Using nsrndmp_save with the -T zfs option

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Abstract

This document describes setting up EMC NetWorker 8.1 with the SUNWndmp package for NDMP backups on Oracle Solaris 11. Recent extensions of the SUNWndmp package introduced a new type of backup in addition to the old *-T dump* in *-T tar* types. The new *-T zfs* is used in this paper for backup and restore of ZFS filesystems, using NDMP and EMC NetWorker 8.1. We show that the main difference is that the *dump* and *tar* types use backup paths (mount points) as saveset, and that the new *zfs* type uses the ZFS dataset name as saveset name. We also show how to do saveset recovery of these ZFS backups using nsrndmp_recover.

1 EMC NetWorker 8.1 backup server

As mentionned in the abstract, EMC NetWorker 8.1 server supports NDMP, the Network Data Management Protocol, already for a long time. It provides a way to make a backup of a system without having to install an EMC NetWorker 8.1 client on that system. With the new *-T zfs* argument of nsrndmp_save however, we will show how to do very fast volume ZFS dataset backups.

```
root@wapper:~# uname -a
SunOS wapper 5.11 11.1 i86pc i386 i86pc
```

On this Oracle Solaris 11 server, we will install both SUNWndmp and EMC NetWorker 8.1 server.

```
root@wapper:~# cat /etc/release
                           Oracle Solaris 11.1 X86
  Copyright (c) 1983, 2012, Oracle and/or its affiliates.  All rights reserved.
                        Assembled 19 September 2012
```

The EMC NetWorker 8.1 packages, manpages, client, server software, are installed as usual :

```
root@wapper:~# strings /usr/sbin/nsrd | grep '(#)'
@(#) Build info:   DBG=0,OPT=
@(#) Build arch.:  solarisx64
@(#) Build date:   Thu Jan 16 22:30:05 PST 2014
@(#) Build number: 238
@(#) Release:      8.1.0.5.Build.238
@(#) Product:      NetWorker
```

2 Installing the SUNWndmp client

Normally, the SUNWndmp machine is a different server, called the NDMP server, and the EMC NetWorker 8.1 server is then the NDMP client, but in our case, we will install the SUNWndmp packages on the same physical system *wapper*.

The SUNWndmp packages are installed as follows:

```
root@wapper:~# pkg install SUNWndmp
          Packages to install:  1
      Create boot environment: No
Create backup boot environment: No
          Services to change:  1

DOWNLOAD                                PKGS         FILES    XFER (MB)    SPEED
Completed                               1/1          28/28     0.3/0.3   176k/s

PHASE                                        ITEMS
Installing new actions                       61/61
Updating package state database              Done
Updating image state                         Done
Creating fast lookup database                Done
```

There are two packages : the NDMP root components and the NDMP user components.

The version of these components is important as only the newer implementation supports the *zfs* backup type:

```
root@wapper:~# pkginfo -l | grep ndmp
   PKGINST:  SUNWndmpr
   PKGINST:  SUNWndmpu
root@wapper:~# pkginfo SUNWndmpr
system      SUNWndmpr Network Data Management Protocol Service (Root)
root@wapper:~# pkginfo -l SUNWndmpu
   PKGINST:  SUNWndmpu
      NAME:  Network Data Management Protocol Service (User)
  CATEGORY:  system
      ARCH:  i386
   VERSION:  11.11,REV=2009.11.11
   BASEDIR:  /
    VENDOR:  Oracle Corporation
      DESC:  Network Data Management Protocol Service (user components)
  INSTDATE:  Feb 19 2014 12:09
   HOTLINE:  Please contact your local service provider
    STATUS:  completely installed
```

There exists older versions of these packages. It is said that the software release 2010.Q3 introduced the *zfs* type support.

3 Configuring the SUNWndmp client

Once the SUNWndmp packages are installed, we have to enable the NDMP service.

```
root@wapper:~# svcadm enable ndmpd
```

After enabling the service, we can check that the daemon runs :

```
root@wapper:~# ps -ef | grep ndmpd
    root  2776    1   0 12:15:32 ?          0:00 /usr/lib/ndmp/ndmpd
    root  2778  2697   0 12:15:41 pts/1      0:00 grep ndmpd
```

This process listens (usually) on TCP port 10000 :

```
root@wapper:~# netstat -an | grep 10000
      *.10000              *.*              0      0 128000      0 LISTEN
```

There are some utilities included, such as *ndmpadm* and *ndmpstat*. For example, with *ndmpadm* we can see that the logfile is in */var/ndmp* :

```
root@wapper:~# ndmpadm get
debug-path=/var/ndmp
dump-pathnode=no
tar-pathnode=no
ignore-ctime=no
zfs-token-support=no
token-maxseq=9
version=4
dar-support=no
tcp-port=10000
backup-quarantine=no
restore-quarantine=no
overwrite-quarantine=no
zfs-force-override=off
drive-type=sysv
type-override=off
cpu-binding=no
fs-export=
```

The man page of ndmp(4) explains some of these properties (such as NDMP version 4 support).

In order to use EMC NetWorker 8.1 with SUNWndmp, we have to set a password. The username (ndmp) and password (ndmp) is set as follows :

```
root@wapper:~# ndmpadm enable -a cram-md5 -u ndmp
Enter new password: ndmp
Re-enter  password: ndmp
```

In this paper we will do DSA NDMP backups, so we do not configure a NDMP device.

4 Configuring the EMC NetWorker 8.1 server and simple file type disk device

The idea here is to simply label and mount a simple Default pool volume, so that we can do backups in EMC NetWorker 8.1. The DSA backup technology allows us to multiplex NDMP and non-NDMP backups to the same device, since version 7.2.

Make a ZFS dataset that is the target for our backups:

```
root@wapper:~# zfs create -o mountpoint=/b2d rpool/b2d
```

Define the device in EMC NetWorker 8.1 :

```
root@wapper:~# nsradmin
NetWorker administration program.
Use the "help" command for help, "visual" for full-screen mode.
nsradmin> create type: NSR device; name: /b2d; media type: file
                        type: NSR device;
                        name: /b2d;
                  media type: file;
Create? y
created resource id 32.0.178.5.38.0.0.0.163.143.4.83.10.117.7.179(1)
nsradmin> q
```

Then label the device in the *Default* pool and mount it :

```
root@wapper:~# nsrmm -l -b Default -f /b2d DISK
root@wapper:~# nsrmm -m -f /b2d
file disk DISK mounted on /b2d, write enabled
```

We are ready now to do regular and NDMP backups. The EMC NetWorker 8.1 daemons currently running are:

```
root@wapper:~# ps -ef | grep nsr
    root  1703  1551   0 12:04:06 ?          0:00 /usr/sbin/nsrindexd
    root  1551     1   0 12:04:03 ?          0:01 /usr/sbin/nsrd
    root  1405     1   0 12:04:02 ?          0:01 /usr/sbin/nsrexecd
    root  1632  1551   0 12:04:04 ?          0:00 /usr/sbin/nsrmmdbd
    root  2680  1405   0 12:04:49 ?          0:01 /usr/sbin/nsrsnmd -s wapper -M 655 -n 47
    root  1831  1405   0 12:04:11 ?          0:00 /usr/sbin/nsrlogd
    root  1777  1551   0 12:04:08 ?          0:01 /usr/sbin/nsrjobd
    root  2820  2680   0 12:29:02 ?          0:00 /usr/sbin/nsrmmd -b 2 -N 470957057 -n 2
    root  3076  2697   0 12:35:49 pts/1      0:00 grep nsr
```

5 NDMP client resource

In order to perform a backup now, we have to setup an NDMP client resource.

As a test, the filesystem that we are going to backup here, is the following:

4

```
root@wapper:~# zfs list rpool/STUDIO
NAME            USED   AVAIL   REFER   MOUNTPOINT
rpool/STUDIO   1.53G   88.5G   1.53G   /opt/solarisstudio12.3
```

Note the difference here between the backup path (mount point) and the ZFS dataset name (the volume). The dataset name is *rpool/STUDIO*.

This filesystem contains about 14926 files, it is a specific ZFS filesystem that we made for installation of our Sun Studio C and C++ compiler application :

```
root@wapper:# df -h /opt/solarisstudio12.3/
Filesystem            Size   Used   Available  Capacity  Mounted on
rpool/STUDIO          116G   1.5G         89G       2%    /opt/solarisstudio12.3
root@wapper:~# find /opt/solarisstudio12.3/ | wc -l
   14926
```

The difference between ZFS dataset name and mountpoint is important, as we will see that unlike the case of the *dump* and *tar* backup types, the *zfs* backup types uses the dataset name as the saveset name.

The backup command in EMC NetWorker 8.1 for our client is:

```
                  backup command: nsrndmp_save -M -T zfs -c wapper;
```

In the case of a regular NDMP (non DSA) backup, leave out the -M option.

The saveset name is the dataset name with a slash in front of it:

```
                     type: NSR client;
                     name: wapper;
                   server: wapper;
                  comment: NDMP;
                    group: NDMP, NDMPprobe;
                 save set: /rpool/STUDIO;
              remote user: ndmp;
                 password: *******;
           backup command: nsrndmp_save -M -T zfs -c wapper;
  application information: ;
                     ndmp: Yes;
          NDMP array name: wapper;
        NetWorker version: 8.1.0.5.Build.238;
```

6   Performing a SUNWndmp probe

With the above settings, we can *probe* the SUNWndmp daemon and discover what we can backup.

We used the saveset name *All* for the probe in a group NDMPprobe :

5

```
root@wapper:~# savegrp -pvI -l full NDMPprobe
90528:savegrp: wapper:All                                    level=full
7236:savegrp: Group will not limit job parallelism
83643:savegrp: wapper:All                                                started
savefs -s wapper -c wapper -g NDMP -p -l full -R -m -v
90491:savegrp: wapper:All succeeded.
83647:savegrp: NDMP wapper:All See the file /nsr/logs/sg/NDMP/32002 for command output
7076:savegrp: --- Probe Summary ---
wapper:/opt/solarisstudio12.3      level=full, vers=ssbrowse, p=12
wapper:/opt/solarisstudio12.3 level=full, pool=Default, save as of February 19, 2014 02:21:
84495:savegrp: Starting nsrim automatically.
nsrim -MXq
84656:savegrp: nsrim job started.
```

In the logfile under /nsr/logs/sg we will find the following:

```
90093:savefs: ******** FILE SYSTEM INFO[10] *********
7213:savefs: fstype = zfs ; logical device = /opt/solarisstudio12.3 ; physical d
evice =
7215:savefs: total-size 88.50 GB
7217:savefs: used-size 1.530 GB
7219:savefs: Avail size 86.97 GB
7221:savefs: Total Indoes 182420010
7223:savefs: Used Indoes 14932
7224:savefs: LOCAL y
7224:savefs: TYPE zfs
7224:savefs: AVAILABLE_BACKUP tar,dump
7224:savefs: AVAILABLE_RECOVERY tar,dump
7225:savefs: Status of the file system =
7226:savefs: **************************
```

The TYPE is set to *zfs* so despite the available backup and recovery types, EMC NetWorker 8.1 passed the *zfs* type
to NDMP.

The indication in AVAILABLE_BACKUP that it supports tar and dump looks confusing to us, as we would expect
it to advertise that it supports tar, dump and *zfs*. In any case the TYPE zfs is used.

7   Performing the actual backup

The actual backup (as opposed to the probe) is running as follows:

6

```
root@wapper:~# savegrp -vI -l full NDMP
90528:savegrp: wapper:/rpool/STUDIO                        level=full
7236:savegrp: Group will not limit job parallelism
83643:savegrp: wapper:savefs                                              started
savefs -s wapper -c wapper -g NDMP -p -l full -R -m -v -F /rpool/STUDIO
wapper:/rpool/STUDIO                 level=full, vers=pools, p=12
90491:savegrp: wapper:savefs succeeded.
83647:savegrp: NDMP wapper:savefs See the file /nsr/logs/sg/NDMP/32035 for command output
83643:savegrp: wapper:/rpool/STUDIO                                       started
nsrndmp_save -M -T zfs -c wapper -s wapper -g NDMP -LL -l full -W 78 -N /rpool/STUDIO /rpoo
3:savegrp: Group NDMP waiting for 1 jobs (0 awaiting restart) to complete.

90491:savegrp: wapper:/rpool/STUDIO succeeded.
83647:savegrp: NDMP wapper:/rpool/STUDIO See the file /nsr/logs/sg/NDMP/32036 for command o
83643:savegrp: wapper:bootstrap                                           started
save -s wapper -S -g NDMP -LL -f - -m wapper -V -l full -W 78 -N bootstrap -x /nsr/res /nsr
90491:savegrp: wapper:bootstrap succeeded.
83647:savegrp: NDMP wapper:bootstrap See the file /nsr/logs/sg/NDMP/32038 for command outpu
mminfo -s wapper -B
/usr/bin/mailx -s "wapper's Bootstrap Information" root
7241:savegrp: nsrim run recently, skipping
```

The key thing here is the rpool/STUDIO backup using nsrndmp_save -T zfs.

Before the backup we checked that there was no snapshot for rpool/STUDIO.

```
root@wapper:~# zfs list -t snapshot
NAME                                      USED  AVAIL  REFER  MOUNTPOINT
rpool/ROOT/solaris@install                7.23M     -  1.92G  -
rpool/ROOT/solaris@2013-12-23-08:25:21    77.0M     -  2.00G  -
rpool/ROOT/solaris/var@install            19.1M     -  96.7M  -
rpool/ROOT/solaris/var@2013-12-23-08:25:21  621M    -   759M  -
```

Also before the backup there were no sessions:

```
root@wapper:/# ndmpadm show-sessions
No active session.
```

During the actual and succesful backup we noticed :

```
root@wapper:/# ndmpadm show-sessions
Session Id: 5
Protocol version: 4
Authenticated: Yes
EOF: No
Client address: 127.0.0.1:41283
scsi.open: No
scsi.adapter: ""
scsi.valid target: No
tape.device: Not open
mover.state: Idle
mover.mode: Read
mover.pause reason: N/A
mover.halt reason: N/A
mover.record size: 64512
mover.record number: 0
mover.pos: 0
mover.win len: -1
mover.win off: 0
data.operation: Backup
data.state: Active
data.halt reason: N/A
data.data socket: 12
data.data type: Local
data.aborted: No
data.read offset: 0
data.read length: 0
data.total size: 0
data.bytes processed: 96768000
data.env[0]: HOST: "wapper"
data.env[1]: NDMP_BUTYPE: "zfs"
data.env[2]: TYPE: "zfs"
data.env[3]: HIST: "n"
data.env[4]: LEVEL: "0"
data.env[5]: NDMP_TAPE_BLOCK_SIZE: "61440"
data.env[6]: PREFIX: "/rpool/STUDIO"
data.env[7]: FILESYSTEM: "/rpool/STUDIO"
data.env[8]: TYPE_OVERRIDE: "off"

1 active sessions.
```

Also in the GUI of EMC NetWorker 8.1 itself the activity can be monitored during the backup :

```
root@wapper:/# nsrwatch

    Server: wapper, NetWorker 8.1.0.5.Build.238 Eval
  Up since: Wed Feb 19 13:55:38 2014
     Response time: 0.002 seconds
            Saves: 4 session(s), 1620 MB total
  Recovers: 0 session(s)

DEVICES     TYPE  VOLUME  POOL     STATUS
/b2d    file  DISK  Default  writing, 1629 MB


  GROUPS    STATUS     START TIME
NDMP   running    Wed Feb 19 15:16:22 2014

  SESSIONS
 wapper:/rpool/STUDIO saving to pool 'Default' (DISK) 1536 MB

  MESSAGES
  Wed 03:16:29 PM NDMP Save Notice: wapper:/rpool/STUDIO NDMP save running on 'wa
  Wed 03:16:39 PM Savegroup Info: Group NDMP waiting for 1 jobs (0 awaiting resta
```

The NDMP backup is flagged as a crNs backup in the media database. The s flag is for DSA.

Also note that the r flag means that this is a recoverable, but not a *browsable* backup. It is a backup of the entire
ZFS volume, but no individual file recovery is possible.

```
root@wapper:~# mminfo -av
 volume        type   client        date      time       size ssid       fl   lvl name
DISK          file   wapper        02/19/14 03:17:14 PM  102 KB 4194614506 cr full bootst
DISK          file   wapper        02/19/14 03:16:28 PM 1620 MB 4211391677 crNs full /rpo
```

During the backup a snapshot was made that seems to persists after completion of the backup.

However, in our experience, a new (second) backup, creates a new snapshot and removes the previous snapshot.

```
root@wapper:~# zfs list -t snapshot
NAME                                      USED  AVAIL  REFER  MOUNTPOINT
rpool/ROOT/solaris@install                7.23M     -  1.92G  -
rpool/ROOT/solaris@2013-12-23-08:25:21    77.0M     -  2.00G  -
rpool/ROOT/solaris/var@install            19.1M     -  96.7M  -
rpool/ROOT/solaris/var@2013-12-23-08:25:21  621M    -   759M  -
rpool/STUDIO@.ndmp.0.level.r.1392819389    2.87M     -  1.53G  -
```

8 Performing a saveset restore

After two full backups, we will try to restore the entire ZFS dataset. In our test setup, we start by deleting the
original data :

```
root@wapper:~# zfs destroy -r rpool/STUDIO
```

Also, the mountpoint can be deleted using the rmdir command :

```
root@wapper:~# rmdir /opt/solarisstudio12.3/
```

Next, we launch the saveset restore. We will see that it creates the ZFS dataset again.

```
root@wapper:~# nsrndmp_recover -c wapper -S 4211391677 -v off /rpool/STUDIO
42571:nsrndmp_recover: Failed to connect to port 10000 at host 'wapper' :No such file or di
42795:nsrndmp_recover: Performing recover from Non-NDMP type of device
42571:nsrndmp_recover: Failed to connect to port 10000 at host 'wapper' :Connection refused
85183:nsrndmp_recover: DSA is listening for an NDMP data connection on: 127.0.0.1, port = 9
42690:nsrndmp_recover: Performing non-DAR Recovery..
86724:nsrdsa_recover: DSA listening at: host 'localhost', IP address '127.0.0.1', port '921
42937:nsrdsa_recover: Performing Immediate recover
42940:nsrdsa_recover: Reading Data...
42942:nsrdsa_recover: Reading data...DONE.
42927:nsrndmp_recover: Successfully done
```

The logfile of the ndmpd daemon shows the following :

```
2014-02-19T15:26:59+0100 [8] -------- restore initiated --------
2014-02-19T15:26:59+0100 [8] env(HIST): "n"
2014-02-19T15:26:59+0100 [8] env(HOST): "wapper"
2014-02-19T15:26:59+0100 [8] env(LEVEL): "0"
2014-02-19T15:26:59+0100 [8] env(NDMP_BUTYPE): "zfs"
2014-02-19T15:26:59+0100 [8] env(ss clone retention): "          1392819389:          13928
2014-02-19T15:26:59+0100 [8] env(TYPE): "zfs"
2014-02-19T15:26:59+0100 [8] env(TYPE_OVERRIDE): "off"
2014-02-19T15:26:59+0100 [8] env(ZFS_BACKUP_SIZE): "1658902724"
2014-02-19T15:26:59+0100 [8] env(roup): "NDMP"
2014-02-19T15:26:59+0100 [8] env(FILESYSTEM): "/rpool/STUDIO"
2014-02-19T15:26:59+0100 [8] env(PREFIX): "/rpool/STUDIO"
2014-02-19T15:26:59+0100 [8] env(RTRV_HOST): "wapper"
2014-02-19T15:26:59+0100 [8] Local operation: 64512
2014-02-19T15:26:59+0100 [8] ZFS_BACKUP_SIZE: 1658902724
2014-02-19T15:26:59+0100 [8] env(LEVEL): "0"
2014-02-19T15:26:59+0100 [8] env(ZFS_MODE) not specified, defaulting to recursive
2014-02-19T15:26:59+0100 [8] env(ZFS_FORCE): not specified, defaulting to 'no'
2014-02-19T15:26:59+0100 [8] env(UPDATE) not specified, defaulting to TRUE
2014-02-19T15:26:59+0100 [8] env(DMP_NAME) not specified, defaulting to 'level'
2014-02-19T15:26:59+0100 [8] restore path: rpool/STUDIO
2014-02-19T15:26:59+0100 [8] TYPE: zfs
2014-02-19T15:26:59+0100 [8] tape header: NDMPUTF8MAGIC; 0 0; 64512
2014-02-19T15:26:59+0100 [8] nz_zfs_force: 0
2014-02-19T15:27:27+0100 [8] Restoring to "rpool/STUDIO" finished
2014-02-19T15:27:27+0100 [8] waiting for session nref: 1
2014-02-19T15:27:28+0100 [8] BYTES_TOTAL: 1658902724
```

In our test, we still had to mount the ZFS dataset after the restore:

```
root@wapper:~# zfs mount rpool/STUDIO
```

A simple check of the restored data:

```
root@wapper:~# find /opt/solarisstudio12.3/ | wc -l
   14926
root@wapper:~# ls -ld /opt/solarisstudio12.3/
drwxr-xr-x  12 root     sys             12 Feb 19 12:42 /opt/solarisstudio12.3/
```

9   Redirected saveset restore

Another restore is to restore the dataset to a different ZFS dataset.

```
root@wapper:~# nsrndmp_recover -c wapper -m /rpool/MYCOPY -S 4211391677 -v off /rpool/STUDI
42571:nsrndmp_recover: Failed to connect to port 10000 at host 'wapper' :No such file or di
42795:nsrndmp_recover: Performing recover from Non-NDMP type of device
42571:nsrndmp_recover: Failed to connect to port 10000 at host 'wapper' :Connection refused
85183:nsrndmp_recover: DSA is listening for an NDMP data connection on: 127.0.0.1, port = 8
42690:nsrndmp_recover: Performing non-DAR Recovery..
86724:nsrdsa_recover: DSA listening at: host 'localhost', IP address '127.0.0.1', port '843
42937:nsrdsa_recover: Performing Immediate recover
42940:nsrdsa_recover: Reading Data...
42942:nsrdsa_recover: Reading data...DONE.
42927:nsrndmp_recover: Successfully done
```

For the redirected saveset recover, the ndmpd logfile shows:

```
2014-02-19T15:38:18+0100 [2] -------- restore initiated --------
2014-02-19T15:38:18+0100 [2] env(HIST): "n"
2014-02-19T15:38:18+0100 [2] env(HOST): "wapper"
2014-02-19T15:38:18+0100 [2] env(LEVEL): "0"
2014-02-19T15:38:18+0100 [2] env(NDMP_BUTYPE): "zfs"
2014-02-19T15:38:18+0100 [2] env(ss clone retention): "          1392819389:          13928
2014-02-19T15:38:18+0100 [2] env(TYPE): "zfs"
2014-02-19T15:38:18+0100 [2] env(TYPE_OVERRIDE): "off"
2014-02-19T15:38:18+0100 [2] env(ZFS_BACKUP_SIZE): "1658902724"
2014-02-19T15:38:18+0100 [2] env(roup): "NDMP"
2014-02-19T15:38:18+0100 [2] env(FILESYSTEM): "/rpool/STUDIO"
2014-02-19T15:38:18+0100 [2] env(PREFIX): "/rpool/STUDIO"
2014-02-19T15:38:18+0100 [2] env(RTRV_HOST): "wapper"
2014-02-19T15:38:18+0100 [2] Local operation: 64512
2014-02-19T15:38:18+0100 [2] ZFS_BACKUP_SIZE: 1658902724
2014-02-19T15:38:18+0100 [2] env(LEVEL): "0"
2014-02-19T15:38:18+0100 [2] env(ZFS_MODE) not specified, defaulting to recursive
2014-02-19T15:38:18+0100 [2] env(ZFS_FORCE): not specified, defaulting to 'no'
2014-02-19T15:38:18+0100 [2] env(UPDATE) not specified, defaulting to TRUE
2014-02-19T15:38:18+0100 [2] env(DMP_NAME) not specified, defaulting to 'level'
2014-02-19T15:38:18+0100 [2] restore path: rpool/MYCOPY
2014-02-19T15:38:18+0100 [2] TYPE: zfs
2014-02-19T15:38:18+0100 [2] tape header: NDMPUTF8MAGIC; 0 0; 64512
2014-02-19T15:38:18+0100 [2] nz_zfs_force: 0
2014-02-19T15:38:44+0100 [2] Restoring to "rpool/MYCOPY" finished
2014-02-19T15:38:44+0100 [2] waiting for session nref: 1
2014-02-19T15:38:45+0100 [2] BYTES_TOTAL: 1658902724
```

So in this case, after the restore, we have a new ZFS dataset, that we can explicitly mount again (but on a different mountpoint).

```
root@wapper:~# zfs list | grep studio
rpool/MYCOPY                    1.53G  83.9G  1.53G  /opt/solarisstudio12.3
rpool/STUDIO                    1.53G  83.9G  1.53G  /opt/solarisstudio12.3
```

Again, if we list (with zfs mount) the mounted ZFS datasets, we see that the newly recovered dataset is not mounted :

```
root@wapper:~# zfs mount | grep studio
rpool/STUDIO                    /opt/solarisstudio12.3
```

We cannot mount it on the original data:

```
root@wapper:~# zfs mount rpool/MYCOPY
cannot mount 'rpool/MYCOPY' on '/opt/solarisstudio12.3': directory is not empty
```

But we can mount the recovered data on a different mountpoint :

```
root@wapper:~# zfs set mountpoint=/opt/mycopy rpool/MYCOPY
root@wapper:~# zfs mount rpool/MYCOPY
```

So in this case, after the redirected saveset restore, we have a second copy (through a SUNWndmp restore) of the original data.

```
root@wapper:~# zfs mount  | grep opt
rpool/STUDIO                     /opt/solarisstudio12.3
rpool/MYCOPY                     /opt/mycopy
```

To clean up, we end by removing the second copy.

```
root@wapper:~# zfs destroy -r rpool/MYCOPY
root@wapper:~# rmdir /opt/mycopy/
```

10   File History and Browsable Restores

In the case of the *dump* and *tar* backups (with NDMP), we can configure EMC NetWorker 8.1 to generate index entries and perform browsable restores.

If we attempt to do this with the new *zfs* type of NDMP backups :

```
            backup command: nsrndmp_save -M -T zfs -c wapper;
    application information: UPDATE=y;
```

The empty *application information* field is replaced here by the UPDATE entry, which normally instructs the NDMP backup to keep track of the index entries in the index database.

But in our test, we get the following error when doing the backup:

```
42903:nsrndmp_save: The Data Server does not support the File History generation
42904:nsrndmp_save: Disabling the File History
83564:nsrndmp_save: Performing full backup
42794:nsrndmp_save: Performing backup to Non-NDMP type of device
```

In the /var/ndmp/ndmplog.0 logfile, no error is logged for this, except for:

```
2014-02-20T10:24:43+0100 [1] Connection closed remotely
```

11   Conclusion

A straightforward way to backup ZFS filesystems is to do a NetWorker backup, via the EMC NetWorker 8.1 client.

But significant speed improvements can be achieved for some filesystems with many small files, by using a SUN-Wndmp backup of the ZFS filesystem, by doing a *dataset* backup.

Also because NDMP uses port 10000, the NDMP backup is easy to firewall, unlike the straightforward NetWorker backup (which uses RPC, which is harder to configure at the firewall compared to firewalls that block and open TCP ports).

The dataset backup uses a saveset name the ZFS dataset name, and not the mountpoint (or backup path). We tested both backup and restore using this new ZFS type of NDMP backup, and this provides an alternative to the traditional -T dump and -T tar NDMP backups.

The *zfs* backup provides complete *zfs* dataset backup and recovery, but no individual file recovery (no browsable restores); for this, the *dump* and *tar* NDMP backups remain valuable.