FLUID DATA STORAGE: A HOW TO GUIDE

Intelligent storage automation for IT administrators.
INTRODUCTION
SANs are supposed to make things easier for the administrator, consolidating storage in one unit, and enabling easy provisioning of storage to any number of servers. All too often though, SANs are difficult to set up and configure, requiring a lot of effort to perform necessary tasks. With a Fluid Data architecture from Compellent, IT administrators can quickly and easily adapt storage to the needs of the data center, whether provisioning volumes for servers, setting up automated tiering without manual intervention to ensure that data uses the fastest available storage, or ensuring fault tolerance with snapshots or data replication.

A Fluid Data architecture automates data management at a more granular level to adapt to storage admin needs. Detailed information about each block is captured in action, providing system intelligence inside the volume. A sophisticated data movement engine uses this metadata, or data about the data, to intelligently store, recover and manage data. A Fluid Data architecture can make life as a storage admin much easier. Business applications are implemented faster, information to make decisions is always available, new technologies are instantly deployed, and data is continuously protected against downtime and disaster.

Streamlining Setup and Administration
Compellent storage is optimized to provide an accessible interface and a simple but intelligent setup process, from starting the system for the first time, to provisioning volumes, to the automated process of enabling data tiering. A full set of wizards automate setting up a volume, including the storage tiers, RAID levels, thin provisioning and the option to create multiple volumes with the same characteristics. Likewise, tasks such as mapping the volume to a server, creating consistency groups, replication volumes to another storage system or setting up snapshots are designed to be as simple and straightforward as possible.

INTELLIGENT STORAGE AUTOMATION
Compellent eliminates the manual classification and migration of tiered storage, automatically moving blocks of data to the optimum disk tier.

INTELLIGENT STORAGE AUTOMATION: COMPPELLENT DOES NOT REQUIRE YOU TO DIRECTLY MAP DISKS TO LUNS.
Since storage is virtualized, there is no direct mapping disks to LUNs, which means that storage can be expanded seamlessly - and the new storage added to existing volumes with no impact or disruption of server operations. Essentially, storage is where you need it, when you need it. This document will guide you step by step through the administration of a Compellent SAN, providing a “how to” approach to building a Fluid Data storage environment. Features will be grouped into the following sections:

» Streamlining Setup and Management
» Optimizing Utilization and Performance
» Continuously Protecting Data
» Advancing Virtualization Support
» Improving Visibility and Control
» Ensuring Scalability and Longevity

Inside the System: System Setup Wizard
Mapping Servers to LUNs is a necessary part of setting up a SAN, but often administrators are forced to deal with distinguishing between Fibre Channel World Wide Names to identify which server to map to. The mapping process on Compellent finds available servers and identifies them by IP address and hostname as well as by the WWN, making it easy to map each LUN to the appropriate server.
Server mapping can also be automated for deployment of virtual servers and clusters, using the GUI to set up multiple LUNs and giving you the power of a scripted interface without the need to remember commands. This allows the simultaneous setup and configuration of identical thin-provisioned volumes for many physical and virtual machines as well as the ability to add and remove servers on the fly. It’s also easy to set up multiple servers with the same LUN for clustering.

Reporting tools are also simple and easy to use, providing the administrator with easy visibility into every aspect of storage usage and performance.

Management through the GUI is simple and straightforward, but large installations may want to script functions. All of Compellent capabilities are available through an integrated PowerShell interface, allowing the administrator to create flexible scripting solutions to automate storage provisioning for new VMs or servers. Administrators can create volumes, assign them to a consistency group, map the volumes to specific servers, assign RAID levels to the volume, change server mappings from one system to another, and set up replication or snapshots of the volumes, all through scripts or via the GUI using Server Mapping. Server Mapping uses the GUI but allows for the creation of volumes mapped to multiple virtual servers or clusters, all with identical thin-provisioned volumes, as well as the ability to add or remove volumes or server mappings on the fly.

**Optimizing Utilization and Performance**

Many SAN systems seem to assume that the administrator will set up a volume and then not change it. However, this is not typical of today’s dynamic computing environment. Compellent gives you the ability to easily ensure that most-used data is placed on the fastest storage, so that high-speed SSD or 15k disks are not underutilized, the ability to set up LUNs for any size desired, while they actually use only the space necessary to accommodate the actual data on the volume.

Faster storage devices come at a premium – 15k RPM disks can be more than 10 times the cost per gigabyte of 7.2K RPM SATA disks, and SSD drives can be more than 10 times more expensive than 15k drives. This means that you don’t want to over-buy fast storage. Compellent Data Progression allows you to fully utilize fast storage while maintaining optimum efficiency and fault tolerance. User-configurable policies control how much data is written to Tier 1 storage with performance-optimized RAID levels such as RAID 10. Then, as the frequency of access declines, the less active blocks of data automatically move to lower-tier
storage with high-overhead, high-protection RAID levels such as RAID 6. This ensures that the fastest tier of storage is utilized as fully as possible, automatically, without the need for an administrator’s intervention, dynamically moving data as needed between the faster and slower drives.

With Data Progression, the most-used files (actually, the blocks that make up files) from all enabled LUNs are automatically moved to the highest tier of storage in RAID 10, then automatically moved to RAID 6 SATA-based storage if a file ceases to be used frequently. Thus, SSDs can be treated as high-speed cache rather than requiring manual movement of LUNs from one tier to another. Since Data Progression functions at the block level, large files such as database files will have only the parts in use moved to the higher tier, again ensuring that only as much data as necessary is using the high-speed storage.

Thin Provisioning is built into every Compellent system and works automatically.

Compellent thin provisioning relies on a Fluid Data architecture to virtualize volumes, allowing volumes to be dynamically enlarged (or decreased) in size as needed. Further, Compellent Free Space Recovery allows volumes to be dynamically shrunk. Windows Server volumes that are formatted with NTFS typically use only new blocks until all new blocks on the volume have been used. The OS then begins to re-use blocks that were originally allocated to files that have been deleted. This is intended to enable recovery of deleted files. However, since this function can be enabled on Compellent volumes through snapshots, the Free Space Recovery tool allows the system to recover blocks from deleted files, keeping the volume from growing to the full provisioned size before these blocks are returned to the storage pool by the operating system.

Existing volumes that aren’t thin provisioned can be copied to the Compellent system using the Thin Import feature, which takes statically provisioned volumes and converts them to

**INTELLIGENT STORAGE AUTOMATION**
VMDK files use only the space actually consumed by files on the Compellent SAN.
thin-provisioned volumes, reclaiming all the unused space on existing volumes easily and quickly.

For volumes attached to hypervisors such as VMware ESX or Microsoft Hyper-V, Compellent offers another advantage. Most hypervisors require you to create a static volume with a pre-allocated space that can’t be easily resized and uses the full capacity of the pre-allocated capacity on disk. (VMware vSphere is an exception to this.) With Compellent thin provisioning, VMDK files stored on a Compellent thin-provisioned volume use only the space actually consumed by files, reducing storage consumption by 80 percent or more in many cases.

Inside the System: Boot from SAN Volume Setup

Boot from SAN support further optimizes utilization because rather than purchasing more drives than you need in a server, you can boot the server from the Compellent system and dynamically adjust capacity and performance of the server’s virtual boot drive as needed. Boot from SAN allows servers that support designating a Fibre Channel HBA as a boot device to boot from a volume on the Compellent system rather than from an internal disk. This not only allows for easy snapshots and replication for fault tolerance, but a boot volume can be cloned, and the server can then boot from the clone, greatly simplifying testing of patches and upgrades, or allowing a server to boot multiple OSes depending on the need. In a large data center, servers could be brought down and booted with another OS to meet changing requirements for clusters or server farms. Since Compellent supports scripting of its interface, the entire process could be automated with a single script.

Continuously Protecting Data

The ultimate in data protection is replication, whether local or remote. Local replication or snapshots are very easy to set up and use very little space with Compellent, since only the deltas from the last snapshots are stored for each snapshot. Snapshots can easily be scheduled at any desired interval from seconds to days. When needed, the Compellent interface makes it simple to find and restore either single files or entire volumes through the GUI, including finding and restoring any of multiple versions of a file as well as coalescing multiple snapshots into a single file or volume in seconds, a considerable advantage over some systems that may take hours to coalesce multiple snapshots into a volume. Once the recovery process is initiated, files can be replaced, or a restored volume can be mounted as a new volume, enabling files to be copied to a new location if desired. This flexibility enables the administrator to respond with great flexibility to any sort of disaster or user error.

INTELIGENT STORAGE AUTOMATION

It literally takes six mouse clicks to set up remote replication of volumes on Compellent.

Remote replication is often complex to configure, but Compellent makes it very easy to set up, not only with a point and click setup of remote replication but with Portable Volumes that make it simple to create the initial replica of a LUN and ship the replica to a remote site to seed the replication process. Compellent Virtual Port technology also makes it easier to create a redundant path to storage and servers at lower cost. Consistency groups allow the creation of multiple volumes for clustering that all have the same replication, snapshot, thin provisioning and other settings.
Once both systems are brought online, the drives are connected to the primary system and data is downloaded quickly onto the portable drives. 128-bit keys are exchanged between the two systems so that the data cannot be read if the drives are lost. Once the drives are connected to the secondary system, Compellent Enterprise Manager software automatically creates the replicas and starts updating the changes from the primary replica to the secondary one.

Compellent Virtual Port technology simplifies configurations and lowers hardware costs by reducing the number of physical I/O ports required in network switches and Compellent controllers by 50 percent. Ports are virtualized and Fibre Channel or iSCSI connections can be shared or moved using software to provide more flexibility while enabling high data availability for both entry-level and enterprise configurations.

The system uses NPIV to create multiple virtual ports on a single physical port, so failover doesn’t require two physical ports on the Compellent system or the switch, while maintaining failover capability.

Consistency groups allow the creation of a group of volumes (up to 40 per group with unlimited numbers of groups) that all have the same characteristics, typically for enabling clustering. This ensures that all the volumes behave in the same way and have the same levels of snapshot protection, making it easier to set up and maintain clustered systems.
Advancing Virtualization Support

Compellent provides a number of features that directly support virtualization and clustering of VMs on both VMware and Hyper-V, and can be used equally well on other virtualization platforms. Scripting allows the administrator to automatically provision multiple volumes with the same characteristics and make them available to one or more virtualization systems, and consistency groups enable up to 40 separate volumes without any special planning or tuning required.

While most virtualization systems consume as much space for a virtual disk as the capacity limit of the disk (a 60 GB virtual disk consumes 60 GB of space on disk), Compellent thin provisioning ensures that virtual disks located on Compellent volumes do not actually use that much space until needed. Compellent thin provisioning is transparent to the virtualization software.

Creating new VMs is also simplified, since the Compellent system can be used to replicate an existing volume and present it to the VMware system as a new volume, creating one or multiple VMs in much less time than would be required to do the same thing through the hypervisor.

In addition, Compellent Data Progression provides the highest possible performance for VMs in actual use, while moving VMs that are not active to lower cost SATA storage.

Ensuring Longevity and Scalability

SAN hardware represents a considerable investment, and having to do a forklift upgrade to a new version of hardware to get new features can cause panic with admins and the financial department alike. Compellent ensures that this won’t happen, continuing to support all the latest features even on their earliest platforms, and providing an easy upgrade path to new standards, (e.g. allowing systems that originally shipped with 1 Gbps Fibre Channel HBAs to be upgraded to 8 Gbps if desired). Software upgrades are also available for all Compellent 10, 20 and 30 series systems that enable all the latest features, without the need to buy new controllers.

Fluid Data storage also includes the idea of easy expansion to meet growing requirements for more storage. With a technology independent platform, Compellent is able to support a variety of drives, including SAS drives, which provide the higher performance than SATA at lower cost than Fibre Channel. The SAS enclosures are two rack units (2u) rather than three, cost less than Fibre Channel enclosures, and can scale from six to 384 SAS drives per controller, with a mix of 450 GB 15k drives and 1TB 7.2K drives within a single enclosure, bringing a high degree of flexibility along with excellent performance.

Improving Visibility and Control

Compellent Enterprise Manager provides extensive visibility into storage usage and performance, as well as the ability to identify potential problems and to set or change characteristics of volumes as necessary to improve performance.

Enterprise Manager includes three components – Enterprise Manager Foundation, Enterprise Manager Reporter and Enterprise Manager Chargeback. Enterprise Manager Foundation provides discovery of Compellent SAN systems, replication management, event management and free space recovery. Enterprise Manager Reporter provides reports and allows management of performance and capacity as well as providing alerts via email or pager as thresholds are exceeded. Enterprise Manager Chargeback allows cost analysis and billing
for storage as well as Hero Reports on savings realized through Compellent features, and green-oriented reports on power usage and CO₂ emissions.

CONCLUSION

Compellent brings the concept of Fluid Data storage to reality with intelligent storage automation. This allows administrators to quickly and easily provision physical or virtual servers with the storage they need, ensuring that the system makes optimum use of high performance storage and gets the best possible performance with all volumes. Compellent also enables a very high degree of reliability and recoverability. Contact a Compellent storage architect to find out what a Fluid Data architecture can do for you, or to talk to other storage administrators building a Fluid Data environment.