# Oracle® Health Sciences Omics Data Bank

Secure File Store Guide

Release 2.5

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This guide contains the following sections:

## 1 Introduction

Oracle Database File System (DBFS) provides file system interface to files stored in the database tables. DBFS enables existing file based tools to access database files through familiar pathnames, directories, and links. Files in DBFS are either kept in a dedicated file store, or shared database files system in database tables within Oracle.

DBFS provides unified data and file backup, disaster recovery, and management of both relational data and files. DBFS also adds advanced features of compression, deduplication, and encryption to files.

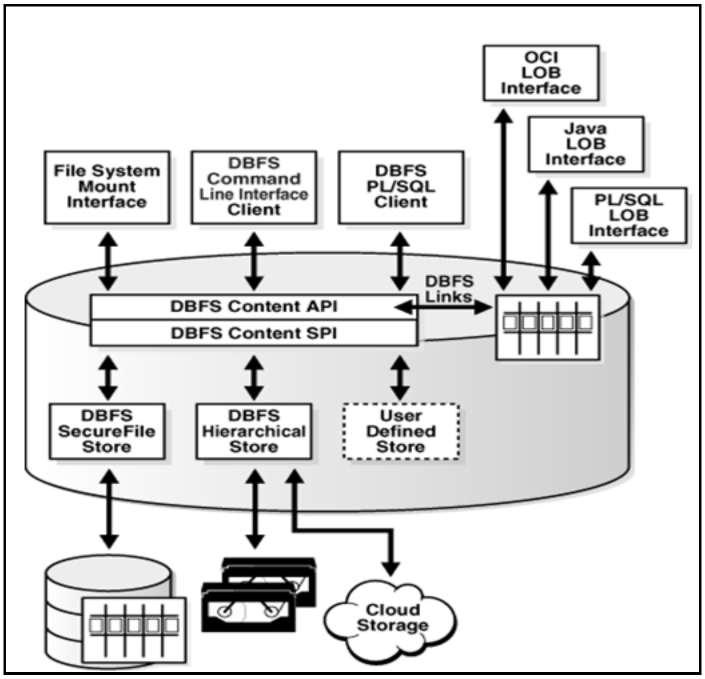
The DBFS Content Store lets each database user to create one or more file systems that can be mounted by clients. Each file system has its own dedicated tables that hold the file system content. The DBFS Content Application Programming Interface (API) is a PL/SQL interface in the Oracle Relational Database Management System (RDBMS).

> **Note:** The secure file is optional for users who want to retain their legacy file systems. Oracle recommends that you migrate to DBFS for easy file management and backup consistency.

### 1.1 Oracle SecureFile Architecture

The following figure depicts Oracle SecureFile architecture:

*Figure 1 Oracle SecureFile Architecture*



## 1.2 Prerequisites

The following prerequisites apply for installing DBFS:

1. Install the core Linux server and standard configurations. To view the instructions, visit the website at http://download.oracle.com/docs/cd/E11882_01/install.112/e16763/pre_install.htm.
2. Purchase an Oracle Advanced Compression database license.
3. It is assumed that there is a single administrator who owns the SecureFiles system. The administrator create, mount the files system, and load the necessary files.

After installation and configuration of the Linux OS you should ensure that the following prerequisites are set to use DBFS:

- 32-bit and 64-bit Linux
- Installation of kernel -devel development package for command-line requirements
- Installation of FUSE package for mounting requirements
- Installation of Oracle client libraries for integration of Oracle database with OS requirements
- Automatic Segment Space Management (ASM) for the full capability of SecureFiles system requirements.

### FUSE Definition

Linux FUSE is a file system user software environment, and is not related to the Oracle database. However, it is required to mount the DBFS.

**Note:** It is not required to install FUSE, if you are not mounting DBFS or using a Non-Linux platform.

## 1.3 Installing the Kernel-Devel Package

FUSE version 2.7.x is selected to install the kernel-devel package and prevent compatibility problems. The OEL installation CD contains the kernel-devel package with the FUSE functionality. The FUSE functionality should not be installed if already present in you system. To install the kernel, perform the following steps:

1. Verify that the kernel-devel package is installed by executing the following command at the shell prompt.

   ```
   # rpm -q kernel-devel
   ```

   The expected output is:

   ```
   kernel-devel-2.6.18-128.el5
   ```

2. Determine the kernel directory.

   ```
   # echo /usr/src/kernels/`uname -r`-`uname -p`
   ```

   The expected output is:

   ```
   /usr/src/kernels/2.6.18-128.el5-x86_64
   ```

3. If the kernel-devel development package was not installed in step 1, then install it now. There are three methods to install the kernel:

   a. You have to configure the Linux server to point to Oracle's public YUM repository. The instructions for this are available at `http://public-yum.oracle.com/`.

      After configuring the YUM, execute the following shell command:

      ```
      # yum install kernel-devel
      ```

      If the kernel is already installed, then a *Nothing to do message: STOP* message is displayed.

   b. If YUM was not used to automatically download and install the kernel then follow these instructions to install the kernel:

      On OEL 4 Update 6 or a newer version, execute the following commands as root to download and copy the appropriate YUM configuration file to the ETC/YUM.REPOS.D directory:

      ```
      # cd /etc/yum.repos.d
      ```

      ```
      # mv Oracle-Base.repo Oracle-Base.repo.disabled
      ```

      ```
      # wget http://public-yum.oracle.com/public-yum-el4.repo.
      ```

      From the/ETC/YUM.REPOS.D directory, execute the following YUM installation command:

      ```
      # yum install kernel-devel
      ```

   c. If you are unable to download the kernel from the Oracle Public YUM Server or if you prefer to install it from the OEL installation media, execute the following command at the shell prompt:

      ```
      # cd /media/cdrom/Server
      ```

```
# rpm -Uvh kernel-devel*
```

## 1.4 Installing the FUSE software

The FUSE software can be installed through:

1. Oracle's Public YUM Server. This is the fastest way of installing FUSE. Oracle recommends to use this server to install FUSE. By assuming that you have configured YUM to point to the Oracle Public YUM Server, and the library is still available on the website `http://public-yum.oracle.com`

   You have to execute the following command to install the FUSE software:

   ```
   # yum install fuse fuse-libs
   ```

   Oracle 11g R2 (11.2.0.2.0) should be installed for completion of the installation process. If Oracle 11g R2 (11.2.0.2.0) is not installed, refer to Installing Oracle 11g R2 (11.2.0.2.0) Database on page 6 to install this Oracle database. Once installed, perform the following steps to complete the FUSE installation:

   Login as the Oracle user, execute the following commands to complete the FUSE installation.

   > **Note:** Ensure that you substitute your kernel directory into the prefix=" " in the following command.

   ```
   # cd fuse-2.7.3

   # ./configure --prefix=/usr
   --with-kernel=/usr/src/kernels/`uname -r`-`uname -p`
   ```

   > **Note:** If this fails, use the next line, replacing 2.6.18-128.el5-x86_64 with your specific kernel.

   ```
   <# ./configure --prefix=/usr
   --with-kernel=/usr/src/kernels/2.6.18-128.el5-x86_64>

   # make

   # sudo su

   $ make install

   $ /sbin/depmod

   $ /sbin/modprobe fuse

   $ chmod 666 /dev/fuse

   $ echo "/sbin/modprobe fuse" >> /etc/rc.modules

   $ chmod 700 /etc/rc.modules
   ```

2. Download the FUSE software from the website `http://fuse.sourceforge.net/` into a temporary directory on your local computer and follow the installation procedure. In this example, the FUSE 2.7.3 package file, fuse-2.7.3.tar.gz, is used.

   a. Query your kernel type by using the following command:

```
uname -a
```

You may need to know your kernel type to successfully perform the next step.

**b.** Unzip the downloaded fuse-2.7.3.tar.gz by executing the following command:

```
# tar -xzvf fuse-2.7.x.tar.gz
```

**c.** Login as the Oracle user, execute the following commands to complete the FUSE installation.

---

**Note:** Ensure that you substitute your kernel directory into the prefix=" " in the following command.

---

```
# cd fuse-2.7.3
```

```
# ./configure --prefix=/usr
--with-kernel=/usr/src/kernels/`uname -r`-`uname -p`
```

---

**Note:** If this fails, use the next line, replacing 2.6.18-128.el5-x86_64 with your specific kernel.

---

```
<# ./configure --prefix=/usr
--with-kernel=/usr/src/kernels/2.6.18-128.el5-x86_64>
```

```
# make
```

```
# sudo su
```

```
$ make install
```

```
$ /sbin/depmod
```

```
$ /sbin/modprobe fuse
```

```
$ chmod 666 /dev/fuse
```

```
$ echo "/sbin/modprobe fuse" >> /etc/rc.modules
```

```
$ chmod 700 /etc/rc.modules
```

**3.** Using your OEL installation media. Execute the following commands:

**a.** Change to the directory `/media/cdrom/Server` by executing:

```
cd /media/cdrom/Server
```

**b.** Execute the following command:

```
# rpm -Uvh fuse-2* fuse-libs-2*
```

**c.** Login as the Oracle user, execute the following commands to complete the FUSE installation.

---

**Note:** Ensure that you substitute your kernel directory into the prefix=" " in the following command.

---

```
# cd fuse-2.7.3
# ./configure --prefix=/usr
--with-kernel=/usr/src/kernels/`uname -r`-`uname -p`
```

**Note:** If this fails, use the next line, replacing 2.6.18-128.el5-x86_64 with your specific kernel.

```
<# ./configure --prefix=/usr
--with-kernel=/usr/src/kernels/2.6.18-128.el5-x86_64>

# make

# sudo su

$ make install

$ /sbin/depmod

$ /sbin/modprobe fuse

$ chmod 666 /dev/fuse

$ echo "/sbin/modprobe fuse" >> /etc/rc.modules

$ chmod 700 /etc/rc.modules
```

## 1.5 Installing Oracle 11g R2 (11.2.0.2.0) Database

This installation is performed only if the Oracle database is not installed in your system. If you already have a user name and password as *Oracle user* for your system then use the sudo command with your *Oracle user* account to perform the following tasks. If the sudo command is disabled, then contact your administrator to perform the steps in Oracle Account Configuration on page 6.

## 1.6 Oracle Account Configuration

- Ensure that you have added the *Oracle user* into /etc/sudoers to enable this account to execute sudo. By doing this, you are enabling the Oracle account to act as a root user.
- Create your connection string for the Oracle account to connect to the database. For more information, refer to Configuring TNS on page 16.

## 1.7 Verifying Oracle Library Dependency

- Check to ensure the entire dependency library is present by executing the following command. If the library is missing install it before you proceed:

  ```
  ldd $ORACLE_HOME/bin/dbfs_client
  ```

  This lists the entire dependency library. This assumes that Oracle 11g R2 (11.2.0.2.0) is installed on your computer and configured appropriately. The output after execution indicates if a library is missing or present.

## 1.8 Integrating the Database to the Operating System

1. You must soft link the library file to the directory. To soft link the library to the directory, execute the following commands:

   ```
   # export ORACLE_HOME=/u01/app/oracle/product/11.2.0/dbhome_1
   # cd /usr/local/lib
   # ln -s $ORACLE_HOME/lib/libclntsh.so.11.1
   # ln -s $ORACLE_HOME/lib/libnnz11.so
   # ln -s /usr/lib/libfuse.so
   ```

2. Create a run-time dynamic link library by executing the following:

   ```
   # ldconfig
   ```

   If you do not perform the above steps, the following dbfs_client error is displayed:

   ```
   dbfs_client: error while loading shared libraries:
   libclntsh.so.11.1: cannot open shared object file: No such
   file or directory
   ```

   It indicates there are two libraries and `libclntsh.so.11.1` is missing. It is located in $ORACLE_HOME/lib. You can adjust the library search path in the following ways:

   1. Modifying /etc/ld.so.conf to include $ORACLE_HOME/lib.
   2. Exporting `LD_LIBRARY_PATH=$ORACLE_HOME/lib`.

   Now, DBFS is already functioning. You can access the files system by using DBFS_CLIENT directory utilities, without mounting the DBFS to the operating system directory.

# 2 Creating the Database Files System

You must now create the database files system. Oracle recommends that you create:

- a separate tablespace to host the file system
- a temporary tablespace to host the temp files associated with files system
- an Undo tablespace to host the undo data
- a database schema user who owns the files system

To create the database file system, perform the following steps:

1. Login to the Oracle database as a privileged user and execute the following commands. For a list of your privileged user names, contact your database administrator.

   ```
   # sqlplus system/xxxxx@app58x1 as sysdba
   ```

   where *xxxxx* is the password and *app58x1* is the server name.

   ```
   SQL>
   ```

   You must create a tablespace to hold the file system. Create a tablespace name of your choice. Oracle recommends a *bigfile* tablespace. The tablespace must be the ASM to use the SecureFiles.

   ```
   CREATE BIGFILE TABLESPACE <tablespace name>
   ```

```
DATAFILE '/u01/oradata/multimedia/<filename.dbf>' SIZE 2000M
REUSE

AUTOEXTEND ON NEXT 1000M MAXSIZE unlimited

Extent management local

SEGMENT SPACE MANAGEMENT AUTO;
```

2. To create temporary tablespace name of your choice for the schema, execute the following:

```
CREATE TEMPORARY TABLESPACE <tablespace name>

TEMPFILE '/u01/oradata/app58x1/ <filename.dbf>' SIZE 32m

AUTOEXTEND ON next 32m maxsize UNLIMITED

Extent management local;
```

3. To create an undo tablespace name of your choice for the schema, execute the following:

```
CREATE UNDO TABLESPACE <tablespace name>

DATAFILE '/u01/oradata/multimedia/<filename.dbf>'

SIZE 2000M AUTOEXTEND ON

RETENTION GUARANTEE;
```

4. To create the schema user to own the file system, execute the following:

```
SQL>

CREATE USER trcdemo IDENTIFIED BY trcdemo

DEFAULT TABLESPACE PROSTRAT_SECUREFILE_TS

TEMPORARY TABLESPACE prostratsecurefile_temp

QUOTA UNLIMITED ON PROSTRAT_SECUREFILE_TS;
```

5. Assign the necessary role and privileges to the user. The minimum required role and privileges are: dbfs_role, create session, resource, and create view. Based on your security policy, you can add more roles and privileges as required.

```
SQL> GRANT CONNECT, CREATE SESSION, RESOURCE, CREATE TABLE,
CREATE PROCEDURE, DBFS_ROLE TO trcdemo;
```

## 3 Creating the SecureFiles System and Tables in the Database

If the procedure listed below is not followed, you will get a basic file system with portion file system created in multiple physical segments in the database and files distributed randomly in them. If the files being loaded are large and make up a large percentage of the total file system, you could get an error *ENOSPC* even if the file system is not full. To create the SecureFiles system and tables in the database, perform the following steps.

1. Navigate to the $ORACLE_HOME/RDBMS/ADMIN directory.
2. Connect to the database with the user details you created earlier.

```
# sqlplus <>/<password>
```

3. Execute the following command. It is a single line with six parameters separated by space.

> **Note:** Execute the following command with the parameters in the exact order given below.

```
SQL> @$ORACLE_HOME/rdbms/admin/dbfs_create_filesystem.sql
ProStrat_Securefile_ts trc_compress_sfs compress-high
deduplicate noencrypt non-partition
```

The available parameters are as follows:

- `Rem compress-high`
- `Rem compress-medium`
- `Rem deduplicate`
- `Rem encrypt`
- `Rem nocompress`
- `Rem nodeduplicate`
- `Rem noencrypt`
- `Rem non-partition`

> **Note:** If you entered `nocompress,nodeduplicate,noencrypt` in the above command, the file system created is a Basic Files system.
>
> In the above example, the table and files system is created under an advanced SecureFiles system.

4. You can view the table structure by executing the following command:

```
SQL> Describe <username>.<base directory name>;
```

The following table contains the description of fields included in the database table:

***Table 1 Description of Fields in Table***

| Attributes | Definition |
|---|---|
| std_access_time | The time of last access of the contents of a path name. |
| std_acl | The Access Control List (ACL) (in standard ACL syntax) associated with the path name. |
| std_canonical_path | The canonical store specific path name of an item, that is cleaned up (leading/, trailing / collapsed, trimmed, and so on). |
| std_change_time | The time of last change to the metadata of a path name. |
| std_children | The number of child directories or folders in a directory or folder path. This property should be available in providers that support feature_folders. |

*Table 1 (Cont.) Description of Fields in Table*

| Attributes | Definition |
|---|---|
| std_content_type | The client-supplied mime-type or types (in standard RFC syntax) describing the (typically type_file) path name. The content type is not necessarily interpreted by the store. |
| std_creation_time | The time at which the item was created in the database table. Once set, this value never changes for the lifetime of the path name. |
| std_deleted | Set to a non-zero number if the path name has been soft-deleted (for more information, refer to above for this feature), but not yet purged. |
| std_guid | A store specific unique identifier for a path name. Clients must not depend on the GUID being unique across different stores, but a given (store-name, store-specific-pathname) has a stable and unique GUID for its lifetime. |
| std_length | The length of the content (BLOB) of a type_file or type_reference path, or the length of the referent of a type_link symbolic link. Directories do not have a well defined length and stores are free to set this property to zero, null, or any other value they choose. |
| std_modification_time | The time of last change to the data associated with a path name. Change to the content of a type_file or type_reference path, the referent of the type_link path, and addition or deletion of immediate children in a type_directory path, all constitute data changes. |
| std_owner | A client-supplied (or implicit) owner name for the path name. The owner name may be used along with the current principal for access checks by stores that support ACLs or locking. |
| std_parent_guid | A store-specific unique identifier for the parent of a path name. Clients must not depend on the GUID being unique across different stores, but a given (store-name, store-specific-pathname) has a stable and unique GUID for its lifetime.<br>■ ostd_parent_guid (pathname ==<br>■ std_guid(parent(pathname))) |
| std_referent | The content of the symbolic link of a type_link path; null otherwise. As mentioned before, the std_referent can be an arbitrary string and must not necessarily be interpreted as path name by clients. This type of interpretation should be done in a careful manner. |
| opt_hash_type | The type of hash provided in the opt_hash_value property; for more information, refer to dbms_crypto for possible options. |

*Table 1 (Cont.) Description of Fields in Table*

| Attributes | Definition |
|---|---|
| opt_hash_value | The hash value of type opt_hash_type describing the content of the path name. |
| opt_lock_count | The number of (compatible) locks placed on a path name. If different principals are enabled to place compatible (read) locks on a path, the opt_locker must specify all lockers (with repeats so that lock counts can be correctly maintained). |
| opt_lock_data | The client supplied user data associated with a user lock, not interpreted by the store. |
| opt_locker | The implicit or client-specified principal or principals that applied a user lock on a path name. |
| opt_lock_status | One of the values (lock_read_only, lock_write_only, lock_read_write) describing the type of lock currently applied on a path name. |
| opt_version | A sequence number for linear versioning of a path name. |
| opt_version_path | A version path name for hierarchical versioning of a path name. |

# 4 Accessing the SecureFiles System

You can access the SecureFile system in any one of the following four ways:

1. You can use the `dbfs_client to` bypass the Linux OS interface call. This method takes advantage of all the Oracle database security that are granted or revoked from a database user. An authorized user can perform limited OS operations, such as ls, cp, mkdir, and so on.
2. Mounting the secure files to a mount point utilizing the FUSE system.
3. Utilizing SQL scripts to query the SecureFiles system through `dbfs_content` API.
4. Mounting the SecureFile in the background securely to enable user access through Oracle Wallet.

## 4.1 Creating a Directory in the SecureFile System

The `dbfs_client` can be executed from any system that meets the requirements mentioned in step 1 of Installing the Kernel-Devel Package on page 3.

```
{client}$ dbfs_client trcdemo@app58x1 --command mkdir dbfs:/
<base directory name>/<new directory name>
```

```
Password: xxxxx
```

For example,

```
[oracle@olsapp58 ~]$ dbfs_client trcdemo/xxxxx@app58x1.world
--command mkdir dbfs:/trc_compress_sfs/fastq
```

```
Password: xxxxx
```

The new directory is created.

## 4.2 Copying a File into a Secure File Directory Using DBFS Syntax

After creating a new directory, you can copy a file in it using the following command:

```
$ dbfs_client xxxxx@app58x1 --command cp /tmp/<new
directoryfiles>

dbfs:/<base directory>/<new directory>

Password: xxxxx

/tmp/<new directory files> -> dbfs:/<base directory>/<new
directory>/new directory files>
```

To list the non system directories, use the following command:

```
 [oracle@olsapp58 ~]$ dbfs_client
<username>/xxxxxx@app58x1.world --command ls -l dbfs:/<base
directory>

Password:<your password>
```

# 5 Implementing SecureFile System Security

It is often necessary to connect to the database through shell scripts in the file system. This can be a chief security issue if these scripts contain the database connection details. A solution for this issue is to use the operating system authentication. However, if you want to access a DBFS Files System by the command line, the operating system authentication will nullify the SecureFiles purpose. Oracle 11g R2 database provides the option of using a secure external password storage where the Oracle login credentials are stored in a client-side Oracle Wallet. This enables scripts to contain connections using the `/@db_wallet` syntax and lets you mount the secure file directory to a Linux operating system mount point securely. This is the recommended and most secure way of deploying DBFS in the enterprise. The users can create stable mount points.

Security in the DBFS is primarily managed by the database, not by the operating system security model. Access to a database file system requires login as a database user with privileges assigned to access the tables underlying the file system. Access to the file system can be granted to other users by the database administrator. This implies that different database users may have different read-only or update privileges to the file system as determined by database administrator. The database administrator has access to all the files stored in the DBFS.

On the client machine, access to a DBFS mount point is limited to the operating system user mounting the file system. However, the number of users who can access DBFS is not limited. Many users can separately mount the same DBFS file system.

When the DBFS is mounted as a file system, the operating system file level permissions are checked by Linux. The DBFS does not check for permissions when using the command interface or when you are directly using the PL/SQL interface. When using the command interface or the PL/SQL interface directly the database privileges are authenticated.

## 5.1 File System Security Model

The dbms_client program is used to mount the DBFS store.

```
dbfs_client <db_user>@<db_server> [options] <mount point>
```

where,

db_user - Name of Database user that owns DBFS content store file system or file systems

db_server - A valid connection string to Oracle database server

mount point - Path to mount Database File System or Systems. All the file systems owned by the database user is seen at the mount point.

For example, hrdb_host:1521/hrservice.

### DBFS Options

- `o direct_io` - Bypasses the Linux page cache. This provides much better performance for large files. Programs in the file system cannot be executed with this option. Oracle recommends this option when DBFS is used as an ETL staging area.
- `-o wallet` - Run `dbfs_client` in background. Wallet must be configured to get credentials.
- `-o failover` - DBFS Client fails over to surviving database instance with no data loss. Some performance cost on writes, especially for small files.
- `-o allow_root` - Enables root access to the file system. This option requires setting the `user_allow_other` parameter in /etc/fuse.conf.
- `-o allow_other` - Enables other users access to the file system. This option requires setting `user_allow_other` parameter in /etc/fuse.conf.
- `-o rw` - Mount the file system read-write. This option exists by default.
- `-o ro` - Mount the file system read-only. Files cannot be modified.
- `-o trace_level=N`

  ```
  Trace Level:
      1->DEBUG,
      2->INFO,
      3->WARNING,
      4->ERROR, (default)
      5->CRITICAL
  ```
- `-o trace_file <file> | 'syslog'`
- `-h` help
- `-v version`

The user mounting the file system enables root access to the file system by specifying the `allow_root` option. This option requires a **user_allow_other** field to be present in /etc/fuse.conf. For example:

# Allow users to specify the `allow_root` mount option.

```
user_allow_other
```

The user mounting the file system can let other users access the file system by specifying the `allow_other` option. Oracle does not recommend DBFS to be run as a root user.

# 6 Implementing Command-Line SecureFiles Access Using Oracle Database Authentication

The use of wallet ensures a safe solution if secure file mounting activities are performed by an administrator.

Based on user interaction with the `dbfs_client,` it is observed that creating a strong wallet encrypted authentication based on X.509 certificates and using AES256 encryption solves many security issues. However, access to the location of the wallet must be restricted.

To mount DBFS through fstab, follow the below steps:

1. Login as root user.
2. Change the user and group of `dbfs_client to` be user root and group fuse.

   ```
   # chown root.fuse $ORACLE_HOME/bin/dbfs_client
   ```

3. Set the setuid bit on `dbfs_client,` and restrict execute privileges to the user and group only.

   ```
   # chmod u+rwxs,g+rx-w,o-rwx dbfs_client
   ```

4. Create a symbolic link to `dbfs_client in` /sbin as *mount.dbfs*.

   ```
   $ ln -s $ORACLE_HOME/bin/dbfs_client /sbin/mount.dbfs
   ```

5. Create a new Linux group called *fuse*.
6. Add the Linux user that is running the DBFS Client to the fuse group.
7. Add the following line to /etc/fstab:

   ```
   /sbin/mount.dbfs#db_user@db_server mount_point fuse
   rw,user,noauto 0 0
   ```

   For example:

   ```
   /sbin/mount.dbfs#/@trcdemo /mnt/dbfs fuse rw,user,noauto 0 0
   ```

8. The Linux user can mount the DBFS file system using the standard Linux mount command. For example:

   ```
   $ mount /mnt/dbfs
   ```

**Note:** FUSE does not currently support automount.

A stringent security practice must be executed for any wallets used for secure file or for other applications. This is applicable for stored wallet locations and users having access to these wallets. In cases, where users access wallets to run processing by CRON or other system scheduler, it should be ensured that permissions on the wallet and the wallet directory are given least privilege after careful consideration. By locking down the wallets and only running batch-type, CRON driven processing from trusted clients, this feature protects credentials required for lights-out processing.

An alternate, less secure option has been provided for those who prefer prompt for user credentials. To implement this, login as the *Oracle user* or a `sudo` privileged user and perform the following steps:

1. `# su - oracle`

2. Create a directory for mounting your dbfs file system as read write:

   ```
   # mkdir /u01/app/upload/trc_mount
   ```

   ```
   # chown oracle:dba /u01/app/upload/trc_mount
   ```

   ```
   # chmod <665> /u01/app/upload/trc_mount -- The 665 is your
   own choice
   ```

   ```
   # dbfs_client trcdemo@app58x1 -o rw,user,direct_io
   /u01/app/upload/trc_mount
   ```

   Or,

   Create another directory for mounting your dbfs file system as read- only:

   ```
   # mkdir /u01/app/upload/trc01simple_mount
   ```

   ```
   # chown oracle:dba /u01/app/upload/trc01simple_mount
   ```

   ```
   # chmod <665> /u01/app/upload/trc01simple_mount
   ```

3. Mount file system trc_compress_sfs as a read-only:

   ```
   # dbfs_client trcdemo@app58x1 -o ro,user,direct_io
   /u01/app/upload/trc01simple_mount
   ```

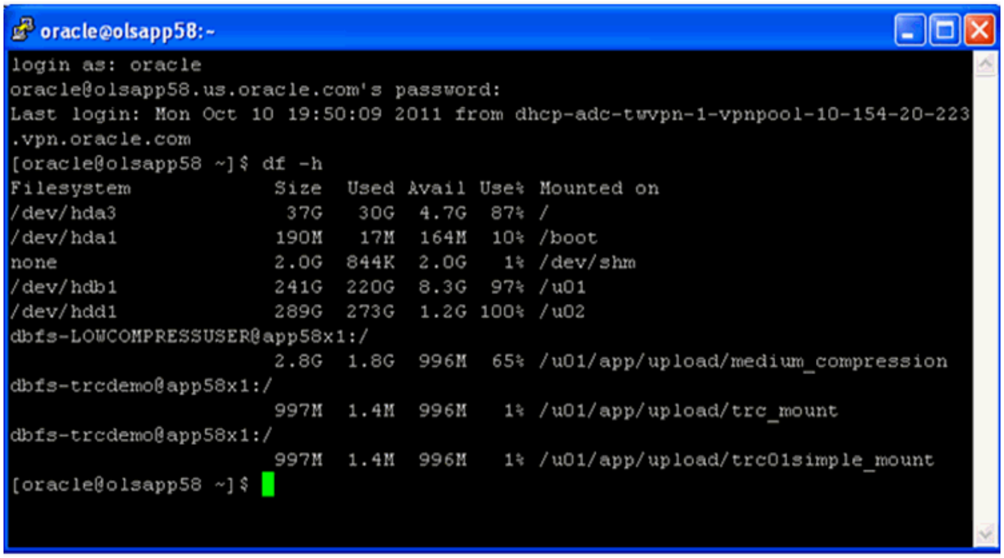
4. To refer to all your mounted files system, you can use the following:

   ```
   [oracle@olsapp58 admin]$ df -h
   ```

   > **Note:** This option does not let you run the mount process in the background.

   When you execute the above command, the end result is that the files system is mounted but the shell command prompt does not return unless you dismount the file system. The state does not return to the command line, and this is normal. This is displayed in the following figure.

*Figure 2* *Screen after Files are Mounted*



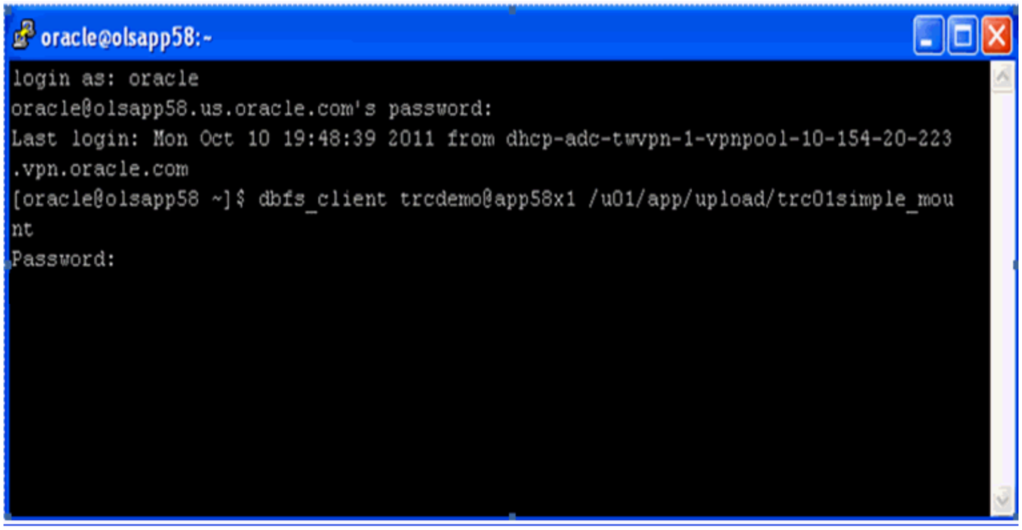
```
login as: oracle
oracle@olsapp58.us.oracle.com's password:
Last login: Mon Oct 10 19:50:09 2011 from dhcp-adc-twvpn-1-vpnpool-10-154-20-223
.vpn.oracle.com
[oracle@olsapp58 ~]$ df -h
Filesystem            Size  Used Avail Use% Mounted on
/dev/hda3              37G   30G  4.7G  87% /
/dev/hda1             190M   17M  164M  10% /boot
none                  2.0G  844K  2.0G   1% /dev/shm
/dev/hdb1             241G  220G  8.3G  97% /u01
/dev/hdd1             289G  273G  1.2G 100% /u02
dbfs-LOWCOMPRESSUSER@app58x1:/
                      2.8G  1.8G  996M  65% /u01/app/upload/medium_compression
dbfs-trcdemo@app58x1:/
                      997M  1.4M  996M   1% /u01/app/upload/trc_mount
dbfs-trcdemo@app58x1:/
                      997M  1.4M  996M   1% /u01/app/upload/trc01simple_mount
[oracle@olsapp58 ~]$ 
```

If you end this session without dismounting the file system, all mount point users gets the following error:

```
………………..Transport endpoint is not connected
```

To verify that the file system is mounted at the designated mount point, open a new session and use the command `df -h`. The output is shown in the following figure:

*Figure 3* *Output of the df -h Command*



```
login as: oracle
oracle@olsapp58.us.oracle.com's password:
Last login: Mon Oct 10 19:48:39 2011 from dhcp-adc-twvpn-1-vpnpool-10-154-20-223
.vpn.oracle.com
[oracle@olsapp58 ~]$ dbfs_client trcdemo@app58x1 /u01/app/upload/trc01simple_mou
nt
Password:
```

# 7 Configuring TNS

The TNS configuration for a non wallet entry is as follows:

```
(<App58x1>=
 (DESCRIPTION =
  (ADDRESS =
   (PROTOCOL = tcp)
   (HOST = <hostname>)
   (PORT = <port>)
  )
  (CONNECT_DATA =
   (SID = <App58x1>)
 )
)
```

The TNS configuration for a wallet entry is as follows:

Oracle Wallet must be set up with the credentials used to connect to the schema where secure file system is installed.

To set up Oracle Wallet perform the following steps:

1. Add the following code to tnsnames.ora under $ORACLE_HOME/NETWORK/ADMIN

   ```
   DB_WALLET =
   (DESCRIPTION =
   (ADDRESS_LIST =
   (ADDRESS = (PROTOCOL = TCP)(HOST = 10.178.187.186)(PORT =
   1521))
   )
   (CONNECT_DATA =
   (SERVICE_NAME = db001)
   )
   )
   ```

   Set the SERVICE_NAME and HOST values above to point to your database installation.

   Oracle Wallet can be created on the client or the middle tier system. Open a command prompt terminal and execute the following:

   ```
   >mkdir wallets
   >cd /wallets
   >mkstore -wrl
   =/u01/app/oracle/product/11.2.0/client_
   1/network/admin/wallets -create -nologo
   Enter password: < type a 8 alphanumeric-character password >
   Enter password again: < retype above password >
   ```

   > **Note:** By running mkstore -create command two files should be created: cwallet.sso and ewallet.p12

2. Add your database credentials to your wallet.

```
>mkstore -wrl =/u01/app/oracle/product/11.2.0/client_
1/network/admin/wallets -createCredential db_wallet trcdemo

Your secret/Password is missing in the command line

Enter your secret/Password: < enter password for trcdemo user
>

Re-enter your secret/Password:< re-enter password >

Enter wallet password:< enter the 8 digit password given
while creating wallet >
```

> **Note:** For every user credential added to the wallet, you must create a new dataset name in tnsnames.ora. The system assumes user name as *trcdemo* in this configuration.

3. Configure SQLNET to look for wallet.

   Add the following lines of code to *sqlnet.or*a under $ORACLE_HOME\NETWORK\ADMIN:

```
WALLET_LOCATION =

(SOURCE=(METHOD=FILE)(METHOD_
DATA=(DIRECTORY=/u01/app/oracle/product/11.2.0/client_
1/network/admin/wallets)))
```

4. Test connectivity by `sqlplus` command. On any command prompt terminal enter the following:

```
>sqlplus /@db_wallet
```

   You get the following result:

```
SQL*Plus: Release 11.2.0.1.0 Production on Fri Nov 25
15:54:35 2011

Copyright (c) 1982, 2010, Oracle. All rights reserved.
```

   Connected to:

```
Oracle Database 11g Enterprise Edition Release 11.2.0.1.0 -
64bit Production
```

   With the Partitioning, OLAP, Data Mining and Real Application Testing options.

Using the SQPLUS or SQLDEVELOPER, you can:

- view the structure of the file system table created:

```
DESCRIBE "TRCDEMO"."T_TRC_COMPRESS_SFS"
```

- verify SecureFiles Store tables and file systems:

```
select * from table(dbms_dbfs_sfs.listTables);

select * from table(dbms_dbfs_sfs.listFilesystems);
```

- verify ContentAPI Stores and mounts:

```
select * from table(dbms_dbfs_content.listStores);
select * from table(dbms_dbfs_content.listMounts);
```

- verify SecureFiles Store features:

```
var fs1f number;

exec :fs1f := dbms_dbfs_content.getFeaturesByName('FS_TRC_
COMPRESS_SFS');

select * from table(dbms_dbfs_content.decodeFeatures(:fs1f));
```

- verify resource and property views:

```
select * from dbfs_content;

select * from dbfs_content_properties;
```

- show the file system paths for this user by column selection:

```
select pathname, pathtype, utl_raw.cast_to_varchar2(filedata)
as contents

from dbfs_content

order by std_creation_time;

Select PATHNAME, OPT_CONTENT_ID, PATHTYPE, OPT_VERSION, STD_
OWNER FROM dbfs_content

Where pathtype = 'file';
```

- create a new directory and create a new file in it:

```
declare

 ret integer;

  b   blob;

  str varchar2(1000)  := '' || chr(10) ||

'#include <stdio.h>' || chr(10) ||

'' || chr(10) ||

'int main(int argc, char** argv)' || chr(10) ||

'{' || chr(10) ||

'  (void) printf(<your message>);' || chr(10) ||

'    return 0;' || chr(10) ||

'}' || chr(10) ||

'';

    begin

        ret := dbms_fuse.fs_mkdir('/trc_compress_sfs/src');

       ret := dbms_fuse.fs_creat('/trc_compress_
sfs/src/hello.c', content => b);

   dbms_lob.writeappend(b, length(str), utl_raw.cast_to_
raw(str));

    commit;

  end;
  /

  show errors;
```

- create another new directory and create a new file in it:

```
declare

 ret integer;

 b   blob;

 str varchar2(1000)  := <you can write some genomic data
into a file by inserting it here>';

  begin

   ret := dbms_fuse.fs_mkdir('/trc_compress_sfs/some_
genomic_files');

   ret := dbms_fuse.fs_creat('/trc_compress_sfs/some_
genomic_files/sanjoy.sam', content => b);

   dbms_lob.writeappend(b, length(str), utl_raw.cast_to_
raw(str));

   commit;

 end;

 /

 show errors;
```

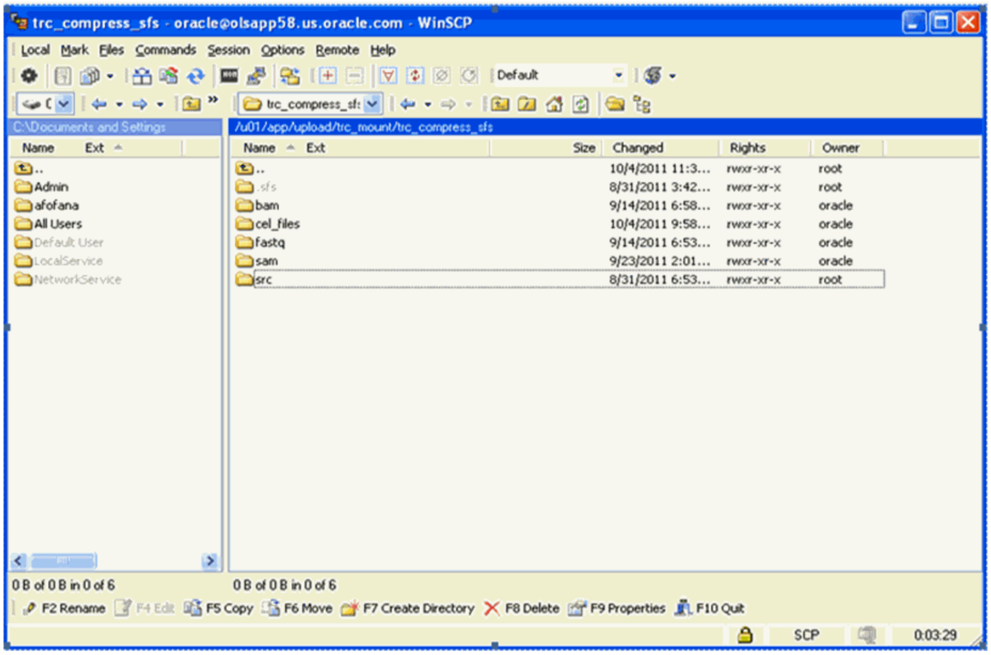
- verify newly created directory and file:

```
 select pathname, pathtype, length(filedata),

   utl_raw.cast_to_varchar2(filedata)

    from dbfs_content

     where pathname like '/trc_compress_sfs/src%' or pathname
like '/trc_compress_sfs/some_genomic_files%'

      order by pathname;
```

### Using a Graphical Interface to Access the Mounted Secure Directories

You can also use any third party user interface to access the Secure Directory giving the appropriate permissions as you perform in an operating system based files system. The following example utilizes WinScp to access the mounted secure mount point (/u01/app/upload/trc_mount/trc_compress_sfs) and its content directories as shown below:

*Figure 4    Graphical Interface to Access Directories*



trc_compress_sfs - oracle@olsapp58.us.oracle.com - WinSCP

C:\Documents and Settings

| Name | Ext |
|---|---|
| .. | |
| Admin | |
| afofana | |
| All Users | |
| Default User | |
| LocalService | |
| NetworkService | |

0 B of 0 B in 0 of 6

/u01/app/upload/trc_mount/trc_compress_sfs

| Name | Ext | Size | Changed | Rights | Owner |
|---|---|---|---|---|---|
| .. | | | 10/4/2011 11:3... | rwxr-xr-x | root |
| .sfs | | | 8/31/2011 3:42... | rwxr-xr-x | root |
| bam | | | 9/14/2011 6:58... | rwxr-xr-x | oracle |
| cel_files | | | 10/4/2011 9:58... | rwxr-xr-x | oracle |
| fastq | | | 9/14/2011 6:53... | rwxr-xr-x | oracle |
| sam | | | 9/23/2011 2:01... | rwxr-xr-x | oracle |
| src | | | 8/31/2011 6:53... | rwxr-xr-x | root |

0 B of 0 B in 0 of 6

You can drag and drop your selected files into the target directory. All relational database capabilities and file management features are automatically applied with no action required by you.

# 8 Disclaimer Regarding Third Party Data

Oracle makes no express or implied warranty, including but not limited to warranties regarding the accuracy, completeness, merchantability, or fitness for a particular purpose, with respect to third party data loaded into this application or the results of any functions of the application using such data. It may be used for information purposes only, and no medical, clinical or other health related decisions may be based upon such results. You are solely responsible for your use of the third party data, including your right to use the data for your purposes.

# 9 Documentation Accessibility

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Oracle Health Sciences Omics Data Bank Secure File Store Guide, Release 2.5
E27538-04