



FlashArray Cloning for IBM AIX Filesystem

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Executive Summary

This white paper provides technical validation and step by step documentation for users of the advanced Snapshot capabilities of a Pure Storage FlashArray with IBM Power servers running AIX . It will cover filesystem creation, filesystem cloning on source and target AIX Host, and filesystem cloning on a single host.

As we will use technology like PowerVM and LVM, it is recommended to check other IBM Power related documents including the “IBM POWERVM WITH FLASHARRAY,” which can be downloaded from the Pure1 Knowledgebase <http://community.purestorage.com/> .

Introduction

Pure Storage FlashArray

Who knew that moving to all-flash storage could help reduce the cost of IT? FlashArray makes server and workload investments more productive, while also lowering storage spend. With FlashArray, organizations can dramatically reduce the complexity of storage to make IT more agile and efficient, accelerating your journey to the cloud.

FlashArray//X and FlashArray//M performance can also make your business smarter by unleashing the power of real-time analytics, driving customer loyalty, and creating new, innovative customer experiences that simply weren't possible with disk. All by transforming your storage with FlashArray.



The FlashArray//M expands upon the FlashArray's modular, stateless architecture, designed to enable expandability and upgradability for generations. The FlashArray//M leverages a chassis-based design with customizable modules, enabling both capacity and performance to be independently improved over time with advances in compute and flash, to meet your business' needs today and tomorrow.

IBM Power system PowerVM and VIOS

The IBM Power Systems is IBM's Power Architecture-based server line, based on an embedded hypervisor (Power Hypervisor). The POWER Hypervisor is a firmware layer sitting between the hosted operating systems and the server hardware.



PowerVM provides virtualization technologies for AIX, VIO Server, IBM i and Linux operating systems (OS) on IBM Power Systems using the IBM POWER Hypervisor. PowerVM virtualizes processor, memory, storage and input/output (I/O) resources for client's virtual machines (VMs).

Most configuration will run with several LPARs (Virtual Machine), in this case the first Partition must be Virtual I/O Server (VIOS) to help to manage the POWER Hypervisor and the different IO models presented. VIOS also contains the Integrated Virtualization Manager (IVM) which can be used instead of the recommended external Hardware Management Console (HMC).

In this white paper, we will present the most commonly used solutions for IBM Power and AIX, which is dedicated PCI HBA (Bare Metal) and NPIV

IBM AIX Logical Volume Manager and Filesystem (LVM and JFS)

The set of operating system commands, library subroutines, and other tools that allow you to establish and control logical volume storage is called the Logical Volume Manager (LVM).

The LVM controls disk/storage resources by mapping data between a simple and flexible logical view of storage space and the actual physical disks. The LVM does this using a layer of device-driver code that runs above traditional disk device drivers.

A hierarchy of structures is used to manage disk storage. Each individual disk drive, called a physical volume (PV) has a name, such as /dev/hdisk0. Every physical volume in use belongs to a volume group (VG). All of the PVs in a VG are divided into physical partitions (PPs) of the same size. The number of PPs in each region varies, depending on the total capacity of the disk drive.

Within each volume group, one or more logical volumes (LVs) are defined. This allows file systems, paging space, and other LVs to be re-sized or relocated, to span multiple physical volumes, and to have their contents replicated for greater flexibility and availability in the storage of data.

Many LVs contain a single **journaled file system** (JFS or JFS2). Each JFS consists of a pool of pagesize (4 KB) blocks. When data is to be written to a file, one or more additional blocks are allocated to that file.

Create an AIX JFS2 Filesystem

Before getting started, establish that FlashArray and AIX Server have been connected with Fibre Channel, Zoning and NPIV (if used). The Host must also be defined on the FlashArray before the process to create the AIX JFS2 filesystem is started.

Before cloning the data, we will create a JFS2 filesystem on a primary system. This will be the source for the “Snap” process.

ON PURE FLASHARRAY

Create the volume here “aix_lun_test1” :

```
pureuser@healthcare-m20r2-e09-30> purevol create --size 100G aix_lun_test1
aix_lun_test1
Name          Size  Source  Created              Serial
aix_lun_test1 100G  -       2017-09-13 13:54:41 PDT 7C06AA5E1FDD4044000111D3
aix_lun_test2 100G  -       2017-09-13 13:54:41 PDT 7C06AA5E1FDD4044000111D4
```

Connect the volume to your host (here HC-AIX-87 which have been previously created in the FlashArray):

```
pureuser@healthcare-m20r2-e09-30> purevol connect --host HC-AIX-87 aix_lun_test1
aix_lun_test2
Name          Host Group  Host          LUN
aix_lun_test1 -          HC-AIX-87    5
aix_lun_test1 -          HC-AIX-87    6
```

ON AIX

Get a list of the current LUN's using lspv:

```
root@HC-AIX-87:/# lspv
hdisk12          00fac29cff727352          rootvg          active
```

Run configuration manager to scan for the LUN:

```
root@HC-AIX-87:/# cfmgr
```

Now we see the new LUNs listed: Here we have added 2 new volumes : hdisk0 and hdisk1

```

root@HC-AIX-87:/# lspv
hdisk0          none                      None
hdisk1          none                      None
hdisk12         00fac29cff727352         rootvg         active

```

Confirm the disk matches the Serial Number on Pure using lsmpio, or lspv-u:

```

root@HC-AIX-87:/# lsmpio -ql hdisk0
Device:  hdisk0
          Vendor Id:  PURE
          Product Id:  FlashArray
          Revision:   8888
          Capacity:   100G
          Volume Serial: 624A93707C06AA5E1FDD4044000111D3  (Page 83 NAA)
root@HC-AIX-87:/# lspv -u
hdisk0          none                      None
3A213624A93707C06AA5E1FDD4044000111D30AFlashArray04PUREfcp
hdisk1          none                      None
3A213624A93707C06AA5E1FDD4044000111D40AFlashArray04PUREfcp

```

Add the volume to a volume group we use all the default here it created the vg00 volume group:

```

root@HC-AIX-87:/# mkvg hdisk0 hdisk1
0516-1254 mkvg: Changing the PVID in the ODM.
0516-1254 mkvg: Changing the PVID in the ODM.
vg00

```

You will now see that the volume has been added to the group:

```

root@HC-AIX-87:/# lspv
hdisk0          00fac29c7ceb5927         vg00          active
hdisk1          00fac29c7ceb59ef         vg00          active
hdisk12         00fac29cff727352         rootvg         active

```

Activate the Volume Group and check the vg configuration with lsvg

```

root@HC-AIX-87:/# varyonvg vg00
root@HC-AIX-87:/# lsvg  vg00
VOLUME GROUP:      vg00                      VG IDENTIFIER: 00fac29c00004c0000000015e7ceb5a49
VG STATE:          active                    PP SIZE:       128 megabyte(s)
VG PERMISSION:     read/write                TOTAL PPs:     1598 (204544 megabytes)
MAX LVs:           256                      FREE PPs:      1598 (204544 megabytes)
LVs:               0                       USED PPs:      0 (0 megabytes)
OPEN LVs:          0                       QUORUM:        2 (Enabled)
TOTAL PVs:         2                       VG DESCRIPTORS: 3
STALE PVs:         0                       STALE PPs:     0
ACTIVE PVs:        2                       AUTO ON:       yes
MAX PPs per VG:    32512

```

MAX PPs per PV:	1016	MAX PVs:	32
LTG size (Dynamic):	1024 kilobyte(s)	AUTO SYNC:	no
HOT SPARE:	no	BB POLICY:	relocatable
PV RESTRICTION:	none	INFINITE RETRY:	no
DISK BLOCK SIZE:	512	CRITICAL VG:	no
FS SYNC OPTION:	no	CRITICAL PVs:	no

Create the logical volume part of this volume group – The default lv is created and named fslv00:

```
root@HC-AIX-87:/# mklv -t 'jfs2' vg00 150G
fslv00
```

Check the logical volume configuration with lslv

```
root@HC-AIX-87:/# lslv fslv00
LOGICAL VOLUME:      fslv00                VOLUME GROUP:      vg00
LV IDENTIFIER:      00fac29c00004c0000000015e7ceb5a49.1 PERMISSION:      read/write
VG STATE:           active/complete        LV STATE:           closed/syncd
TYPE:               jfs2                   WRITE VERIFY:       off
MAX LPs:            1200                   PP SIZE:            128 megabyte(s)
COPIES:             1                      SCHED POLICY:       parallel
LPs:                1200                   PPs:                1200
STALE PPs:          0                      BB POLICY:           relocatable
INTER-POLICY:       minimum                 RELOCATABLE:        yes
INTRA-POLICY:       middle                   UPPER BOUND:        32
MOUNT POINT:        N/A                     LABEL:              None
MIRROR WRITE CONSISTENCY: on/ACTIVE
EACH LP COPY ON A SEPARATE PV ?: yes
Serialize IO ?:     NO
INFINITE RETRY:     no                      PREFERRED READ: 0
```

Create mount point (/FA_TEST) and the new filesystem:

```
root@HC-AIX-87:/# mkdir /FA_TEST
root@HC-AIX-87:/# crfs -v jfs2 -d fslv00 -m /FA_TEST
File system created successfully.
157281396 kilobytes total disk space.
New File System size is 314572800
```

Mount the new logical volume (/FA_TEST) and check with “df -g”:

```
root@HC-AIX-87:/# mount /FA_TEST
root@HC-AIX-87:/# df -g
Filesystem      GB blocks      Free %Used      Iused %Iused Mounted on
/dev/hd4        20.00        19.82    1%      12567    1% /
[ . . . ]
/dev/fslv00     150.00       149.98    1%         4    1% /FA_TEST
```

At this point the Volume is mounted on the AIX system and ready to be used.

```
root@HC-AIX-87:/# touch /FA_TEST/test1
root@HC-AIX-87:/# ls /FA_TEST
lost+found test1
root@HC-AIX-87:/# ls -la /FA_TEST
total 8
drwxr-xr-x   3 root      system      256 Sep 13 15:52 .
drwxr-xr-x  22 root      system     4096 Sep 13 15:44 ..
drwxr-xr-x   2 root      system      256 Sep 13 15:45 lost+found
-rw-r--r--   1 root      system         0 Sep 13 15:52 test1
```



During the first iteration of the copy, the metadata for filesystem LV and VG must be “exported.” To do so the filesystem must be unmounted and the VG varied off. Then, import the VG and remount the filesystem: the metadata has been saved. Because it requires unmounting the filesystem, it is better to run this command as soon as the VG is created.

To **export** the metadata for the VG it is necessary to un-mount any filesystem, run a “varyoffvg” command and then export the VG. Then the VG can be reimported, “varyon” and mounted as filesystem:

```
root@HC-AIX-87:/# umount /FA_TEST
root@HC-AIX-87:/# varyoffvg vg00
root@HC-AIX-87:/# exportvg vg00
root@HC-AIX-87:/# lspv
hdisk0          00fac29c7ceb5927          None
hdisk1          00fac29c7ceb59ef          None
hdisk12         00fac29cff727352          rootvg          active
root@HC-AIX-87:/# importvg hdisk0
vg00
root@HC-AIX-87:/# mount /FA_TEST
root@HC-AIX-87:/# lspv
hdisk0          00fac29c7ceb5927          vg00          active
hdisk1          00fac29c7ceb59ef          vg00          active
hdisk12         00fac29cff727352          rootvg        active
root@HC-AIX-87:/# ls -la /FA_TEST
total 8
drwxr-xr-x   3 root      system      256 Sep 13 15:52 .
drwxr-xr-x  22 root      system     4096 Sep 13 15:44 ..
drwxr-xr-x   2 root      system      256 Sep 13 15:45 lost+found
-rw-r--r--   1 root      system         0 Sep 13 15:52 test1
```

Data Cloning on FlashArray with Source and Target Host

This process is the most commonly used one for a snapshot; it can be used to create a set of test data based on a production database, for example, or to create a pristine copy that can be used as a test database or backed up on a secondary server.

ON AIX SOURCE HOST OR LPAR

Check the “hdisk” from the VG that needs to be copied:

```
root@HC-AIX-87:/# lsvg -p vg00
vg00:
PV_NAME      PV STATE      TOTAL PPs   FREE PPs   FREE DISTRIBUTION
hdisk0       active        799         0          00..00..00..00..00
hdisk1       active        799         397        77..00..00..160..160
```

Note the serial number of the hdisk from “lspv -u” ex hdisk1 = **7C06AA5E1FDD4044000111D3**

```
root@HC-AIX-87:/# lspv -u
hdisk0 00fac29c7ceb5927 vg00 3A213624A937077C06AA5E1FDD4044000111D30AFlashArray04PUREfcp
hdisk1 00fac29c7ceb59ef vg00 3A213624A937077C06AA5E1FDD4044000111D40AFlashArray04PUREfcp
```



Optional: Freeze the write to the filesystem. The act of freezing a file system produces a nearly consistent on-disk image of the file system, and writes all dirty file system metadata and user data to the disk. In its frozen state, the file system is read-only, and anything that attempts to modify the file system or its contents must wait. Here the filesystem /FA_TEST is frozen for a maximum of 60 seconds and could be unfrozen at any time using the “chfs -a freeze=0” command.

```
root@HC-AIX-87:/# chfs -a freeze=60 /FA_TEST
```

ON FLASHARRAY

Compare the serial number with the one collected on AIX: **7C06AA5E1FDD4044000111D3** and **7C06AA5E1FDD4044000111D4**

```
pureuser@healthcare-m20r2-e09-30> purevol list
Name      Size  Source      Created      Serial
aix_lun_test1  100G -      2017-09-13 13:54:41 PDT 7C06AA5E1FDD4044000111D3
aix_lun_test2  100G -      2017-09-13 13:54:52 PDT 7C06AA5E1FDD4044000111D4
```

Optional : If it has not been done already, create a “protection group” with the volumes (here aix-test-pg). This is optional, but if the AIX VG contains more than one volume it is better to avoid any desynchronization of the snapshot and also it reduce the number of command to run.

```
pureuser@healthcare-m20r2-e09-30> purepgroup create --vollist  
aix_lun_test1,aix_lun_test2 aix-test-pg
```

Name	Source	Targets	Host Groups	Hosts	Volumes
aix-test-pg	healthcare-m20r2-e09-30	-	-	-	aix_lun_test1 aix_lun_test2

Create the snapshot on the protection group. It can be done at the volume level if no protection group has been created.

```
pureuser@healthcare-m20r2-e09-30> purepgroup snap aix-test-pg
```

Name	Source	Created
aix-test-pg.1	aix-test-pg	2017-09-14 10:24:32 PDT

If the Filesystem is frozen on AIX, it is time to thaw it with “chfs -a freeze=0”

Collect the name of the snapshot which have been created: here **aix-test-pg.1.aix_lun_test1** and **aix-test-pg.1.aix_lun_test2**

```
pureuser@healthcare-m20r2-e09-30> purevol list --snap
```

Name	Size	Source	Created	Serial
aix-test-pg.1.aix_lun_test1	100G	aix_lun_test1	2017-09-14 10:24:32 PDT	7C06AA5E1FDD4044000111D7
aix-test-pg.1.aix_lun_test2	100G	aix_lun_test2	2017-09-14 10:24:32 PDT	7C06AA5E1FDD4044000111D8

Copy the Snapshot to an actual volume; here we copy it to 2 volumes: **aix_target_test1** and **aix_target_test2** and we use the **--overwrite** option in case of the

```
pureuser@healthcare-m20r2-e09-30> purevol copy --overwrite aix-test-pg.1.aix_lun_test1 aix_target_test1
```

Name	Size	Source	Created	Serial
aix_target_test1	100G	aix_lun_test1	2017-09-14 10:24:32 PDT	7C06AA5E1FDD4044000111D9

```
pureuser@healthcare-m20r2-e09-30> purevol copy --overwrite aix-test-pg.1.aix_lun_test2 aix_target_test2
```

Name	Size	Source	Created	Serial
aix_target_test2	100G	aix_lun_test2	2017-09-14 10:24:32 PDT	7C06AA5E1FDD4044000111DA

Present the new volumes to the new host here **HC-AIX-88**

```
pureuser@healthcare-m20r2-e09-30> purevol connect --host hc-aix-88 aix_target_test1 aix_target_test2
```

Name	Host Group	Host	LUN
aix_target_test1	-	HC-AIX-88	5
aix_target_test2	-	HC-AIX-88	6

ON AIX TARGET HOST OR LPAR

Rescan the devices and check the new device and serial number: note the serial number of the hdisk from “lspv -u” ex hdisk15 = **7C06AA5E1FDD4044000111D9**

```
root@HC-AIX-88:/# cfmgr
root@HC-AIX-88:/# lspv -u
hdisk0 00fac29cff727352 rootvg 3A213624A9370B58F0E55BEF541D0000110BF0AFlashArray04PUREfcp
hdisk15 00fac29c7ceb5927 None 3A213624A937077C06AA5E1FDD4044000111D90AFlashArray04PUREfcp
hdisk16 00fac29c7ceb59ef None 3A213624A937077C06AA5E1FDD4044000111DA0AFlashArray04PUREfcp
```

Import the disk and rescan the devices now the VG should be vg00

```
root@HC-AIX-88:/# importvg hdisk15
vg00
root@HC-AIX-88:/# lspv
hdisk0          00fac29cff727352          rootvg          active
hdisk15         00fac29c7ceb5927          vg00             active
hdisk16         00fac29c7ceb59ef          vg00             active
```

Check that the LV is ready with “lsvg -l” and then mount the filesystem (for the first installation, check the mountpoint directory (/FA_TEST) and the “/etc/filesystem” for an automatic mount.)

```
root@HC-AIX-88:/# lsvg -l vg00
vg00:
LV NAME          TYPE      LPs      PPs      PVs  LV STATE      MOUNT POINT
fslv00           jfs2      1200     1200     2    closed/syncd  /FA_TEST
loglv00          jfs2log   1         1         1    closed/syncd  N/A
root@HC-AIX-88:/# mount /FA_TEST
root@HC-AIX-88:/# ls -la /FA_TEST
total 8
drwxr-xr-x   3 root    system      256 Sep 13 15:52 .
drwxr-xr-x  22 root    system     4096 Sep 14 11:45 ..
drwxr-xr-x   2 root    system      256 Sep 13 15:45 lost+found
-rw-r--r--   1 root    system         0 Sep 13 15:52 test1
```

Data Cloning on FlashArray with Single Host

This process is usually used to compare filesystem within the same host or to have a second instance of the same database on the same host for a fast restart (just replaying the log with a pristine database).

The target volumes are now connected to the source host .

```
pureuser@healthcare-m20r2-e09-30> purevol connect --host hc-aix-87 aix_target_test1 aix_target_test2
Name                Host Group  Host      LUN
aix_target_test1    -          HC-AIX-87  3
aix_target_test2    -          HC-AIX-87  4
```

ON AIX SOURCE HOST OR LPAR

Rescan the devices and check the new device and serial number: note the serial number of the hdisk from “lspv -u” ex hdisk2 = **7C06AA5E1FDD4044000111D9** is different from hdisk0 but it has the same PVID : **00fac29c7ceb5927** and Volume group **vg00**

```
root@HC-AIX-88:/# cfmgr
root@HC-AIX-87:/# lspv -u
hdisk0 00fac29c7ceb5927 vg00 active 3A213624A93707C06AA5E1FDD4044000111D30AFlashArray04PUREfcp
hdisk1 00fac29c7ceb59ef vg00 active 3A213624A93707C06AA5E1FDD4044000111D40AFlashArray04PUREfcp
hdisk2 00fac29c7ceb5927 vg00 active 3A213624A93707C06AA5E1FDD4044000111D90AFlashArray04PUREfcp
hdisk3 00fac29c7ceb59ef vg00 active 3A213624A93707C06AA5E1FDD4044000111DA0AFlashArray04PUREfcp
```

To fix the PVID (Physical Device ID) discrepancy we need to use the “chdev -a pv=clear” function to clear the value and create + import a new VG vgtarget

```
root@HC-AIX-87:/# chdev -l hdisk3 -a pv=clear
hdisk3 changed
root@HC-AIX-87:/# chdev -l hdisk2 -a pv=clear
hdisk2 changed
root@HC-AIX-87:/# lspv -u
hdisk0 00fac29c7ceb5927 vg00 active 3A213624A93707C06AA5E1FDD4044000111D30AFlashArray04PUREfcp
hdisk1 00fac29c7ceb59ef vg00 active 3A213624A93707C06AA5E1FDD4044000111D40AFlashArray04PUREfcp
hdisk2 none None 3A213624A93707C06AA5E1FDD4044000111D90AFlashArray04PUREfcp
hdisk3 none None 3A213624A93707C06AA5E1FDD4044000111DA0AFlashArray04PUREfcp

root@HC-AIX-87:/# recreatevg -y vgtarget hdisk2 hdisk3
vgtarget

root@HC-AIX-87:/# lspv -u
hdisk0 00fac29c7ceb5927 vg00 active 3A213624A93707C06AA5E1FDD4044000111D30AFlashArray04PUREfcp
hdisk1 00fac29c7ceb59ef vg00 active 3A213624A93707C06AA5E1FDD4044000111D40AFlashArray04PUREfcp
hdisk2 00fac29c821d7e1c vgtarget active 3A213624A93707C06AA5E1FDD4044000111D90AFlashArray04PUREfcp
hdisk3 00fac29c821d7ed9 vgtarget active 3A213624A93707C06AA5E1FDD4044000111DA0AFlashArray04PUREfcp
```

Now the VG “vgtarget” is up and running and have a mount point called “/fs/FA_TEST”

```
root@HC-AIX-87:/# lsvg -l vgtarget
vgtarget:
LV NAME          TYPE      LPs      PPs      PVs  LV STATE      MOUNT POINT
fsfslv00         jfs2      1200     1200     2    closed/syncd  /fs/FA_TEST
fsloglv00        jfs2log   1        1        1    closed/syncd  N/A
```

Check the content of the VG to validate that the LV is in place:

```
root@HC-AIX-87:/# lsvg -l vgtarget
vgtarget:
LV NAME          TYPE      LPs      PPs      PVs  LV STATE      MOUNT POINT
fsfslv00         jfs2      1200     1200     2    closed/syncd  /fs/FA_TEST
fsloglv00        jfs2log    1         1         1    closed/syncd  N/Aroot@HC-AIX-88:/# cfgmgr
```

We can now “mount” the copy of the filesystem and compare the data:

```
root@HC-AIX-87:/# mount /fs/FA_TEST
Replaying log for /dev/fsfslv00.

root@HC-AIX-87:/# ls -la /FA_TEST
total 8
drwxr-xr-x   3 root    system          256 Sep 13 15:52 .
drwxr-xr-x  23 root    system        4096 Sep 14 15:38 ..
drwxr-xr-x   2 root    system          256 Sep 13 15:45 lost+found
-rw-r--r--   1 root    system           0 Sep 13 15:52 test1

root@HC-AIX-87:/# ls -la /fs/FA_TEST
total 0
drwxr-xr-x   3 root    system          256 Sep 13 15:52 .
drw-rw----   3 root    system          256 Sep 14 15:38 ..
drwxr-xr-x   2 root    system          256 Sep 13 15:45 lost+found
-rw-r--r--   1 root    system           0 Sep 13 15:52 test1
```

Conclusions

This set of examples can be applied to numerous different functions: database cloning, test and validation, backup, creation of a pristine reference image, or even operating system imaging.

With a few more commands, we can use FlashArray to FlashArray Asynchronous replication to create a disaster recovery copy.

Of course, all those commands can be used in a script, the cli command of the FlashArray can be called thru an SSH session. This will be covered on a subsequent white paper “FlashArray Scripted Snapshot for IBM AIX Filesystem”.

About the Author



Jean-Luc Degrenand is Storage Architect for Healthcare at Pure Storage. His primary responsibility is overseeing, testing, designing, documenting, and demonstrating healthcare solutions integration with Pure Storage's technology. Jean-Luc has been with Pure Storage since 2015 and has been working in vendor enterprise storage/Healthcare integration roles since 2001.

Jean-Luc has over 25 years of experience with storage and servers vendors. During his Career with IBM, Amdhal, Sun Microsystems and Compaq, he worked in different role including development, test, integration and presale in France and since 1998 in the USA.

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