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How to Migrate Your Data to Oracle Solaris 11 Using Shadow Migration

by Dominic Kay



Data migration is a fundamental building block of an Oracle Solaris 11 adoption strategy. This article describes shadow migration, which is a technology for moving large amounts of data from one file system to another while the data remains online and accessible to users.

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With the advent of Oracle Solaris 11, all data is stored on ZFS file systems by default. ZFS also underpins much of the rest of Oracle Solaris 11, such as booting, root file systems, upgrading, and updating.

From a data management perspective, a strong case can be made for migrating data to ZFS, particularly in the areas of the scalability and ease of data management required in the cloud as well as in the large number of no-cost data services that are available, such as encryption, compression, deduplication, snapshots, and remote replication. These services, along with the high availability and performance of Oracle Solaris 11 at scale, are strong incentives to consolidate on that platform.

While the UFS file system is still available in Oracle Solaris 11 (except as a root file system), ZFS is the preferred storage mechanism and provides far greater reliability and functionality than UFS.

About Shadow Migration

Shadow migration allows you to migrate data from a legacy file system to a ZFS file system while simultaneously allowing access and modification to the data during the process. You can use shadow migration to migrate a local or remote file system to a local file system. To be more specific, you can migrate data from any file system that can either be mounted directly on the Oracle Solaris 11 host (UFS, ZFS, VxFS, and so on) or any remote file system that can be set to "read only" and mounted on the Oracle Solaris 11 host using NFS. This extends to filers such as NetApp and other operating systems such as AIX, HP-UX, and Linux.

The use cases for shadow migration extend beyond moving data to Oracle Solaris 11. When you want to enable ZFS services such as compression, deduplication, and encryption—where data needs to go through a transformation—shadow migration within the server between an existing and a new file system (to subsequently be renamed) might be the best method of achieving the data transformation.

The following were the principal design requirements for shadow migration:

It must be able to migrate over standard data protocols (NFS) from arbitrary data sources without the need to have special software running on the source system.

Migrated data must be available before the entire migration is complete and must be accessible with native performance. All the data to migrate the file system must be stored within the file system itself and must not rely on an external database to ensure consistency. (See the references in the "See Also" section for further detail on the design and implementation.)

An Example

Here is a quick demonstration of shadow migration that you can try out for yourself. This example migrates data from a local file system. However, the principles apply to remote file systems mounted over NFS. The syntax for remote file systems is in the administration manual (see the "See Also" section).

First create the file system you want to migrate

```
root@solaris:~# zpool create oldstuff c3t4d0
root@solaris:~# zfs create oldstuff/forgotten
```

Then populate it with some files:

```
root@solaris:~# cd /var/adm
root@solaris:/var/adm# find . -print | cpio -pdv /oldstuff/forgotten
```

You need to install the shadow-migration package, as shown in Listing 1:

```
root@solaris:~# pkg install shadow-migration
Packages to install: 1
Create boot environment: No
Create backup boot environment: No
Services to change: 1
```

DOWNLOAD	PKGS	FILES	XFER (MB)
Completed	1/1	14/14	0.2/0.2
PHASE	ACTIONS		
Install Phase	39/39		
PHASE	ITEMS		
Package State Update Phase	1/1		
Image State Update Phase	2/2		

Listing 1. Installing the shadow-migration Package

You then enable the shadowd service:

```
root@solaris:~# svcadm enable shadowd
root@solaris:~# svcs shadowd
STATE      TIME      FMRI
online     7:16:09   svc:/system/filesystem/shadowd:default
```

Set the file system to be migrated to read-only:

```
root@solaris:~# zfs set readonly=on oldstuff/forgotten
```

Create a new ZFS file system with the shadow property set to the file system to be migrated:

```
root@solaris:~# zfs create -o shadow=file:///oldstuff/forgotten mypool/remembered
```

Use the shadowstat(1M) command to see the progress of the migration, as shown in Listing 2:

```
root@solaris:~# shadowstat
```

EST

DATASET	BYTES		ERRORS	ELAPSED TIME
	XFRD	LEFT		
mypool/remembered	92.5M	-	-	00:00:59
mypool/remembered	99.1M	302M	-	00:01:09
mypool/remembered	109M	260M	-	00:01:19
mypool/remembered	133M	304M	-	00:01:29
mypool/remembered	149M	339M	-	00:01:39
mypool/remembered	156M	86.4M	-	00:01:49
mypool/remembered	156M	8E	-	(completed)

Listing 2. Checking Migration Progress

As noted above, if you had created /mypool/remembered as encrypted, this would be the preferred method of encrypting existing data. The same is true for compressing or deduplicating existing data.

Testing and Caveats

The migration of production data requires backup and thorough testing before the live migration. In particular, be aware of the following:

Clients will be accessing a different physical location to access the data. Name services and network addressing need to be amended so that clients do not attempt to modify the "old" data, which will be read-only, and thus return an error.

Name service entries for authentication—user and group names that control ownership, and so on—need to be migrated as well as the data.

There will be a transition stage when it is possible that both the "old" and the "new" data sets might require backup.

Particular attention needs to be paid to metadata and settings, especially when migrating non-ZFS to ZFS. In particular, access control lists (ACLs), extended attributes, and similar settings need testing.

Shadow migration moves data from one file system to another on a one-to-one basis. Consolidation from many file systems to fewer should be attended to as a separate stage in the migration process.

Performance

The performance of shadow migration feature depends on the following:

The nature of the data (small files are inherently slower than large ones)

The access pattern by clients to new data

The relative disk configurations of the source and destination systems

The throughput and latency of the networking media

A design goal of shadow migration was to make the performance of the transfer unimportant to clients, the important factor being that clients continue to enjoy fast access to the data they require. However, if raw performance of the transfer between old and new media itself is important, you might not want to use shadow migration, because it is designed to be seamless and "invisible," but not fast itself.

See Also

Eric Schrock describes the [motivation and design](#) and also the [engineering internals](#) of shadow migration in his blogs. The formal treatment of shadow migration is in the [Oracle Solaris Administration: ZFS File Systems](#) manual.

Here are some additional resources:

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