Dell SC Series Storage and IBM SAN Volume Controller Best Practices

Dell Storage Technical Solutions

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A Dell Best Practices Guide
## Revisions

<table>
<thead>
<tr>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>October 2011</td>
<td>Initial release</td>
</tr>
<tr>
<td>October 2013</td>
<td>Updated for SCOS v6.3.x and SC8000</td>
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<td>September 2015</td>
<td>Updated for SCOS v6.5.x</td>
</tr>
</tbody>
</table>

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Executive summary

The IBM® SAN Volume Controller is a storage virtualization platform that enables a single source for control of storage resources to help support enhanced business application availability and improved resource utilization. From a single management interface, the storage admin can deploy and manage storage capacity to end-system hosts utilizing multiple backend storage platforms. The IBM SVC consists of at least two nodes that comprise a clustered I/O group, and can scale up to four 2-node I/O group pairs.

This document contains best practices and recommendations when using the Dell™ SC Series storage as backend storage for the IBM SAN Volume Controller (SVC).

It is assumed that the SC Series SAN and SVC are already configured and in a functional environment, and that the reader is familiar with the setup of each platform. The setup of the SC Series arrays or SVC are not covered in this document. This document is not intended to replace or take precedence over any IBM resources or SC Series product documents.

For the SC Series arrays to be utilized as storage by the SVC, they must be configured to present volumes to the storage node clusters as if they were servers. The SVC then virtualizes the storage for use by servers configured to connect to the SVC. Keep in mind that only the SC Series volumes presented to the SVC are managed by the SVC. The administrator can choose to provision storage partially through the SC Series arrays in the traditional fashion, splitting the management and provisioning of storage between SVC and non-SVC environments.

Audience

The target audience for this document is mid-level and higher storage administrators who are responsible for the management of IBM SAN Volume Controller systems that use SC Series SANs for back-end storage controller(s).

Purpose

This document provides an overview of the best practices advised by Dell Storage when using Storage Center Operating System (SCOS) version 5.4.x and 5.5.x with IBM SVC version 6.2 and SCOS version 6.5.x with SVC version 7.4.0.x and higher.
Important notes

Note: Level 2 support is provided for an SC Series storage environment that is used with an IBM SVC. Therefore, handle any issues with storage presentation to a server with a support call to IBM first. If the issue turns out to involve the Dell storage, IBM will then involve Dell.

Note: The customer must follow IBM guidelines and requirements for cabling and zoning the SVC. These are spelled out in the IBM System Storage SAN Volume Controller Software Installation and Configuration Guide and SAN Volume Controller Best Practices and Performance Guidelines. These and other SVC documents can be obtained from the IBM support site for the SVC (http://www.ibm.com/storage/support/2145) in the Documentation section.

Note: Check the Dell SC Series customer portal and review any Copilot Services Technical Alerts (CSTA) for the IBM SVC and/or your specific operating system before attempting any configuration additions or changes.

Note: Dell does not recommend or endorse using the SVC in any way that may conflict with the IBM published requirements. If there are questions about usage that have not been addressed in this document, reference the IBM documentation for standard practices.
1 **Hardware/software versions**

The utilization of the IBM SVC in front of SCOS has been certified to work by IBM on the following code releases:

SCOS version 5.4.x and higher requires SVC version 6.2.0.3 and higher.

SCOS version 5.2 and 5.3 is supported on SVC version 5.1.0.6 and higher.

SCOS version 6.5.x is supported on SVC version 7.1.0.5 and higher.

In addition, Dell has tested the above versions using SC Series SAN models SC030 and SC040 in both Legacy Port Mode and Virtual Port Mode, which requires N_Port ID Virtualization (NPIV). The SC8000 has been tested in Virtual Port Mode. The information in this paper was derived using the above hardware and software versions and configurations.
2 Glossary terms

2.1 General

LUN: Logical Unit Number, a generic term for storage presented to a server using Fiber Channel or iSCSI.

Quorum disk: Tie breaking device used when there are systems clustered together.

2.2 IBM

Image mode: Any incoming LUN that is presented directly to a server without using any of the SVC management features.

Managed mode: Any incoming LUN that is utilized inside an MDisk group that is not presented directly to a server.

MDisk: (Managed Disk) an incoming LUN presented by a storage system (such as SC Series storage) to the SVC.

VDisk: (Virtual Disk) an outgoing LUN presented by an SVC to a host connected to an SVC.

2.3 Dell SC Series

Front-end primaries: A Fibre Channel port intended for active use with systems.

Front-end reserves: A Fibre Channel port intended for standby use with systems.

NPIV - N_Port ID virtualization: When this is enabled on the SC Series SAN and connected Fiber Channel switches, all front-end Fiber Channel ports are in an active state and utilized for I/O between the SAN and IBM SVC.

Volume: A logical volume created on SC Series storage for use by a server.
3 Configuring the fabric

Although SC Series storage and IBM SVC solutions provide multiple controller and node redundancies, it is also recommended to have two separate fabrics provided by two separate Fiber Channel switch networks. Balance the IBM SVC and SC Series ports equally across these two fabrics. This approach provides I/O redundancy if a single port, switch, node, or controller were to fail within the environment. As always with multi-pathing, it is highly recommended to test failure scenarios before going into production. This includes cable, switch, and controller failures.

In order to ensure proper discovery of the SC Series SAN as a backend storage controller, as well as provide for failover redundancy, it is necessary to configure the fabric following the recommendations below. Several fabric zones need to be configured, and the exact zoning will vary depending on the port mode in use with the SC Series storage. At a high level, the zone topology includes an IBM SVC zone, an SC Series zone, a Disk zone that enables connectivity between the SVC and SC Series storage, and a Host zone that enables connectivity between the SVC and the host system(s).

Ensure that there is a fabric zone containing just the IBM SVC Fibre Channel ports. There is no requirement for hard or soft zoning, so either mode is acceptable.

For use with the SVC, a similar zoning approach for the SC Series SAN is recommended. Configure a zone that includes just the SC Series front-end ports. This zone can use either hard or soft zoning. In addition, confirm that the Disk zone between the SVC and SC Series storage does not contain any other backend storage controllers.

Table 1 High-level fabric zones

<table>
<thead>
<tr>
<th>Zone</th>
<th>Port</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>SVC port zone</td>
<td>Port</td>
<td>Contains only the IBM SVC cluster ports</td>
</tr>
<tr>
<td>SC Series zone</td>
<td>Port/WWN</td>
<td>Contains only the SC Series storage front-end ports</td>
</tr>
<tr>
<td>Disk zone</td>
<td>WWN</td>
<td>Contains the WWNs of the SVC and the front-end ports of the SC Series storage</td>
</tr>
<tr>
<td>Host zone</td>
<td>Port/WWN</td>
<td>Contains the host system ports or WWNs and the IBM SVC ports/WWNs</td>
</tr>
<tr>
<td>SVC WWN zone</td>
<td>WWN</td>
<td>Contains the WWNs for the SVC cluster ports</td>
</tr>
</tbody>
</table>

The SC Series SAN supports two modes of front-end port configuration, legacy and virtual (NPIV). Refer to the section below titled “SC Series SAN configuration recommendations” for information on these modes.

When zoning the SC Series SAN to the IBM SVC, utilize a WWN zoning policy. Establish a zone in each fabric that contains the WWNs of the IBM SVC cluster in that fabric. When the SC Series storage is configured in Legacy port mode (Table 2), put the WWNs for the front-end primary ports into a zone.
Place the WWNs for the front-end reserve ports into a separate zone. Assign the zone containing the front-end primary WWNs to the WWNs for the IBM SVC cluster to complete the Disk zone connectivity. Table 1 above provides more information on this configuration.

Table 2  Legacy port mode zone examples

<table>
<thead>
<tr>
<th>Zone</th>
<th>Zone Type</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>SC Series – Front-end Primary (FEP)</td>
<td>WWN</td>
<td>Contains only the WWNs for the front-end primary SC Series ports (Legacy mode)</td>
</tr>
<tr>
<td>SC Series – Front-end Reserve (FER)</td>
<td>WWN</td>
<td>Contains only the WWNs for the front-end reserve SC Series ports (Legacy mode)</td>
</tr>
<tr>
<td>SVC WWN Zone</td>
<td>WWN</td>
<td>Contains the WWNs for the SVC cluster ports</td>
</tr>
<tr>
<td>SC Series FEP WWNs to SVC WWNs</td>
<td>WWN</td>
<td>Contains the WWNs for the front-end primary (legacy) ports and SVC cluster</td>
</tr>
</tbody>
</table>

When utilizing the Virtual Port mode configuration of the SC Series SAN, the zoning configuration is similar to the Legacy Port mode above. However, zone the NPIV WWNs to the IBM SVC WWNs to complete the Disk zone connectivity. Port zoning is not supported; if used it will result in controller discovery failure. Refer to the IBM SVC documentation regarding NPIV support as well as the switch vendor regarding NPIV support.

Table 3  Virtual Port mode examples

<table>
<thead>
<tr>
<th>Zone</th>
<th>Zone Type</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>SC Series – Physical Port WWN</td>
<td>WWN</td>
<td>Contains only the WWNs for the front-end ports physical WWNs</td>
</tr>
<tr>
<td>SC Series – Virtual (NPIV) Port WWN</td>
<td>WWN</td>
<td>Contains only the WWNs for the front-end ports virtual WWNs (NPIV)</td>
</tr>
<tr>
<td>SVC WWN Zone</td>
<td>WWN</td>
<td>Contains the WWNs for the SVC cluster ports</td>
</tr>
<tr>
<td>SC Series NPIV WWNs to SVC WWNs</td>
<td>WWN</td>
<td>Contains the WWNs for the front-end primary (legacy) ports and SVC cluster</td>
</tr>
</tbody>
</table>
4 SC Series SAN configuration recommendations

The SC Series SAN supports two modes of front-end port configuration, legacy and virtual (NPIV). Both modes are supported and can be used to present storage from the SC Series SAN to the IBM SVC. Refer to Section 3, “Configuring the fabric” for details on the proper zoning scheme to use for each of these port mode types. Refer to the appropriate version of the Storage Center System Manager User Guide for details.

Legacy Port mode consists of a configuration where there is a primary (or active) port that handles I/O and then a corresponding reserve (or passive) port on the other controller. This relationship is configured by adding these ports to the same fault domain, which activates and assumes the WWN of the primary port on the reserve port if the primary port goes offline.

Virtual Port mode consists of a configuration where all front-end ports are active and the WWN is virtualized. This NPIV WWN can be associated with any physical port in the associated fault domain. It is set up during the SC Series storage configuration, and accessed through the Storage Center management GUI using the path: Storage Management > System Setup > Configure Local Ports.

4.1 Server object definitions for SVC

Before presenting volumes from the SC Series SAN to the IBM SVC, the SVC nodes must be defined as server objects in the SC Series software. As the SVC nodes are clustered, define a server cluster folder for each SVC node I/O group pair. Add each SVC node pair to the appropriate server cluster folder. Define these server cluster folders with an operating system type of Other multipath or Windows 2008 MPIO.

The environment can be configured so that other hosts can communicate with the Dell SC Series SAN for storage requirements that fall outside of the SVC. Hosts can also be configured that communicate with the SVC directly for storage and communicate directly with the SC Series SAN for storage. However, consider the SVC requirements for host connectivity, and do not configure either of these scenarios without careful planning and suitable documentation.

4.2 Presenting volumes to the SVC

When deciding how many volumes to present to the SVC for use as MDisks, four large volumes per MDisk group are recommended, and no more than ten MDisk groups per controller. This is based on the IBM document, SAN Volume Controller Best Practices and Performance Guidelines, and is subject to change.

Note: Volumes greater than 2 TB are supported by SVC version 7.1.0.5 or greater and SCOS version 6.3.x or greater as backend storage. Refer to the IBM SVC configuration documentation for setup and configuration information.

4.3 Solid-state drive (SSD) usage with the SVC

The IBM SVC can provide different levels of storage performance by tiering drives within storage arrays according to their performance capability, similar to the way SC Series storage moves data between tiers.
The administrator can manually or automatically (with the use of additional IBM software) move data to tiers of storage based on performance requirements. If an SC Series array was completely filled with SSD, this could then be used by the SVC to provide a pool of top-tier high performing disks. IBM also provides internal SSD upgrades for some models of SVC for the sole purpose of improving I/O performance.

4.4 Quorum disks
Since SC Series storage is certified for use with the SVC, SC Series LUNs can be used as quorum disks. IBM recommends at least three quorum disks from different arrays for each SVC cluster.

4.5 Import volume to SVC using Image Mode
It is possible to take existing volumes presented directly from an SC Series SAN to a host and re-present the volume to the host using SVC without the need to copy data to a new volume or LUN. This can be accomplished by first un-mapping the volume from the host and mapping it to the SVC Cluster Server object. Next, perform an MDisk discovery from within SVC, import the MDisk as an image mode MDisk and map it to the host server.

**Note:** The IBM SVC supports Boot-from-SAN volumes. See the documentation in the [IBM SAN Volume Controller Information Center](https://www.ibm.com/support/pages/san-volume-controller-information-center) for supported operating systems and configuration information.

4.6 Using SVC volume mirror with multiple SC Series systems
When using the SVC volume mirror feature, assign one-half of each volume mirror to the Storage Pool(s) MDisks associated with different back-end SC Series systems. By doing this, if one SC Series cluster is taken offline for maintenance or a site failure occurs for that system, the SVC volume will remain online and available for I/O. The result is a higher availability of the volume to the host it is mapped to from SVC.

For example, an installation has two SC Series SANs connected to a single SVC cluster; each SAN is presenting a series of MDisks in the pools associated with it. For example, MDisk1 is in pool sc09-manage-mode on the SVC that is storage presented from the sc1 SAN, and MDisk2 is in pool sc11-manage-mode on the SVC that is storage presented from the sc2 SAN. A volume (voltest1) is created using the SVC management GUI with mirrored properties. The primary pool for voltest1 is sc09-manage-mode and the secondary pool for voltest1 is sc11-manage-mode. If sc1 were to go offline, the voltest1 volume would remain available to the host as long as the other half of the mirror to the volume is still available. When the sc1 system returns online to the SVC, then the SVC will initiate the process to re-sync the volume mirror.

4.7 IBM SAN volume controller recommendations
Refer to the IBM SVC support site for detailed documentation pertaining to the proper setup and configuration of SVC. Dell does not endorse any method that contradicts information on the IBM SVC support site. Any information in this document that unintentionally conflicts with IBM SVC documentation is superseded by the IBM documentation.
4.8 MDisk pools

It is recommended that volumes presented to SVC from the same SC Series SAN be placed in the same MDisk group. Separate these further based on whether the MDisk(s) will be used as “managed” or “image” mode MDisks. For example, if MDisk1, MDisk2 and MDisk3 represent managed MDisks from the SC Series storage alpha, then place these MDisks in the same MDisk group (or pool) for logical management of the MDisks. If MDisk4 is an image mode MDisk from SC Series storage alpha, place it in a different pool. If there is another SC Series array presenting volumes to SVC (for example beta), put any MDisks from that SC Series array into a different pool from the alpha MDisks.
5 Host connection to an SVC using SC Series arrays

IBM requires loading a Subsystem Device Driver (SDD) for the SVC onto hosts that are connected to an SVC. The SDD facilitates multi-pathing and enhances error recovery. Obtain this software on the IBM support site at: http://www-01.ibm.com/support/dlsearch.wss?rs=540&tc=ST52G7&dc=D430.

If your operating system does not have an SDD available, it is not required. For example, Red Hat® Enterprise Linux® (RHEL) 4 has an SDD driver, while RHEL 5 does not and supports the SVC natively.

5.1 VDisk setup using Storage Center MDisks

VDisks can be created with or without a read/write cache; they can also be configured as sequential or striped. IBM recommends turning on caching and that a VDisk be striped across all MDisks in an MDisk group. At this time, this is the Dell SC Series storage recommendation for general use as well.

5.2 Dell SC Series SAN features with the IBM SVC

There are two modes where storage presented to the IBM SVC is labeled, managed and unmanaged (image). Depending on the mode, because SC Series SAN storage is handled by the IBM SVC, some advanced features of the SC Series SAN are not available. It is important for the storage administrator to understand what features are available when using the SC Series SAN as back-end storage with the IBM SVC. Carefully plan and develop storage provisioning policies that consider this limitation and ensure necessary features are available to the volumes that require them. Refer to Table 4 for a high-level overview of the SC Series features available, depending on the SVC mode.

Table 4 SC Series feature status with SVC

<table>
<thead>
<tr>
<th>SC Series feature</th>
<th>IBM SVC managed mode status</th>
<th>IBM SVC unmanaged mode (image) – status¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Progression</td>
<td>Supported</td>
<td>Supported</td>
</tr>
<tr>
<td>Data Instant Replay</td>
<td>Not Usable</td>
<td>Supported</td>
</tr>
<tr>
<td>Thin Provisioning</td>
<td>Supported²</td>
<td>Supported²</td>
</tr>
<tr>
<td>LUN Expansion</td>
<td>Partial Support⁴</td>
<td>Supported³</td>
</tr>
<tr>
<td>Copy/Mirror/Migrate</td>
<td>Not Usable</td>
<td>Supported</td>
</tr>
</tbody>
</table>

¹ When presenting this image mode LUN to the host, Dell recommends turning off SVC based caching and striping.

² Thin provision reclamation (TPR) is not supported. The SCSI commands to initiate a TPR event will not pass through the SVC to the SC Series array.

³ Online LUN expansion will not work under any circumstance. If there is an image mode MDisk that needs to be expanded, remove the MDisk from the SVC, expand it and then re-present the LUN to the SVC. If expanding is a possibility, plan ahead by putting each of the image mode LUNs in its own MDisk group.

⁴ LUN Expansion using the SVC management GUI is possible when the VDisk size is within the total allocated size of the MDisk presented from SC Series storage.
5.3 Data Progression

A core component of the SC Series SAN platform is the tiered storage capabilities. This process is referred to as Data Progression. When using the SC Series SAN as a back-end controller to the IBM SVC, this feature is fully functional. This SCOS process occurs at the block-level and functions regardless of the volume mode on the SVC.

**Note:** It is recommended to schedule at least a daily Data Instant Replay (DIR) of a volume in order to ensure proper data progression.

5.4 Data Instant Replay

When a volume presented to the SVC is in managed mode, the SC Series Data Instant Replay (DIR) will not work. The IBM SVC provides its own software to accomplish snapshots of a VDisk presented to a host by the SVC. Refer to the IBM SVC documentation for more information.

Data Instant Replay does work when volumes are used in image mode. Follow the existing Dell Storage recommended best practices for setting up DIR profiles. When creating a View Volume based on a DIR, import the view volume as an image mode MDisk. This will preserve the data from the DIR. The View volume can be mapped directly to the host or with the SVC to make the data on that DIR available.

5.5 Thin provisioning

Thin provisioning works with both managed and image mode MDisks. However, Thin Provision Reclamation (TPR) does not work because the SCSI TPR command is not sent all the way back through the SCSI stack to the SC Series storage. The SC Series SAN uses thin provisioning by default, and this will function as expected when used with native volume presentation. In addition, SVC supports thin provisioning of managed volumes; this also works when using the SC Series SAN as back-end storage.

5.6 LUN expansion

There are multiple points where a LUN expansion can be performed so it is important to understand the different platform interactions that allow LUN expansion to work. When a volume from an SC Series SAN is presented to the SVC, and is functioning in a managed mode capacity, LUN expansion at the storage layer will not work.

However, LUN expansion from the SVC layer will work with volumes that are managed by SVC and presented from the SC Series storage. For example, if a 2TB volume is created on the storage, mapped to the SVC, created as a managed MDisk to create a 100GB volume (VDisk) and presented to a host, that VDisk can be expanded. First, the VDisk is expanded from within the SVC Management GUI and then host OS operations are needed to expand the device and file system. To see an example of the high-level process for expanding the device and file system on a Linux operating system, see appendix A.
5.7 Copy, mirror, and migrate
The SC Series storage copy, mirror, and migrate functions will not work if a volume is being managed by the SVC. If these features are required, then import the volume(s) to the IBM SVC as image mode MDisks. As image mode MDisks, the blocks are managed by the back-end storage system. This will enable the ability to utilize the SC Series advanced features.

For managed mode volumes that require replication type protection, it is necessary to use IBM SVC FlashCopy® to accomplish replication type services. Refer to IBM FlashCopy documentation for more information at http://publib.boulder.ibm.com/infocenter/svc/ic/index.jsp.

5.8 Volume import
If volumes were previously presented to hosts from an SC Series SAN and need to be presented through the SVC to hosts, it is possible to preserve the data. Simply un-map the volumes from the host, map them to the IBM SVC Server Cluster folder and import the volume(s) as image mode MDisk(s). Next, map these image mode MDisk(s) to the host and the data will remain unaffected.

**Note:** This has not been tested with boot-from-SAN volumes.

**Warning:** Use caution when importing these volumes to SVC. If these are mistakenly configured as managed MDisk(s) then all data on the volume could be lost.
Conclusion
The SC Series SAN can be used to provide backend storage to the IBM SAN Volume Controller platform. As a back-end storage controller, the SC Series SAN can provide core functionality to the IBM SVC. In addition, the SC Series SAN can be used alongside an IBM SVC providing storage to the SVC, through the SVC to end-user host systems and provide storage directly to end-user host systems.
A Expanding a LUN example

This appendix provides a high-level example of the process for expanding a LUN using a Red Hat® Enterprise Linux® 6.0 system.

1. Expand the 100GB V Disk using the SVC management GUI. For example, a 100GB VDisk was expanded to 125GB. Below is the size before the expansion process was started:

```
{root@brock} {~} # df /svc-data-voll
Filesystem Size Used Avail Use% Mounted on
/dev/mapper/svc-data-voll 99G 99G 0 100% /svc-data-voll
```

2. Perform a rescan of the SCSI device(s). The multipath –ll command can be used to determine the physical paths:

```
{root@brock} {~} # multipath -ll svc-data-voll
svc-data-voll (3600507680181053ad80000000000004e) dm-4 IBM,2145
size=100G features='1 queue_if_no_path' hwhandler='0' wp=rw
|+- policy='round-robin 0' prio=50 status=active
| | - 0:0:5:1 sdb 8:16 active ready running
| | - 0:0:7:1 sdd 8:48 active ready running
| `-- 1:0:5:1 sdj 8:144 active ready running
`-- policy='round-robin 0' prio=10 status=enabled
| - 0:0:9:1 sdf 8:80 active ready running
| - 0:0:11:1 sdh 8:112 active ready running
| - 1:0:9:1 sdn 8:208 active ready running
`- 1:0:11:1 sdp 8:240 active ready running
{root@brock} {~} # for a in sdb sdd sdj sdl sdf sdh sdn sdp
<<<269>>> do
<<<269>>> echo 1 > /sys/block/${a}/device/rescan
<<<269>>> done
{root@brock} {~} # dmesg | tail
sd 1:0:7:1: [sdl] 262144000 512-byte logical blocks: (134 GB/125 GiB)
sdl: detected capacity change from 107374182400 to 134217728000
sd 0:0:9:1: [sdf] 262144000 512-byte logical blocks: (134 GB/125 GiB)
sdf: detected capacity change from 107374182400 to 134217728000
sd 0:0:11:1: [sdh] 262144000 512-byte logical blocks: (134 GB/125 GiB)
sdh: detected capacity change from 107374182400 to 134217728000
sd 1:0:9:1: [sdn] 262144000 512-byte logical blocks: (134 GB/125 GiB)
sdn: detected capacity change from 107374182400 to 134217728000
sd 1:0:11:1: [sdp] 262144000 512-byte logical blocks: (134 GB/125 GiB)
sdp: detected capacity change from 107374182400 to 134217728000
```
3. Re-load the multipathd service to trigger device-mapper-multipath and see the new size of the devices.

```bash
{root@brock} {~} # /etc/init.d/multipathd reload
Reloading multipathd: [ OK ]
{root@brock} {~} # multipath -L
```

4. Perform a file system resizing operation to expand to the new size.

```bash
{root@brock} {~} # resize2fs /dev/mapper/svc-data-voll
resize2fs 1.41.12 (17-May-2010)
Filesystem at /dev/mapper/svc-data-voll is mounted on /svc-data-voll; on-line resizing required
old desc_blocks = 7, new_desc_blocks = 8
Performing an on-line resize of /dev/mapper/svc-data-voll to 32768000 (4k) blocks.
The filesystem on /dev/mapper/svc-data-voll is now 32768000 blocks long.
{root@brock} {~} # df /svc-data-voll
Filesystem Size Used Avail Use% Mounted on
```

It is possible to expand an SC Series volume and have this new size recognized by the IBM SVC when it is used in image mode on the SVC. An example of this process is highlighted below when used with a Red Hat Enterprise Linux 6.0 host. In the example below an image mode VDisk is expanded from 100GB to 150GB.

5. If the volume is mounted on the host as a file system, unmount from the host and flush the multipath maps.

```bash
{root@brock} {~} # df /svc-sc09-image-voll
Filesystem Size Used Avail Use% Mounted on
/dev/mapper/svc-sc09-image-voll 99G 82G 13G 87% /svc-sc09-image-voll
{root@brock} {~} # umount /svc-sc09-image-voll
{root@brock} {~} # multipath -f svc-sc09-image-voll
```
6. From the SVC GUI, remove the host mapping and delete the volume.

7. Remove the devices from the Linux host by issuing the delete flag to each of the physical device paths.

```
{root@brock} (~) # multipath -ll svc-sc09-image-vol1
svc-sc09-image-vol1 (3600507680181053ad80000000000004f) dm-5 IBM,2145
size=100G features='1 queue_if_no_path' hwhandler='0' wp=rw
|-- policy='round-robin 0' prio=50 status=active
| |-- 0:0:9:2 sds 65:32 active ready running
| |-- 0:0:11:2 sdt 65:48 active ready running
| |-- 1:0:9:2 sdw 65:96 active ready running
| `-- 1:0:11:2 sdx 65:112 active ready running
`-- policy='round-robin 0' prio=10 status=enabled
|-- 0:0:5:2 sdq 65:0 active ready running
|-- 0:0:7:2 sdr 65:16 active ready running
|-- 1:0:5:2 sdu 65:64 active ready running
`-- 1:0:7:2 sdv 65:80 active ready running
```

8. From the SC Series GUI, remove the device mapping to SVC and then expand the volume to the desired size. Remap the volume to the SVC.

9. Use the SVC management GUI to rediscover the volume and import it as an image mode MDisk.

10. Map the image mode VDisk to the Linux host.

11. On the Linux host, rescan for SCSI devices.

12. Update the `/etc/multipath.conf` file with the SCSI ID for the resized volume.

```
{root@brock} (~) # scsi_id -u -g /dev/sds
3600507680181053ad800000000000052
{root@brock} (~) # vi /etc/multipath.conf
```

13. Reload the multipathd service. A multipathd `–ll` command will show the new size of the volume.

```
{root@brock} (~) # /etc/init.d/multipathd reload
{root@brock} (~) # multipath -ll svc-sc09-image-vol1
svc-sc09-image-vol1 (3600507680181053ad800000000000052) dm-5 IBM,2145
size=150G features='1 queue_if_no_path' hwhandler='0' wp=rw
|-- policy='round-robin 0' prio=50 status=active
| |-- 0:0:9:2 sds 65:32 active ready running
| |-- 0:0:11:2 sdt 65:48 active ready running
| |-- 1:0:9:2 sdw 65:96 active ready running
| `-- 1:0:11:2 sdx 65:112 active ready running
`-- policy='round-robin 0' prio=10 status=enabled
|-- 0:0:5:2 sdq 65:0 active ready running
|-- 0:0:7:2 sdr 65:16 active ready running
|-- 1:0:5:2 sdu 65:64 active ready running
`-- 1:0:7:2 sdv 65:80 active ready running
```
14. Remount the file system, run resize2fs to see the new size; the volume and the expanded space are available.

```
{root@brock} (~) # mount /dev/mapper/svc-sc09-image-voll /svc-sc09-image-voll
{root@brock} (~) # df /svc-sc09-image-voll
Filesystem Size Used Avail Use% Mounted on
/dev/mapper/svc-sc09-image-voll 99G 82G 13G 87% /svc-sc09-image-voll
{root@brock} (~) # resize2fs /dev/mapper/svc-sc09-image-voll
resize2fs 1.41.12 (17-May-2010)
Filesystem at /dev/mapper/svc-sc09-image-voll is mounted on /svc-sc09-image-voll; on-line resizing required
old desc_blocks = 7, new_desc_blocks = 10
Performing an on-line resize of /dev/mapper/svc-sc09-image-voll to 39321600 (4k) blocks.
The filesystem on /dev/mapper/svc-sc09-image-voll is now 39321600 blocks long.
{root@brock} (~) # df /svc-sc09-image-voll
Filesystem Size Used Avail Use% Mounted on
/dev/mapper/svc-sc09-image-voll 148G 82G 60G 58% /svc-sc09-image-voll
```
B  Additional resources

B.1  Technical support

For support of Dell SC Series products:

- Global online support
- Email: mailto:support@compellent.com (non-emergency business hours)
- Phone: 866-EZ-STORE (866-397-8673) (United States only)

The Dell SC Series Customer Portal is an online portal for existing customers. A valid portal account is required to access the Knowledge Center. Once logged in to the portal, go to Knowledge center.

Dell.com/support is focused on meeting customer needs with proven services and support.

B.2  Referenced or recommended documentation

- Dell TechCenter: An online technical community for IT professionals that is a great resource to discover and learn about a wide range of technologies including storage.
  http://en.community.dell.com/techcenter/
- Storage Center System Manager User Guide on dell.com/support

Referenced or recommended IBM resources:

- IBM SAN Volume Controller Information Center:
- SAN Volume Controller Best Practices and Performance Guidelines