Dell Compellent Volume Expansion with Solaris 10 UFS

Technical Tip

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Document revision

<table>
<thead>
<tr>
<th>Date</th>
<th>Revision</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/30/2011</td>
<td>A</td>
<td>Initial Draft</td>
</tr>
<tr>
<td>10/14/2011</td>
<td>B</td>
<td>Fixed Some Typos</td>
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General syntax

Table 1. Document syntax

<table>
<thead>
<tr>
<th>Item</th>
<th>Convention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Menu items, dialog box titles, field names, keys</td>
<td><strong>Bold</strong></td>
</tr>
<tr>
<td>Mouse click required</td>
<td><strong>Click:</strong></td>
</tr>
<tr>
<td>User Input</td>
<td><strong>Monospace Font</strong></td>
</tr>
<tr>
<td>User typing required</td>
<td><strong>Type:</strong></td>
</tr>
<tr>
<td>Website addresses</td>
<td><strong><a href="http://www.compellent.com">http://www.compellent.com</a></strong></td>
</tr>
<tr>
<td>Email addresses</td>
<td><strong><a href="mailto:info@compellent.com">info@compellent.com</a></strong></td>
</tr>
</tbody>
</table>

Conventions

- **Note**
  Notes are used to convey special information or instructions.

- **Timesaver**
  Timesavers are tips specifically designed to save time or reduce the number of steps.

- **Caution**
  Caution indicates the potential for risk including system or data damage.

- **Warning**
  Warning indicates that failure to follow directions could result in bodily harm.
Preface

Audience
The audience for this document is System Administrators who are responsible for the management of Solaris 10 systems that utilize the Dell Compellent SAN.

Purpose
This document provides an overview of LUN expansion with UFS on Solaris 10 when using the Dell Compellent Storage Center. For Solaris Best Practices and additional Technical Tips, download these from http://knowledgecenter.compellent.com.

Customer support
Dell Compellent provides live support 1-866-EZSTORE (866.397.8673), 24 hours a day, 7 days a week, 365 days a year. For additional support, email Dell Compellent at support@compellent.com. Dell Compellent responds to emails during normal business hours.
Introduction

The goal of this paper is to describe the steps to expand a UFS formatted file system with Solaris 10 and the Dell Compellent SAN. As this is a process to update the underlying geometry of the device holding the data, it is recommended to make sure an up-to-date backup of the data exists. As of this writing, this process is not supported with the source file system online. Using UFS, the underlying size of the device cannot be modified while the UFS file system is mounted.

Solaris 10 supports UFS file system sizes of up to 16 Terabytes, minus approximately 1% for system overhead. With Solaris 10, Sun enables “largefiles” support by default on UFS formatted file systems. However, the Open Boot PROM version can also be a limiting factor in the maximum file size and volume size of a UFS file system.

In order to use LUNs greater than 2TB the LUN will need to be labeled with an EFI disk label. If your design implementation keeps LUNs less than 2TB, then you can continue to use the SMI disk label and managing the LUNs will be the same as before. If you expect to need to grow the file system beyond 2TB in the future, then be sure to label the disk with an EFI label. Note that using the EFI disk label type allows the LUN and underlying UFS file system to be expanded without taking the file system offline.

Refer to the following Oracle links for further discussion on the Solaris 10 disk management.


In the scenarios below a Solaris 10 10/09 system is configured with the OS booting from the Dell Compellent SAN. Please refer to the Dell Compellent Tech Tip Boot from SAN with SPARC based Solaris Servers and Dell Compellent Storage Center for further information on such a configuration. In addition, multipath is configured using the Dell Compellent Best Practices. It is important to note that as is common in Solaris, there are many ways to do what is covered in this document. This guide does not contain every possible way, and the way covered might not be the best for all situations. This documentation is brief and intended as a starting point of reference for end users. Users are encouraged to consult more detailed documentation available from Sun Microsystems.

Test Bed Environment

In the examples detailed below, the environment utilized was composed of the hardware and software versions listed below.

Dell Compellent SAN

- Model: SC030
- Storage Center OS: 5.4.5
- Description: Dual-controller, with Legacy Port Mode. Each controller contained a quad-port QLogic QLE2464 HBA.
- Enclosure: 1 x FC SBOD
- HDD: 16 x Seagate ST3400755FC

Fiber Channel Switches

- Model: 2 x Cisco 9134
- Firmware: 4.1(3a)
Server

- Make/Model: Oracle SunFire T2000
- Operating System: Solaris 10 10/09
- Multipath Software: Solaris SAN Foundation Suite w/ MPxIO
- HBA
  - Make/Model: Emulex LPe12002-M8
  - Firmware: 1.10a5
  - FCode/BIOS Version: Boot:5.03a2 Fcode:3.01a1
  - OS Driver: emlxs
  - Driver Version: 2.50o (2010.01.08.09.45)

Expand a UFS Formatted LUN (<2TB) on Solaris 10 and Dell Compellent

In this scenario, we have a UFS formatted file system that is currently mounted at /datavol1. Multipath is configured for this system using the native Sun SFS software MPxIO. This file system is approaching 100% utilization. The Solaris admin received an alert the file system had reached the 75% utilized threshold and now wants to expand this area to accommodate the capacity requirements.

The volume is currently provisioned at 100GB and the Solaris admin would like to expand it to 200GB. This process requires a couple minutes of downtime to re-label the device with the new disk geometry. The most time consuming aspect of this modification occurs when the UFS file system is grown using the `growfs` command. This step can be done online to minimize the downtime impact. Below are the details for accomplishing the above with Solaris 10 and Dell Compellent SAN.

1. The starting size of the volume is 100GB and is approximately 79% filled.

   ```bash
   {root@ceaser} {/datavol1} # df -h .
   Filesystem size  used avail capacity Mounted on
   /dev/dsk/c6t60000D31000006700000000000000685d0s6 98G 76G 21G 79% /datavol1
   ```

2. Identify the volume to be expanded on the Storage Center SAN. This can be done by cross-referencing the Solaris device name with the Serial Number listed for the volume in Storage Center.
3. Expand the volume on the Dell Compellent SAN. This is done by using the Storage Center GUI. This is a one step process that simply involves highlighting the volume, selecting Expand, and setting the new size. The volume was expanded to 200GB.
4. Unmount the volume on the host. This step is required to allow the format command to run without error/warning messages.

   ![Timesaver]
   If the device is listed in the /etc/vfstab, comment it out or you will receive an error message, and unable to proceed, when performing the next step.

5. Use the Solaris `format` command to configure the device using the new disk geometry. Be cautious and make sure to preserve the same partition (0-7) and starting cylinder. The selection sequence is: format → select device → type → auto-configure → label → p → p to see new partition with added space. Then quit out of format.

   <SNIP>
   Specifying disk type (enter its number)[19]: 0
c6t6000D3100006700000000000000685d0: configured with capacity of 199.99GB
   <COMPELNT-CompellentVol-0504 cyl 63935 alt 2 hd 32 sec 205>
   selecting c6t6000D3100006700000000000000685d0
   [disk formatted]
   format> label
   Ready to label disk, continue? yes
   <SNIP>
   partition> print
   Current partition table (default):
   Total disk cylinders available: 63935 + 2 (reserved cylinders)
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<table>
<thead>
<tr>
<th>Part</th>
<th>Tag</th>
<th>Flag</th>
<th>Cylinders</th>
<th>Size</th>
<th>Blocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>root</td>
<td>wm</td>
<td>0</td>
<td>0 (0/0/0)</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>swap</td>
<td>wu</td>
<td>0</td>
<td>0 (0/0/0)</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>backup</td>
<td>wu</td>
<td>0 - 63934</td>
<td>199.99GB (63935/0/0)</td>
<td>419413600</td>
</tr>
<tr>
<td>3</td>
<td>unassigned</td>
<td>wm</td>
<td>0</td>
<td>0 (0/0/0)</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>unassigned</td>
<td>wm</td>
<td>0</td>
<td>0 (0/0/0)</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>unassigned</td>
<td>wm</td>
<td>0</td>
<td>0 (0/0/0)</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>usr</td>
<td>wm</td>
<td>0 - 63934</td>
<td>199.99GB (63935/0/0)</td>
<td>419413600</td>
</tr>
<tr>
<td>7</td>
<td>unassigned</td>
<td>wm</td>
<td>0</td>
<td>0 (0/0/0)</td>
<td>0</td>
</tr>
</tbody>
</table>

6. Use the Solaris `devfsadm` command with the “-C” option to clean up the device tree.

```bash
{root@ceaser} {/} # devfsadm -C
```

7. Grow the file system using the Solaris `growfs` command. This can be done either with the file system mounted or unmounted. This can be the most time-consuming step, so to return the file system to a usable, online state as soon as possible, it can be mounted first. The example shown below is with the file system mounted:

```bash
{root@ceaser} {/} # mount /dev/dsk/c6t6000D31000006700000000000000685d0s6 /datavol1
{root@ceaser} {/} # cd /datavol1/
{root@ceaser} {/datavol1} # df -h.
```

```
Filesystem size used avail capacity Mounted on
/dev/dsk/c6t6000D31000006700000000000000685d0s6 98G 76G 21G 79% /datavol1
```

```bash
{root@ceaser} {/datavol1} # growfs -M /datavol1
```

```
Warning: 416 sector(s) in last cylinder unallocated
/dev/rdsk/c6t6000D31000006700000000000000685d0s6: 419413600 sectors in 68264 cylinders of 48 tracks, 128 sectors
204791.8MB in 4267 cyl groups (16 c/g, 48.00MB/g, 5824 i/g) super-block backups (for fsck -F ufs -o b=#) at:
32, 98464, 196896, 295328, 393760, 492192, 590624, 689056, 787488, 885920, Initializing cylinder groups:

super-block backups for last 10 cylinder groups at:
418484384, 418582816, 418681248, 418779680, 418878112, 418976544, 419074976, 419173408, 419271840, 419370272
```

8. Finally, verify the new size of the file system.

```bash
{root@ceaser} {/datavol1} # df -h.
```

```
Filesystem size used avail capacity Mounted on
/dev/dsk/c6t6000D31000006700000000000000685d0s6 197G 76G 120G 39% /datavol1
```

Expand a UFS Formatted LUN (>2TB) on Solaris 10 and Dell Compellent

In this scenario we have a 2.44TB (2500 GB) volume presented from the Dell Compellent SAN to the Solaris 10 host. As it is >2TB in size, the disk is labeled with the EFI signature. Note that when the volume is mapped to the Solaris 10 host from the Dell Compellent SAN, and the `cfgadm` command is used to scan and discover the LUN, the Solaris 10 OS should automatically detect the size of the LUN is
greater than 2TB and assign the EFI label to it. This volume is configured as a LUN with the UFS file system placed on the device using Solaris 10 defaults when executing the `newfs` command. The “largefiles” option is enabled by default for UFS on the Solaris 10 release. The Solaris admin wants to increase this UFS formatted LUN to 3TB. The steps below are very similar to the process used for a LUN that is smaller than 2TB, but is completed with the file system mounted during the expansion process, this is highlighted to show the support and functionality exists between the Solaris 10 host and the Dell Compellent SAN.

1. First determine the LUN to be expanded using the `format` command and comparing the device name to the serial number listed in Storage Center.

```bash
{root@ceaser} {/} # format
Searching for disks...done

AVAILABLE DISK SELECTIONS:
0. c6t6000D3100000670000000000000068Cd0 <COMPELNT-Compellent Vol-0504-2.44TB> DATAVOL2
   /scsi_vhci/ssd@g6000d3100000670000000000000068c
1. c6t6000D3100000670000000000000060Dd0 <COMPELNT-CompellentVol-0504 cyl 49930 alt 2 hd 8 sec 126> SOL10OS
   /scsi_vhci/ssd@g6000d3100000670000000000000060d
2. c6t6000D31000006700000000000000685d0 <COMPELNT-Compellent Vol-0504 cyl 63935 alt 2 hd 32 sec 205> DATAVOL1
   /scsi_vhci/ssd@g6000d31000006700000000000000685

Specify disk (enter its number): ^C
```

2. Using the Dell Compellent Storage Center GUI, increase the volume to the desired size, in this case 3TB.

3. After expanding the volume on the Dell Compellent Storage Center, run the format command and you will see the size is automatically updated, showing the new size, however...

```bash
{root@ceaser} {/mnt/datavol2} # format
Searching for disks...done

AVAILABLE DISK SELECTIONS:
0. c6t6000D3100000670000000000000068Cd0 <COMPELNT-Compellent Vol-0504-3.00TB> DATAVOL2
   /scsi_vhci/ssd@g6000d3100000670000000000000068c
1. c6t6000D3100000670000000000000060Dd0 <COMPELNT-CompellentVol-0504 cyl 49930 alt 2 hd 8 sec 126> SOL10OS
   /scsi_vhci/ssd@g6000d3100000670000000000000060d
2. c6t6000D31000006700000000000000685d0 <COMPELNT-Compellent Vol-0504 cyl 63935 alt 2 hd 32 sec 205> DATAVOL1
   /scsi_vhci/ssd@g6000d31000006700000000000000685

Specify disk (enter its number):

...the device partition table is still not aware of the new geometry.

<SNIP>
partition> par
partition> pr
Volume: DATAVOL2
Current partition table (original):
Total disk sectors available: 5242863582 + 16384 (reserved sectors)
4. Use the Solaris format -e command to configure the device to recognize the new disk geometry. This process is exampled below:

```
[root@ceaser] {/mnt/datavol2} # format -e
Searching for disks...done
AVAILABLE DISK SELECTIONS:
  0. c6t6000D31000006700000000000000068Cd0 <COMPELNT-Compellent Vol-0504-3.00TB>
     DATAVOL2
     /scsi_vhci/ssa@g6000d31000006700000000000000068c
  1. c6t6000D31000006700000000000000060Dd0 <COMPELNT-CompellentVol-0504 cyl 49930 alt 2 hd 8 sec 126> SOL10OS
     /scsi_vhci/ssa@g6000d31000006700000000000000060d
  2. c6t6000D310000067000000000000000685d0 <COMPELNT-CompellentVol-0504 cyl 63935 alt 2 hd 32 sec 205> DATAVOL1
     /scsi_vhci/ssa@g6000d310000067000000000000000685
Specify disk (enter its number)[0]: 0
selecting c6t6000D31000006700000000000000068Cd0: DATAVOL2
[disk formatted]
Warning: Current Disk has mounted partitions.
/dev/dsk/c6t6000D31000006700000000000000068Cd0s0 is currently mounted on /mnt/datavol2. Please see umount(1M).
format> type
AVAILABLE DRIVE TYPES:
  0. Auto configure
  1. other
Specify disk type (enter its number)[1]: 0
c6t6000D31000006700000000000000068Cd0: configured with capacity of 3072.00GB <COMPELNT-Compellent Vol-0504-3.00TB>
selecting c6t6000D31000006700000000000000068Cd0
[disk formatted]
Warning: Current Disk has mounted partitions.
/dev/dsk/c6t6000D31000006700000000000000068Cd0s0 is currently mounted on /mnt/datavol2. Please see umount(1M).
format> par
PARTITION MENU:
  0  - change `0' partition
  1  - change `1' partition
  2  - change `2' partition
  3  - change `3' partition
```
4 - change '4' partition
5 - change '5' partition
6 - change '6' partition
7 - change '7' partition
8 - change '8' partition
select - select a predefined table
modify - modify a predefined partition table
name - name the current table
print - display the current table
label - write partition map and label to the disk
!<cmd> - execute <cmd>, then return
quit

partition> pr
Volume: DATAVOL
Current partition table (default):
Total disk sectors available: 6442434526 + 16384 (reserved sectors)

<table>
<thead>
<tr>
<th>Part</th>
<th>Tag</th>
<th>Flag</th>
<th>First Sector</th>
<th>Size</th>
<th>Last Sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>unassigned</td>
<td>wm</td>
<td>34</td>
<td>3.00TB</td>
<td>6442434526</td>
</tr>
<tr>
<td>1</td>
<td>unassigned</td>
<td>wm</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>unassigned</td>
<td>wm</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>unassigned</td>
<td>wm</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>unassigned</td>
<td>wm</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>unassigned</td>
<td>wm</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>6</td>
<td>unassigned</td>
<td>wm</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>unassigned</td>
<td>wm</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>reserved</td>
<td>wm</td>
<td>6442434527</td>
<td>8.00MB</td>
<td>6442450910</td>
</tr>
</tbody>
</table>

partition> lab
[0] SMI Label
[1] EFI Label
Specify Label type[1]:
Ready to label disk, continue? yes

partition> q
{root@ceaser} [/mnt/datavol2] # format
Searching for disks...done

AVAILABLE DISK SELECTIONS:
  0. c6t6000D31000006700000000000000068Cd0 <COMPELNT-Compellent Vol-0504-3.00TB>
     /scsi_vhci/ssd@g6000d31000006700000000000000068c
  1. c6t6000D31000006700000000000000060Dd0 <COMPELNT-CompellentVol-0504 cyl 49930 alt 2 hd 8 sec 126> SOL100S
     /scsi_vhci/ssd@g6000d31000006700000000000000060d
  2. c6t6000D310000067000000000000000685d0 <COMPELNT-CompellentVol-0504 cyl 63935 alt 2 hd 32 sec 205>
     /scsi_vhci/ssd@g6000d310000067000000000000000685
Specify disk (enter its number):

5. The file system can now be grown to utilize the additional space:

{root@ceaser} [/mnt/datavol2] # growfs -M /mnt/datavol2
/dev/rdsk/c6t6000D31000006700000000000000068Cd0s0
Warning: 4176 sector(s) in last cylinder unallocated
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/dev/rdsk/c6t6000D31000006700000000000000068Cd0s0: 644234480 sectors in 1048574 cylinders of 48 tracks, 128 sectors
3145720.0MB in 7333 cyl groups (143 c/g, 429.00MB/g, 448 i/g)
super-block backups (for fsck -F ufs -o b=#) at:
32, 878752, 1757472, 2636192, 3514912, 4393632, 5272352, 6151072, 7029792, 7908512,
Initializing cylinder groups:

super-block backups for last 10 cylinder groups at:
6433932704, 6434811424, 6435690144, 6436568864, 6437447584, 6438326304, 6439205024, 6440083744, 6440962464, 6441841184

6. The df command can be used to view the new file system size as well:

```
[root@ceaser] {/mnt/datavol2} # df
Filesystem size used avail capacity Mounted on
/dev/dsk/c6t6000D31000006700000000000000060Dd0s0 20G 4.4G 15G 23% /
 devicesto/dev/dsk/c6t6000D31000006700000000000000068Cd0s0
 cifs 0K 0K 0K 0% /system/contract
 proc 0K 0K 0K 0% /proc
 mnttab 0K 0K 0K 0% /etc/mnttab
 swap 9.7G 1.6M 9.7G 1% /etc/svc/volatile
 objfs 0K 0K 0K 0% /system/object
 shares 0K 0K 0K 0% /etc/dfs/sharetab
/platform/SUNW,Sun-Fire-T200/lib/libc_psr/libc_psr_hwcap1.so.1 20G 4.4G 15G 23% /platform/sun4v/lib/libc_psr.so.1
 fd 0K 0K 0K 0% /dev/fd
 swap 9.7G 32K 9.7G 1% /tmp
 swap 9.7G 64K 9.7G 1% /var/run
 /dev/dsk/c6t6000D31000006700000000000000068Cd0s0 197G 79G 116G 41% /datavol1
 /dev/dsk/c6t6000D31000006700000000000000068Cd0s0 3.0T 33G 2.9T 2% /mnt/datavol2
```

Summary
The above examples demonstrated the ability to expand a UFS file system using the Solaris built-in commands and the Expand LUN feature of the Dell Compellent SAN. The above process can be performed to successfully expand a Solaris 10 UFS formatted file system, and once completed, the underlying space available to the OS is expanded and this additional space can be used immediately.