Using Logical Volume Manager (LVM) to Reduce the Hassle of Managing Disk Space on Linux

Mark Post
Novell, Inc.

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Agenda

• Quick overview of concepts and terminology
• Starting with nothing
• Adding space
• Removing space
• Displaying information
• LVM (Sub)Commands

• I will take questions during the presentation unless time gets short.
• This is the first time this session has been given. Constructive feedback is very much welcome.
Overview

• Logical Volume Manager (LVM) is used to create “pools” of disk storage.

• Additional storage devices can be added dynamically.

• Currently in-use devices can be removed dynamically.
  • Moving data off currently in-use devices can be done dynamically.

• Space in the pool can be given to and taken from a particular use dynamically.

• We won't be covering everything you could possibly do with LVM.
Terminology

• Physical Volume (PV) – Actual underlying storage device.
  • DASD Volume
  • Minidisk
  • SCSI over FCP DISK
• Volume Group (VG) – One or more PVs collected together.
• Logical Volume (LV) – A Logical/virtual storage device created from space owned by one (and only one) VG.
• Logical / Physical Extent – Minimum amount of allocation space that can be used or removed. (Default is 4MB.)
### Sample File System Layout

```
# df -h

<table>
<thead>
<tr>
<th>Filesystem</th>
<th>Size</th>
<th>Used</th>
<th>Avail</th>
<th>Use%</th>
<th>Mounted on</th>
</tr>
</thead>
<tbody>
<tr>
<td>/dev/dasda1</td>
<td>388M</td>
<td>119M</td>
<td>250M</td>
<td>33%</td>
<td>/</td>
</tr>
<tr>
<td>/dev/dasda2</td>
<td>97M</td>
<td>4.2M</td>
<td>88M</td>
<td>5%</td>
<td>/home</td>
</tr>
<tr>
<td>/dev/dasda3</td>
<td>74M</td>
<td>21M</td>
<td>50M</td>
<td>30%</td>
<td>/opt</td>
</tr>
<tr>
<td>/dev/dasdc1</td>
<td>1.2G</td>
<td>1.1G</td>
<td>100M</td>
<td>92%</td>
<td>/srv</td>
</tr>
<tr>
<td>/dev/dasdb1</td>
<td>291M</td>
<td>17M</td>
<td>260M</td>
<td>6%</td>
<td>/tmp</td>
</tr>
<tr>
<td>/dev/dasdb2</td>
<td>1.2G</td>
<td>915M</td>
<td>183M</td>
<td>84%</td>
<td>/usr</td>
</tr>
<tr>
<td>/dev/dasdb3</td>
<td>245M</td>
<td>69M</td>
<td>164M</td>
<td>30%</td>
<td>/var</td>
</tr>
</tbody>
</table>
```
Sample LVM File System Layout

# df -h

<table>
<thead>
<tr>
<th>Filesystem</th>
<th>Size</th>
<th>Used</th>
<th>Avail</th>
<th>Use%</th>
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</tr>
</thead>
<tbody>
<tr>
<td>/dev/dasda1</td>
<td>388M</td>
<td>119M</td>
<td>250M</td>
<td>33%</td>
<td>/</td>
</tr>
<tr>
<td>/dev/vgl/home</td>
<td>97M</td>
<td>4.2M</td>
<td>88M</td>
<td>5%</td>
<td>/home</td>
</tr>
<tr>
<td>/dev/vgl/opt</td>
<td>74M</td>
<td>21M</td>
<td>50M</td>
<td>30%</td>
<td>/opt</td>
</tr>
<tr>
<td>/dev/vgl/srv</td>
<td>1.2G</td>
<td>1.1G</td>
<td>100M</td>
<td>92%</td>
<td>/srv</td>
</tr>
<tr>
<td>/dev/vgl/tmp</td>
<td>291M</td>
<td>17M</td>
<td>260M</td>
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<td>/dev/vgl/usr</td>
<td>1.2G</td>
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<td>84%</td>
<td>/usr</td>
</tr>
<tr>
<td>/dev/vgl/var</td>
<td>245M</td>
<td>69M</td>
<td>164M</td>
<td>30%</td>
<td>/var</td>
</tr>
</tbody>
</table>
Starting With Nothing

• Need one or more disk storage devices
  • Make sure you know what the “node names” are for these:
    • /dev/dasda2
    • /dev/sda1
• Create a Physical Volume (PV)
• Create a Volume Group (VG) with one or more initial PVs
• Create one or more Logical Volumes (LV)
Starting With Nothing

- `pvcreate /dev/dasda2`
- `vgcreate vg1 /dev/dasda2`
- `vgchange -a y vg1`
- `lvcreate -n logicalvol1 -L 100M vg1`
- `lvcreate -n logicalvol2 -L 50M vg1`
- `lvcreate -n logicalvol3 -l 13 vg1 (42MB)`
Adding Space

• Need one or more additional disk storage volumes
• Create Physical Volume(s)
• Extend the Volume Group (VG)

• Create more Logical Volumes (LV)
• Expand existing Logical Volumes
Adding Space

- pvcreate /dev/dasdb1 /dev/dasdc1
- vgextend vg1 /dev/dasdb1 /dev/dasdc1
- lvcreate -n lvol3 -L 2G vg1
- lvresize -L +500M /dev/vg1/srv
- lvextend -L +500M /dev/vg1/srv
- lvextend -l +125 /dev/vg1/srv
- lvresize -L 2500M /dev/vg1/srv

- lvresize and lvextend are synonymous (in this particular case)
Removing Space

- Remove space from a Logical Volume
  - Resize the file system on the Logical Volume
  - Resize the Logical Volume
- Remove a Physical Volume from the Volume Group
  - Determine if the Physical Volume is still in use
  - Move data off the Physical Volume if needed
  - Remove the Physical Volume from the Volume Group
Removing Space From an LV

• File system resizing is dependent on the file system being used. It may or may not be allowed while the file system is mounted. (EXT3 does not allow it.)

• `lvresize -L -300M /dev/vg1/lvol2`
• `lvreduce -L -300M /dev/vg1/lvol3`
• `lvreduce -L 1G /dev/vg1/lvol4`
• `lvresize -l 250 /dev/vg1/lvol4`

• `lvresize` and `lvreduce` are synonymous (in this particular case)
Removing PV From a Volume Group

- `pvdisplay -m /dev/dasdb1`
- `pvmove /dev/dasdb1`
- `pvmove /dev/dasdb1 /dev/dasdc1`
- `vgreduce vg1 /dev/dasdb1`
- `pvremove /dev/dasdb1` (optional but prudent)
Displaying Information

- Physical Volume
  - pvdisplay
  - pvs
- Logical Volume
  - lvdisplay
  - lvs
- Volume Group
  - vgdisplay
  - vgs
# pvdisplay /dev/dasdb1

--- Physical volume ---

<table>
<thead>
<tr>
<th>PV Name</th>
<th>/dev/dasdb1</th>
</tr>
</thead>
<tbody>
<tr>
<td>VG Name</td>
<td>vg01</td>
</tr>
<tr>
<td>PV Size</td>
<td>2.29 GB / not usable 42.94 MB</td>
</tr>
<tr>
<td>Allocatable</td>
<td>yes (but full)</td>
</tr>
<tr>
<td>PE Size (KByte)</td>
<td>32768</td>
</tr>
<tr>
<td>Total PE</td>
<td>72</td>
</tr>
<tr>
<td>Free PE</td>
<td>0</td>
</tr>
<tr>
<td>Allocated PE</td>
<td>72</td>
</tr>
<tr>
<td>PV UUID</td>
<td>b7v5M6-E1dc-VwV1-LgzU-gnW9-Pz7I-IeNIywW</td>
</tr>
</tbody>
</table>
pvdisplay

# pvdisplay -m /dev/dasdb1
--- Physical volume ---
PV Name /dev/dasdb1
VG Name vg01
PV Size 2.29 GB / not usable 42.94 MB
Allocatable yes (but full)
PE Size (KByte) 32768
Total PE 72
Free PE 0
Allocated PE 72
PV UUID b7v5M6-EIdc-VwV1-LgzU-gnW9-Pz7I-IeNInW

--- Physical Segments ---
Physical extent 0 to 71:
  Logical volume /dev/vg01/usr
  Logical extents 0 to 71
lvdisplay

# lvdisplay /dev/vg01/tmp

--- Logical volume ---
LV Name /dev/vg01/tmp
VG Name vg01
LV UUID 000000-0000-0000-0000-0000-000002
LV Write Access read/write
LV Status available
# open 1
LV Size 3.41 GB
Current LE 109
Segments 2
Allocation normal
Read ahead sectors 1024
Block device 253:2
lvdisplay

# lvdisplay -m /dev/vg01/tmp
--- Logical volume ---
LV Name /dev/vg01/tmp
VG Name vg01
LV UUID 000000-0000-0000-0000-0000-0000-000002
LV Write Access read/write
LV Status available
# open 1
LV Size 3.41 GB
Current LE 109
Segments 2
Allocation normal
Read ahead sectors 1024
Block device 253:2

--- Segments ---
Logical extent 0 to 95:
  Type linear
  Physical volume /dev/dasdd1
  Physical extents 120 to 215

Logical extent 96 to 108:
  Type linear
  Physical volume /dev/dasdd1
  Physical extents 95 to 107
**vgdisplay**

```
# vgdisplay vg01
--- Volume group ---
VG Name                vg01
System ID              lslack321149984288
Format                 lvml
VG Access              read/write
VG Status              resizable
MAX LV                 256
Cur LV                 8
Open LV                7
Max PV                 256
Cur PV                 3
Act PV                 3
VG Size                26.94 GB
PE Size                32.00 MB
Total PE               862
Alloc PE / Size        857 / 26.78 GB
Free PE / Size         5 / 160.00 MB
VG UUID                jg5SuT-sGQe-YM7W-W4Xe-Vhn0-Xuk6-Dyghml
```
vgdisplay (and others)

- `vgdisplay -v`
  - Provides information about all LVs and PVs in the VG.

```bash
# vgs
VG   #PV #LV #SN Attr   VSize  VFree
vg01   3   8   0 wz--n- 26.94G 160.00M

# pvs
PV          VG   Fmt  Attr  PSize  PFree
/dev/dasdb1 vg01 lvm1 a-    2.25G      0
/dev/dasdc1 vg01 lvm1 a-    2.25G      0
/dev/dasdd1 vg01 lvm1 a-   22.44G 160.00M
```
```plaintext
# lvs

<table>
<thead>
<tr>
<th>LV</th>
<th>VG</th>
<th>Attr</th>
<th>LSize</th>
<th>Origin</th>
<th>Snap%</th>
<th>Move</th>
<th>Log</th>
<th>Copy%</th>
<th>Convert</th>
</tr>
</thead>
<tbody>
<tr>
<td>build</td>
<td>vg01</td>
<td>-wn-a-</td>
<td>5.41G</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ccache</td>
<td>vg01</td>
<td>-wn-ao</td>
<td>768.00M</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>current</td>
<td>vg01</td>
<td>-wn-ao</td>
<td>7.00G</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>opt</td>
<td>vg01</td>
<td>-wn-ao</td>
<td>320.00M</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>slack-10.2</td>
<td>vg01</td>
<td>-wn-ao</td>
<td>4.00G</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>tmp</td>
<td>vg01</td>
<td>-wn-ao</td>
<td>3.41G</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>usr</td>
<td>vg01</td>
<td>-wn-ao</td>
<td>5.28G</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>var</td>
<td>vg01</td>
<td>-wn-ao</td>
<td>640.00M</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```
LVM (Sub)Commands

- dumpconfig (subcmd only)
- formats (subcmd only)
- help (subcmd only)
- lvchange
- lvconvert
- lvcreate
- lvdisplay
- lvextend
- lvmchange
- lvmdiskscan
- lvmsadc
- lvmsar
- lvreduce
- lvremove
- lvrename
- lvresize
- lvs
- lvscan
- pvchange
- pvresize
- pvck
- pvcreate
- pvdata
- pvdisplay
LVM (Sub)Commands (2)

- pvmove
- pvremove
- pvs
- pvscan
- segtypes
- vgcfgbackup
- vgcfgrestore
- vgchange
- vgck
- vgconvert
- vgcreate
- vgdisplay
- vgexport
- vgextend
- vgimport
- vgmerge
- vgmknodes
- vgreduce
- vgremove
- vgrename
- vgs
- vgscan
- vgsplit