



# NetApp HFC (Incremental Accelerator)

**Bacula Systems Documentation**

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# 1 Overview

This user's guide presents various techniques and strategies to backup NetApp NAS having a huge number of files with Bacula Enterprise.

## 2 Scope

This paper will present solutions for **Bacula Enterprise** 6.0.6 and later, which are not applicable to prior versions.

## 3 Presentation

The plugin Incremental Accelerator for NetApp is designed to simplify and the optimize backup and restore performance of your NetApp NAS hosting a huge number of files.

When using the plugin, for Incremental backup Bacula Enterprise will query the NetApp for a previous backup snapshot then quickly determine a list of all files modified since the last backup instead of having to walk through the entire filesystem. Once Bacula has the backup list, it will use a standard network share (such as NFS or CIFS) to access files.

In order to compute the file list modified since the last backup, Bacula must store a few Snapshots on the NetApp device. The Incremental Accelerator Plugin will manage the snapshot list to minimize resource usage.

This plugin is available for Red Hat Enterprise Linux 5 and 6 (32 / 64 bit) and SUSE Linux Enterprise Server 11 and 12 (64 bit) and supports NetApp 7-mode 7.3.6, 8.0, 8.1, 8.2 and 8.3, as well as all versions in c-mode.

Most recent product tests have been performed with SUSE Linux Enterprise Server 12 SP3 and NetApp Release 9.1.

## 4 Using The Incremental Accelerator for NetApp

## 5 Installation

The Incremental Accelerator for NetApp Plugin is available as a Bacula Enterprise package for all supported platforms. The package is composed of:

- /opt/bacula/plugins/netapp-hfc-fd.so Bacula Enterprise File Daemon plugin
- /opt/bacula/bin/snapmgr Bacula Enterprise NetApp Snapshot Manager

You must install this plugin on a Client machine that has network access to the NetApp filer. Bacula Systems advises you to use the Client that resides on your Storage Daemon so that the File daemon to Storage daemon data transfers are made internally rather than across the network.

Download the NetApp SDK installation files from the NetApp Support site for All Platforms: <http://mysupport.netapp.com/NOW/cgi-bin/software/?product=NetApp+Manageability+SDK&platform=All+Platforms>. Note: A form is required to download the software. Please complete and state that you want to use the SDK for Data ONTAP with Perl, and in the solution field enter "NetApp SDK"

```
% unzip netapp-manageability-sdk-5.4.zip netapp-manageability-sdk-5.4/lib/perl/NetApp/*
Archive: netapp-manageability-sdk-5.4.zip
creating: netapp-manageability-sdk-5.4/lib/perl/NetApp/
inflating: netapp-manageability-sdk-5.4/lib/perl/NetApp/DfmErrno.pm
inflating: netapp-manageability-sdk-5.4/lib/perl/NetApp/NaElement.pm
```

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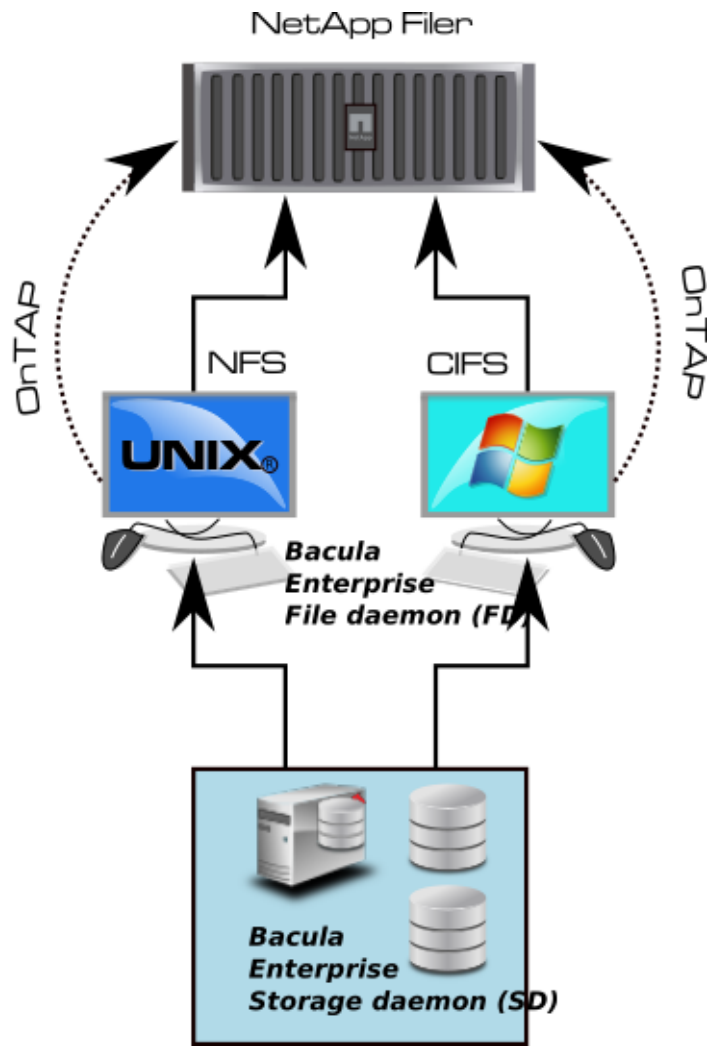


Fig. 1: NetApp Incremental Accelerator Feature

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```
inflating: netapp-manageability-sdk-5.4/lib/perl/NetApp/NaErrno.pm
inflating: netapp-manageability-sdk-5.4/lib/perl/NetApp/NaServer.pm
inflating: netapp-manageability-sdk-5.4/lib/perl/NetApp/ONTAPILogParser.pm
inflating: netapp-manageability-sdk-5.4/lib/perl/NetApp/ONTAPITestContainer.pm
inflating: netapp-manageability-sdk-5.4/lib/perl/NetApp/SdkEnv.pm
inflating: netapp-manageability-sdk-5.4/lib/perl/NetApp/Test.pm
inflating: netapp-manageability-sdk-5.4/lib/perl/NetApp/OCUMAPI.pm
inflating: netapp-manageability-sdk-5.4/lib/perl/NetApp/OCUMClassicAPI.pm
inflating: netapp-manageability-sdk-5.4/lib/perl/NetApp/Ontap7ModeAPI.pm
inflating: netapp-manageability-sdk-5.4/lib/perl/NetApp/OntapClusterAPI.pm

% mv netapp-manageability-sdk-5.4/lib/perl/NetApp /opt/bacula/bin/
```

In order to save Windows extended file attributes such as NTFS ACLs, you will need to install the Incremental Accelerator for NetApp Plugin on a Windows server, this functionality will be available in a future version.

## 6 Configuration

As with all Bacula plugins, you must to specify the `Plugin Directory` directive in the `FileDaemon` resource of the `bacula-fd.conf` file.

```
FileDaemon {
    Name = test-fd
    ...
    Plugin Directory = /opt/bacula/plugins
}
```

Your Backup Job should be defined as:

```
Job {
    Name = "NetApp-HFC"
    Client = storage-fd
    FileSet = FS_netapp
    ...
}

FileSet {
    Name = FS_netapp
    Include {
        Options {
            Signature = MD5
        }
        Plugin = "netapp-hfc: host=nas1 password=pw exclude=vol0"
    }
}

FileSet {
    Name = FS_netapp_cmode
    Include {
        Options {
            Signature = MD5
        }
    }
}
```

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```
}
  Plugin = "netapp-hfc: host=nas1 password=pw exclude=vol0 vserver=vserver1 https"
}
```

In this example, all NetApp volumes have to be mounted in the /nas1 directory (the mount\_base plugin option permits to configure the base mount point). The second FileSet FS\_netapp\_cmode is valid for a “Cluster Mode”.

```
% ls /nas1
vol1  vol2  vol3  vol4
```

The Incremental Accelerator for NetApp plugin accepts the parameters listed in table ‘Incremental Accelerator Plugin Options’.

Table 1: Incremental Accelerator Plugin Options

Option	Re-quired*	Default	Info	Example
host	Yes		NAS Hostname	host=19 2.168.0.1
user	Yes	root	Username	user=root
password	Yes		Password	password=password
volume	No		Volume to backup	volume=vol0
include	No	*	Volumes to backup	include=vol1*
exclude	No		Volumes to exclude from backup	exclude=vol0
mount_base	No	/host	Where to find the volume mounted using NFS / CIFS	mount_base=/mnt
key	No	Job Name	Advanced snapshot pruning control	key=MyKey
snap_dir	No	.snapshot	Name of the directory where snapshots are visible	snap_dir=.snap
vserver	No		Vserver name. This option is required for C-Mode support	vserver=vserver1
https	No	No	Use HTTPS with NetApp	https

**Note:** Because the NetApp Incremental Accelerator Plugin uses a dynamic strip FileSet option, the FileSet Include section should include **ONLY** the NetApp plugin; mixing other plugins or normal files with the HFC Plugin is not supported.

**Note** also that the NetApp filer needs to be configured to allow management access on the data access network interface, and a user with http access and the “vsadmin” role assigned should be used for this plugin. In c-mode, this may require creation of a user account on the SVM being backed up.

## 6.1 Snapshot Pruning

The NetApp SnapDiff API is based on Snapshots to generate the list of the changes. Once a snapshot is no longer required, the Bacula NetApp HFC Plugin will prune the snapshot.

The snapshot registry that is maintained by the plugin is stored in the Bacula working directory. The registry uses the Job name as a key to compute the snapshot chain. If you are doing multiple backups with the same Job or you have the same volume name in different context, we advise to set the extra key parameter in the Plugin command line to uniquely identify your jobs.

```
FileSet {
  Name = FS_netapp_cmode
  Include {
    Options {
      Signature = MD5
    }
    Plugin = "netapp-hfc: host=n1 password=pw volume=vol0 vserver=v1 key=prod https"
  }
}
```

## 6.2 External Password Storage

To avoid storing passwords in the Bacula Director configuration file, you can create a special configuration file located where the Plugin is installed and store the password in it.

```
% cat /opt/bacula/etc/snapmgr.conf
nas1:root = mypassword
netapp2:admin = myotherpassword
```

The first line will define the password for the root account on the “nas1” nas box. The Bacula NetApp HFC Plugin will use this entry with the following plugin command:

```
plugin = "netapp-hfc: host=nas1 user=root exclude=vol0"
```

You can have multiple lines in the `snapmgr.conf`.

## 6.3 NFS Configuration

The NetApp HFC Plugin will detect the list of all volumes from the NetApp device, then the Plugin will assume that each volume is mounted and available under `mount_base` directory. For example, if you have the following volumes defined on your NetApp device (Fig *NetApp Volume List*).

	Name	Status	Root	Containing Aggregate	FlexClone	Avail	Used	Total	Files	Max Files
<input type="checkbox"/>	<a href="#">vol0</a>	online,raid0	✓	<a href="#">aggr0</a>	-	82.9 MB	66%	242 MB	9.6 k	20 k
<input type="checkbox"/>	<a href="#">vol1</a>	online,raid4		<a href="#">aggr1</a>	-	7.99 GB	0%	8 GB	3.31 k	307 k
<input type="checkbox"/>	<a href="#">vol2</a>	online,raid4		<a href="#">aggr1</a>	-	7.5 GB	0%	7.5 GB	100	288 k
<input type="checkbox"/>	<a href="#">vol3</a>	online,raid4		<a href="#">aggr1</a>	-	39.9 MB	0%	40 MB	105	1.52 k

Fig. 2: NetApp Volume List

You will need to mount each of them under your `mount_base` directory. For example, in `/mnt`:

```
% ls -l /mnt
drwxr-xr-x 2 root root 4096 May 23 14:52 vol0
drwxr-xr-x 2 root root 4096 May 23 14:52 vol1
drwxr-xr-x 2 root root 4096 May 23 14:52 vol2
drwxr-xr-x 2 root root 4096 May 22 10:07 vol3
```

We advise you to create a directory with your NetApp host name and mount volumes under it. For example, instead of using `/mnt` as the previous example was showing, using `/netapp-box` will simplify restore operation and file identification during restore. (Fig *NetApp and Volume Structure*).

```
% ls -l /netapp-box
drwxr-xr-x 2 root root 4096 May 23 14:52 vol0
drwxr-xr-x 2 root root 4096 May 23 14:52 vol1
...
```

The following article will give you information about how to find optimal settings for NFS mounts <http://nfs.sourceforge.net/nfs-howto/ar01s05.html>

For example, you may want to mount NFS shares with the following options:

```
% mount -t nfs -o soft,intr nas1:/vol/vol3 /nas1/vol3
```

Snapshots should be visible in the `.snapshots` directory.

**Configure Snapshots** ?

Volumes → Snapshots → Configure

**Volume:** Select the volume for which snapshots will be configured. Only online volumes are displayed.  ?

**Snapshot Reserve:** Enter the size of volume's snapshot reserve, a percentage between 0 and 100.  % ?

**Snapshot Directory Visible:** Select to make the `.snapshot` directory visible.  Directory

Fig. 3: Configuration for Snapshot Directory



## 6.4 Snapshot Management

The Incremental Accelerator for NetApp Plugin uses Snapshots to determine which files changed since the last backup. The Plugin will keep a number of Snapshots on your NetApp filer. Depending on your strategy, the Plugin will keep 3 to 4 Snapshots per volume.

## 6.5 Volume Management

To list all volumes available on the NetApp system, the following command might be used:

```
# /opt/bacula/bin/snapmgr -V -f host -u user -p pass  
or  
# /opt/bacula/bin/snapmgr -V -f host -u user -p pass -e vserver1  
or  
# /opt/bacula/bin/snapmgr -s -V -f host.with.https -u user -p pass -e vserver1
```

Where, `host` is the NetApp hostname or address, `user` is the username used to connect the NetApp and `pass` is the required password.

With NetApp c-mode, the `vserver` option is required.

In version prior to 12.4.1, `snapmgr` error messages can be found in `working/snapmgr.err` or `/tmp/snapmgr.err`. Starting with 12.4.1, error messages are automatically included in the Bacula Job log.

## 7 Estimate Information

The information returned by the `estimate` command will give you the list of all files that have changed. However, be careful when using the `estimate` command with the level Full (default). It will result in a heavy load of your NetApp filer if it contains many files.

## 8 Accurate Mode

By default, the Incremental Accelerator for NetApp Plugin backup result will be similar to what a traditional backup traversing the whole filesystem would do. Some operations (such as deleting or moving) on a directory (see figure *Directory Structure When Restoring (Without Accurate Support)*) will lead to *non accurate* directory structure when restoring.

This issue can be solved using Bacula's Accurate feature in your Job definition. However, be aware that the Accurate feature will consume additional memory on your File Daemon machine and CPU cycles on your catalog database system, and when dealing with million of files, you need to properly configure your File Daemon hardware. Using Bacula Accurate mode is transparent for the NetApp system.

Bacula Enterprise allows you to turn Accurate mode on or off in the Job Schedule. Doing that, you are able to, for example, turn the Accurate mode on only for weekly differential jobs. This can provide a good compromise by having a completely accurate weekly backup without the additional overhead each day.

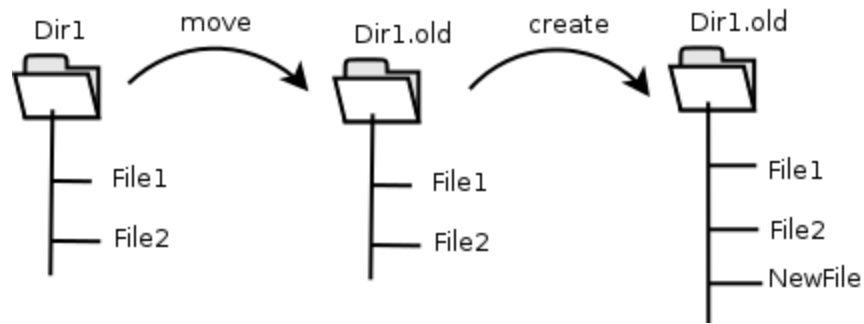


Fig. 4: Directory Structure When Restoring (Without Accurate Support)

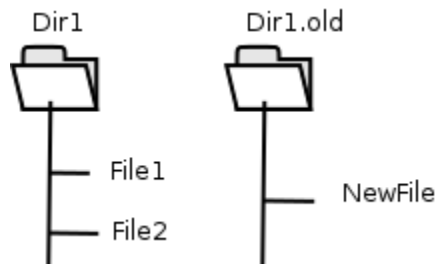


Fig. 5: Directory Structure When Restoring (Without Accurate Support)

## 9 Backup Information

During a backup, some essential information is stored in the `netapp-hfc.dat` file located in the working directory that is required for sequences of Jobs, so please take care not to remove the `netapp-hfc.dat` files.

## 10 Restore Scenarios

During restoration, files will be presented in a simple virtual filesystem structure.

```
/<netapp host name>/<volume>/<files and directories>/...
```

For example (Fig *NetApp and Volume Structure*), the file `/etc/passwd` in the volume `vol0` of the NetApp device `netapp-box` will be stored as:

```
/netapp-box/vol0/etc/passwd
```

## 11 Limitations

- NetApp Data ONTAP version 7.3.5 and lower did not properly support Unicode characters in filenames outside of 7-bit ASCII. All NetApp versions after 7.3.5 support the full range of Unicode characters.
- As noted above, if you want to backup all of Windows file attributes, you must mount the NetApp volume using the CIFS protocol, and use a Bacula Windows File daemon with the Incremental Accelerator plugin, which is not available at this time. Consequently restoring Windows files will restore only the file attributes that can be mapped into Unix file permissions.

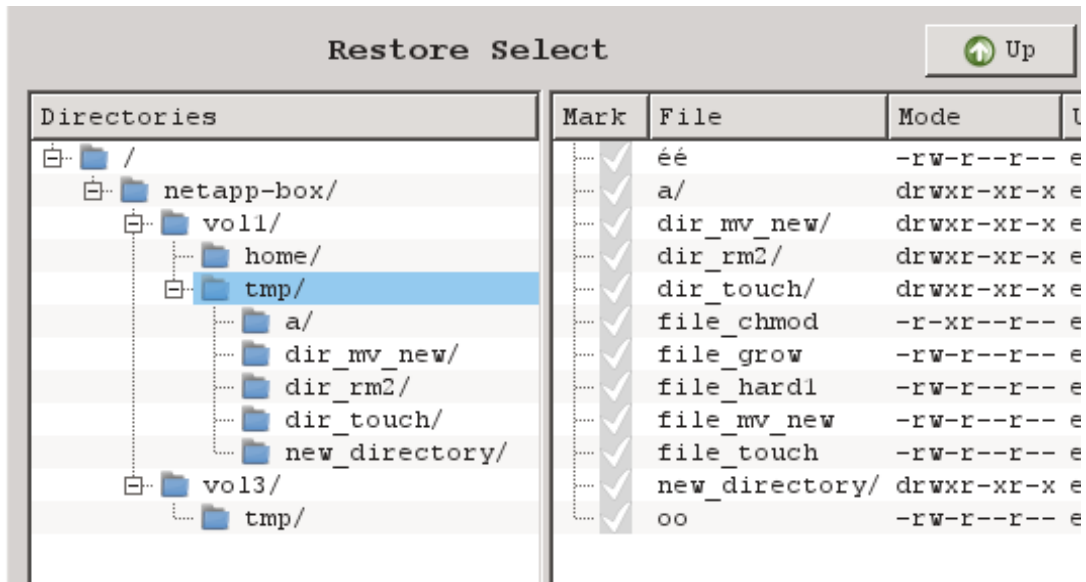


Fig. 6: NetApp and Volume Structure

- The Incremental Accelerator plugin only works with NetApp appliances.