeftHand SANs simple is their superior architecture, which lets you scale storage, change a volume's RAID level, or migrate volumes between storage tiers without taking applications off line. Providing still greater ease of use is the CMC, which simplifies access to all SAN features on all of your HP LeftHand SANs, whether local or remote.

Now, everyday administration is efficient and easy. When you need to change attributes of a volume, such as its network RAID level, its location, or whether it is thin or fully provisioned, the HP SAN/iQ CMC puts these management tasks only a click of the mouse away. When you need to do something more complex, such as failing back to an original volume after a failover to a remote site, wizards and tools take the guesswork out of operations where time and accuracy are critical.

Monitoring SAN performance is easy and intuitive

Quickly assess the performance of your SAN with the HP SAN/iQ Software's performance management system, which is also included with every HP LeftHand SAN. The performance management system is designed from the ground up to make it easy for you to obtain the performance metrics you need, when you need them. One click of the mouse, and the system's performance monitor is up and running in the CMC. Once running, the monitor lets you select from a short list of relevant statistics and counters to obtain performance metrics that are rolled up to the level of abstraction that you choose.

The HP SAN/iQ Software's performance monitor gives you specific performance information on each application server/virtual machine, logical volume, snapshot, storage cluster and storage node, so there is no wading through irrelevant statistics in search of the ones you need. The performance monitor's graphical user interface is simple and elegant – not cluttered with counters and statistics that are irrelevant or difficult to understand – and each statistic includes a detailed explanation of what it means for SAN performance, integrated directly into the management interface.

Why HP LeftHand SANs?

HP LeftHand SANs provide the fundamentals of a proven storage solution, helping IT departments cope with today's influx of data in a simple, flexible and cost-effective way. With HP SAN/iQ Software's virtualisation capabilities built into every HP LeftHand SAN, you get a comprehensive enterprise-class storage feature set – including storage clustering, thin provisioning, remote copy, network RAID, snapshots and SmartClone Technology – as well as simplified management capabilities. Start confronting storage-related issues head-on with great ease, lower costs and the flexibility to take advantage of your virtual server environment's inherent benefits. HP SAN/iQ Software within every HP LeftHand SAN helps you create and maintain a truly effective storage strategy – one that accommodates change and grows seamlessly with your business.

HP Education Services for HP LeftHand SANs

A well-trained IT staff helps make your HP LeftHand SAN Solutions still simpler to use and brings still more agility – and greater value – to your business. Educated customers experience improved solution reliability, fewer end-user support requests, speedier support issue resolution and faster project implementation.

To help you get the most from your HP LeftHand SAN Solutions, HP offers two levels of HP LeftHand SAN training:

- Basic Training imparts the knowledge you need to understand, manage and configure your HP LeftHand SAN.
- Advanced Training outlines best practices for HP LeftHand SAN, based on field experience and applied industry knowledge.

Visit www.hp.com/learn/storage for more information.

HP Financial Services

HP Financial Services provides innovative financing and financial asset management programmes to help customers acquire, manage and ultimately retire their HP solutions cost-effectively. For more information on these services, please contact your HP representative or visit www.hp.com/go/hpfinancialservices.

HP Services

Put the strategic and technical know-how of HP Services experts to work for you: When you buy HP LeftHand SAN Solutions, it is a good time to think about other levels of service and support you may need. You can trust the service professionals at HP to collaborate with you to make technology the difference in your business.

Recommended services

- **HP Support Plus 24 Service** – for around-the-clock, reactive on-site hardware support and over-the-phone software support
- **HP Installation and Startup for HP LeftHand SAN Solutions** – fast, reliable start-up for enhanced server virtualisation and business continuance with SAN solutions

Related services

- **HP Proactive 24 Service** – integrated proactive and reactive services for businesses looking to achieve better performance, higher availability and greater stability
- **HP Proactive Select Service** – to improve IT performance and manageability for businesses looking for services flexible enough to cover the IT product life-cycle and adapt to changing needs

When technology works, business works. For more information, contact your HP sales representative or HP-authorised Channel Partner or, visit www.hp.com/hps/storage.

For more information

To learn more about HP SAN/iQ Software, which is embedded in every HP LeftHand SAN, visit www.hp.com/go/p4000.

Technology for better business outcomes

To learn more, visit www.hp.com

© Copyright 2009 Hewlett-Packard Development Company, L.P. The information contained herein is subject to change without notice. The only warranties for HP products and services are set forth in the express warranty statements accompanying such products and services. Nothing herein should be construed as constituting an additional warranty. HP shall not be liable for technical or editorial errors or omissions contained herein.

Microsoft is a U.S. registered trademark of Microsoft Corporation.

4AA2-5247EEW, April 2009

