Enterprise Strategy Group

Storage and Information Management Brief

StoreAge: Delivering on the Original Promise of SANs

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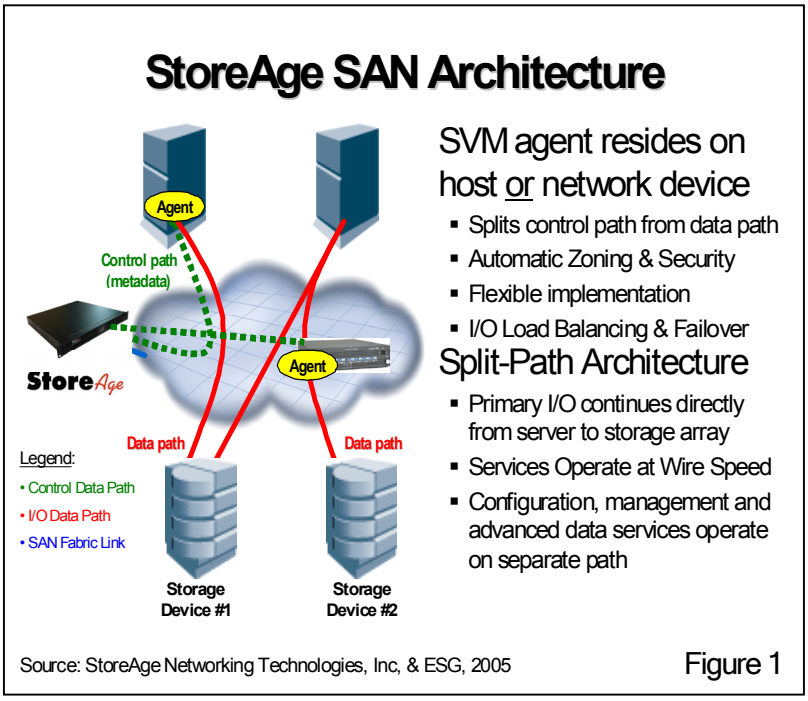
Storage vendors have been more focused on the function of SAN "end-points" by putting storage services in the storage array or the server, rather than the network itself. This is a distinct departure from mainstream networking methodologies, limiting the true value proposition of the SAN. StoreAge's solutions realign storage networking with mainstream networking by providing "Split-Path" storage services in the network and delivering on the original promise of SANs.

StoreAge – Delivering on the Original Promise of Storage Networking



Source: StoreAge Networking Technologies, Inc, & ESG, 2005

Figure 1

StoreAge Networking Technologies is a 6 year old company with roots in Irvine, CA (US Corporate) and Haifa, Israel (International Corporate and R&D). StoreAge is the innovator of a Storage Area Network (SAN) architecture called the Storage Virtualization Manager (SVM) that is the foundation for a family of storage management and data protection applications. StoreAge has demonstrated a high degree of maturity having well survived the harsh, post-bubble purchasing down-turn by establishing a 4 year track record of delivering innovative products to over 300 customers worldwide.

StoreAge could be lumped into the highly ambiguous "virtualization product" bucket. However, virtualization is not – by our definition – a stand-alone product category. Virtualization is a means of abstracting proprietary or system-embedded functions in a way that enables broad, standards-based use of critical system or network functions. Given this definition, virtualization is an enabler that StoreAge employs to facilitate reliable, intelligent storage management and data protection capabilities across heterogeneous, distributed SAN infrastructure. StoreAge delivers wire-speed performance for its management and data protection services by splitting I/O data from control data, handling each in separate logical paths within or across multi-protocol SAN infrastructure as illustrated in Figure 1.

The solutions provided by StoreAge open the door to achieving the long promised benefits of networking heterogeneous storage hardware and server systems such as:

- Any-to-any physical host to physical storage relationships,
- Any-to-any physical storage to data set/structure relationships,
- Improvements in the ratio of capacity managed per administrator, and
- Reduced cost of data protection and business continuance practices through multiple-tiers of data protection.

The Challenges of SAN Management and Operations

Storage Area Networks were originally promoted as a means to eliminate the direct-attached storage (DAS) problems of islands of storage. The SAN was promoted by the industry as a way to create large pools of storage that could be used as needed. By adopting a SAN infrastructure, end-users have been able to exploit distinct server and storage functions independently. The separation of functions facilitated by storage networking has allowed end-users to purchase storage or server systems that more exactly match a given workload or application. End-users are now free to mix and match different classes or types of physical machines in a common network environment.

However, users found that much of the benefit was lost due to the inability to pool storage from different vendors or share storage services (e.g., snapshot, replication, mirroring) between vendors because the tools were tied to the storage device. Once storage and server systems were unbundled, vendors aggressively enhanced the embedded features of storage arrays and servers as a means to differentiate. The result has been that SAN end-points are now more complex and proprietary at the cost of achieving "network effect" benefits. To resolve the problem of aligning and orchestrating features embedded in arrays, hosts or both, SAN management tools have had to operate on top of or invoke functions at the SAN end-points rather than from within the network "fabric" itself. The complexity of managing SANs via the storage array has led to various sub-optimal outcomes exemplified by;

- Rigid binding of servers or application instances to storage volumes,
- Emergence of multiple SAN instances, or "Islands," within a data center or corporate campus, and
- Non-standard "network" functions between SAN nodes.

The best way to address these challenges, which are essentially management issues from the perspective of end-users, would be to move functional intelligence from the end-points (e.g., storage arrays) into the network. To this point, ESG has conducted extensive survey-based research to determine end-user preferences regarding functional intelligence in storage networks. Our survey results are unambiguous, showing conclusively that end-users have a strong preference for network-based intelligence. The research specifically indicates that end-users prefer to have many of the functions currently tied to SAN end-points performed in the network "fabric." Examples of these functions are:

- Volume management,
- Provisioning,
- Replication,
- Snapshots & mirroring,
- Data migration, and
- Data protection.

"StoreAge provides the functionalities ESG has identified as market requirements, has a mature product family and has done well with customers despite being early, even ahead of the market."

StoreAge provides the functionalities listed above, has a mature product family and has done well with customers despite being early, even ahead of the market. Even though adoption of "intelligent" storage networking devices has been limited to date, end-user survey responses indicate that there is now a deep level of pent-up demand. This demand is not based on wishful thinking or market hype. Survey respondents who have deployed an intelligent storage network solution have achieved cost savings that exceeded their own expectations. These unexpected cost savings were enjoyed by nearly all of the approximately 100 survey respondents who have deployed intelligent storage networking solutions.

Conversely, a mere 7% of over 300 respondents indicated that they had no intention of adopting this class of technology, leaving a wide swath of the marketplace in between, ready to adopt and eager to benefit. Figure 2 (below) shows specific respondent preferences and priorities for adopting intelligent storage networking solutions that enable the functions listed above.

Though the actual cost savings have proven to be compelling, end-users can not simply "move" preferred functions into the network fabric since they are tightly bound to SAN end-point devices. Our research indicates that end-users may eventually adopt intelligence on SAN switches, but that intelligent appliances will be favored initially. Appliance-based intelligent solutions will gain early favor since this type of platform can be introduced into an existing storage network infrastructure with minimal disruption to the architecture, operational procedures or business processes. Ultimately, our research leads us to believe that storage networks will consist of both types of intelligent platform, appliances and switches.

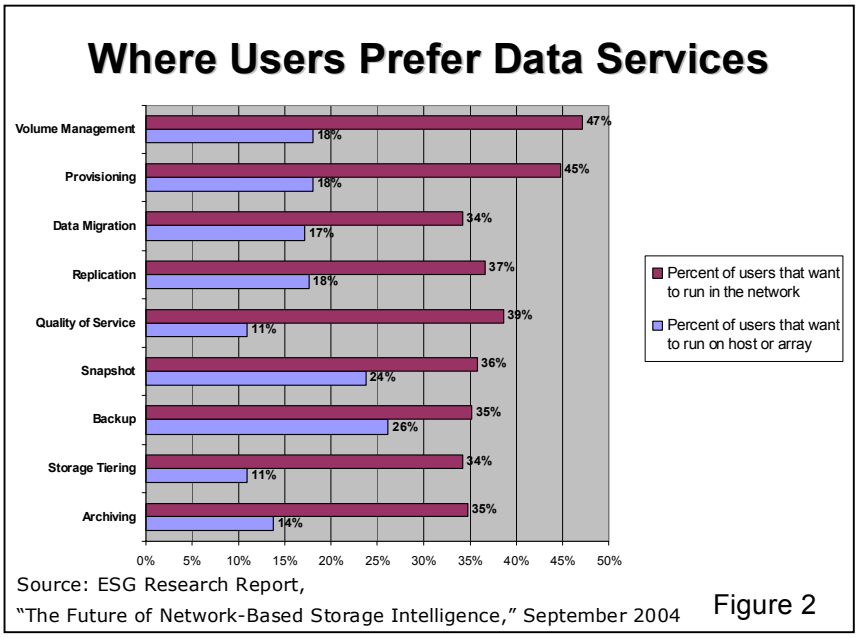


Figure 2

StoreAge Networking Technologies – Intelligent Networking for Data Services

StoreAge is principally a software company. StoreAge delivers its storage virtualization, management and data protection applications on an intelligent appliance. The appliance itself is composed of redundant, industry-standard components and network services along with two Fibre Channel interfaces. The software family consists of three classes of software

- A virtual volume manager,
- Portable agents, and
- Data movement/protection.

StoreAge software is highly portable, having been configured for an appliance currently offered by Troika Networks with other partners' offerings forth coming. The Troika intelligent switch hosts the StoreAge software which abstracts or virtualizes heterogeneous back-end storage arrays into pools of storage capacity. These capacity pools are presented to server systems as standard data volumes. Servers accessing storage through the Troika intelligent switch have access to the full suite of StoreAge management and data protection storage services.

On the surface SVM behaves like a standard volume manager. It provides hosts with a storage target for different applications and software functions to access. However, SVM differs from operating system embedded or host resident volume managers in several notable ways, as SVM:

- Presents volumes consisting of heterogeneous and/or tiered storage arrays,
- Presents volumes to heterogeneous server systems,
- Spans LUNs across heterogeneous hosts without requiring server clustering, and
- Supports dynamic adjustments to volume size in-line with actual storage capacity requirements.

Additionally, SVM – in concert with the agents – load-balances I/O traffic across both the pooled or virtualized storage arrays. These capabilities provide high performance, optimal pathing and/or fail-over options. Although similar outcomes can be achieved through the use of legacy, host resident volume management and clustering tools, scalability and bandwidth aggregation are distinctly limited due to operational overhead.

Since SVM is network-based, I/O management functions exploit the full aggregate throughput of available I/O bandwidth of both the virtualized pool of arrays as well as the server systems. In fact, traditional server clustering can be used on StoreAge-enabled hosts that operate side-by-side with single instance hosts on a common StoreAge SAN. The linear scaling capability delivered by SVM exploits the "network effect" of resource sharing and concatenation in a manner comparable to a switched data communications network. SVM's dynamic sizing capability allows arrays or servers to be added to existing virtualized pools thereby delivering both larger resource pools and a linear scaling capability for storage and server I/O beyond that achievable by legacy clustering techniques alone. Lastly, I/O data can be selectively striped across virtualized arrays in-line with application performance and/or data protection requirements.

In addition to the virtualized volume management features, StoreAge provides a complement of data protection applications that also reside in the network on the intelligent SVM appliance. The application suite offered by StoreAge is called the "multi" family, a name that alludes to the any-to-any facility for data movement across heterogeneous, tiered arrays. It also refers to the notion of a multi-tiered approach to data protection. The company explains that every user environment is different, and data protection and recovery objectives vary. Each tool protects against a different type of data failure.

multi*View*

The multi*View* application creates instant, read/write, low-capacity snapshots (logical point-in-time copies) of any virtualized volume on any storage array in a SAN. Each snapshot is a fraction of the size of the original volume, and may be mounted by any host on the SAN for any purpose, such as zero-downtime backup and rapid online recovery of "logical" failures (e.g., accidental file deletion, virus corruption, data corruption). StoreAge suggests snapshots as tool to create multiple recovery points throughout the day. Where most people backup to tape once a day, snapshots can be created several times a day. Although multi*View* is similar to copy-on-write snapshot features offered by other vendors, StoreAge uses a redirect-on-write approach. When a snapshot is issued, the source is "frozen" and a small temporary space is created for new "writes". The temporary space can grow as necessary depending on the amount of changes made to the source data. There are many unique advantages to a redirect-on-write approach. Two key benefits are: 1) It is possible to create multiple writeable snapshots, from the same point-in-time (PiT) image; and 2) the "views" or snapshot copies have the same performance as the production volume, no matter how many snapshots are created. This performance outcome is important because it allows snapshots to be used in production environments. In a Copy-on-Write implementation, the snapshot is several times slower than the primary production original. Therefore, it cannot be used in a production environment. Utilizing snapshots for production environments allows quick recovery and quick provisioning of fresh data to applications.

The applications that make up the data protection family are:

- **multi*View*** – Snapshots
- **multi*Copy*** – Replication
- **multi*Mirror*** – Mirroring

multi*Copy*

The multi*Copy* application is a data replication application that creates multiple read/write point-in-time physical copies of any virtualized volume on any heterogeneous storage array in a SAN. The application allows for full volume clones to be made of a specific volume and supports one-to-many copies and any-to-any storage targets. multi*Copy* can create clones within the local SAN or remote SAN over wide-area network links. Source volumes remain fully available during multi*Copy* operations. multi*Copy* can be used to migrate data volumes to new or different classes of storage array without interrupting business operations. multi*Copy* is often used to migrate applications off of older storage devices as they are coming off of lease and onto new storage devices without interruption to the user application.

multi*Mirror*

The multi*Mirror* application provides local (synchronous) and remote (asynchronous) mirroring over Fibre Channel or IP network links between SVM appliances on local or remote SANs. multi*Mirror* supports any-to-any volume mirroring between heterogeneous, tiered storage arrays. The multi*Mirror* application is positioned to protect against "physical" failures rather than "logical" failures as mentioned above. StoreAge implements a snapshot-enhanced remote mirroring application. Essentially, the remote mirror is implemented by asynchronously sending changes to the remote location and applying those deltas. The time slice can be adjusted depending on the user's Recovery Point Objectives (RPO). This architecture offers several compelling advantages over standard asynchronous mirroring. First, when looking at the TCO of remote mirroring implementations, network-bandwidth is typically the most costly component of the project. A snapshot-enhanced mirror can dramatically reduce the network-bandwidth requirements. Second, since StoreAge supports heterogeneous storage devices and the I/O requirements for the target are dramatically reduced, the target device can be a much lower Quality-of-Service (QoS) device. Therefore, an expensive, high-end array could be mirrored to a cost-effective SATA device. Finally, because the mirror is snapshot-based, multi*Mirror* can recover from failures normal mirrors could not. For example, if a virus infected a primary site, a typical mirror solution would mirror the corruption to the remote site (as it was designed to do). However, multi*Mirror* would allow you to utilize one of the target snapshots to recover from an older PiT copy.

The data protection applications offered by StoreAge deliver a high degree of freedom in the provisioning and use of physical resources and data assets. These assets and resources are easier to manage through the centralized facility of the virtualized volume manager as compared to managing individual devices at the end-points of a SAN. The data assets themselves are further protected by native high-availability characteristics which are inherent to the distributed SVM architecture.

As mentioned above, StoreAge promotes a multi-tiered data protection approach, where several tools are put in place to protect against multiple types of failures and to give multiple "safety nets" for recoverability. Often "rolling failures" occur where a small failure will trigger a much greater failure within the IT infrastructure. Research indicates that over 90% of data loss events occur from "logical" failures (e.g., file deletion, virus infection, or data corruption). StoreAge suggests that rather than recovering from tape (a relatively time consuming process), these types of failures can be recovered within seconds from snapshots. However, they also explain that should a "physical" failure eliminate access to the storage device, then the snapshots would not be available for recovery, therefore, the next level of data protection should be put in place. This can be a tape backup (driven by a snapshot so as not to interrupt the user application) or a local mirror. Finally, a remote mirror should be considered to protect against a site failure. Every user's data protection and recovery objectives will vary, but by applying the correct set of tools, the appropriate mix of tiering for protection can be created to meet an organization's objectives.

Market Movement: From End-Point to Split-Path

Despite the capabilities and benefits described above, the debate surrounding the use and impact of intelligent solutions has contributed to the limited market adoption. To date, advanced storage services have predominantly been deployed at the "end-points" of the SAN – either at the host or in the storage array. However, as our research indicates, this is changing. End-user feedback shows strong demand for network-based storage services.

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StoreAge is leading the charge to simplify the debate surrounding the use and impact of SAN-centric intelligent solutions by pioneering a technical approach to managing Fibre Channel traffic flows that avoids historical pitfalls. StoreAge architected it's product from day-one as a Split-Path solution, separating the data-path from the control-path. As the market has evolved from array-based solutions, to in-band network solutions, and now to split-path network solutions, StoreAge has emerged as a leader in this space. Today, it provides the only native, split-path application on the market.

Split-Path architectures can be compared to multi-processor server architectures, in the respect that the hardware benefits can only be recognized if the software running on these platforms is written to take advantage of the functionality. The software applications which run on these devices must be specifically designed to take advantage of the benefits of the Split-Path technique. StoreAge offers a native Split-Path solution that leverages the benefits of the newer Split-Path hardware devices (e.g., Troika, iVivity, Aarohi, Maxxan, Brocade, and others).

StoreAge's approach to Split-Path architecture gives it some notable advantages. First, the solution accommodates higher levels of scalability than non-Split-Path products due the simplicity and flexibility it provides for adding additional servers and storage devices to a SAN – independent of management control. Field reports confirm that a single pair of SVM appliances can manage SAN environments of considerable size. The StoreAge solution is limited only by the scaling capability of a given SAN, meaning that can it operate to the maximum limit of SAN infrastructure components in terms of switch port-count, array capacities and device I/O thresholds. Secondly, it is an excellent application for intelligent network devices due to the software's portability and wire-speed operation.

We believe that the Split-Path architecture puts storage networking on a maturation path that brings it into greater alignment with mainstream networking methodologies than is presently found. By way of comparison, the Split-Path architecture echoes the methodologies of the older yet certainly mainstream network architecture found in the SS7 telecommunications network where signaling or control data is separated or split from call or I/O data. The resilience, reliability and performance capabilities of SS7 as the underlying technology for the public telecommunications infrastructure are legendary. We offer this comparison only as an instructive analog and do not wish to convey the impression that Fibre Channel-based Split-Path architecture equates to the telecommunications signaling system.

One obvious point of differentiation between these two architectures is that the SS7 system is a circuit switched network while Fibre Channel is a packet switched network.

"Enabling" the Intelligent SAN

StoreAge has a rapidly growing list of important technology partners that, under the "StoreAge Enabled" program, collaborate to embed the StoreAge suite onto their own products to provide complete SAN solutions. Many of these hardware products leverage Split-Path architecture. Members of this program include SAN switch makers, appliance vendors, chipset suppliers and even independent software vendors. A unique StoreAge benefit is that whether the software is resident in the host (via an agent), in the network (via a switch or appliance), or in a subsystem (via chipset in a RAID controller) they can all be centrally managed from a single SVM management console.

The StoreAge suite can serve as a foundation for the maturation of various network-centric functions that further enhance intelligence storage network capabilities. To this point, a growing body of emerging and established vendors is already delivering or will immanently release Split-Path enabling technologies or will offer their own Split-Path-based SVM-like solutions. Many of these vendors are partnering with StoreAge to leverage its applications. Troika Networks (a StoreAge Enabled partner that was mentioned above) has released a SAN Volume Suite (SVS) that embeds StoreAge software onto the Troika Accelera platform. iVivity and Aarohi (also StoreAge Enabled partners), are two SAN chip vendors who are working with StoreAge by embedding the storage software into their ASICs. Cisco and EMC are partnering to bring EMC's much discussed, but yet to ship Storage Router to market.

The Bottom Line

The dispositions and concerns of both vendors and end-users described above not with standing, networks in-and-of themselves have a unique way of addressing resilience through redundancy and distribution. Mainstream network paradigms utilize innate network characteristics to deliver high "nines" levels of availability while facilitating robust, centrally managed intelligent network services. As our survey data anticipates – and we expect – it is only a matter of time before storage networks mature such that network resident intelligence in commonplace in SANs.

"Based on its mature portfolio of data services solutions and Split-Path architecture, StoreAge is in a strong position to capitalize on identifiable market demand and an unambiguous long-term trend."

It is clear from our discussions that end users have realized tangible cost benefits and operational efficiencies after adopting StoreAge solutions and our research supports these findings as well. End-users that have adopted StoreAge and other network resident intelligence storage solutions were very satisfied with the outcomes and expressed intentions to expand the footprint of network based intelligent data services. ESG research also indicates that there is pent-up demand for ways to better manage and execute data services in a cost effectively manner within heterogeneous storage networks. We expect that this market will ramp over the course of the next 12 months. Based on its mature portfolio of data services solutions and Split-Path architecture, StoreAge is in a strong position to capitalize on identifiable market demand and an unambiguous long-term trend.