

Oracle 10g: From Tru64 UNIX to HP Integrity Servers using Heterogeneous Transportable Tablespaces



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Introduction

Migration of an Oracle® 10g database from a Tru64 UNIX® server to an HP Integrity server running HP-UX 11i is a very complex process because of the endian change between the two platforms. The Oracle 10g heterogeneous transportable tablespaces feature makes the migration of your database much simpler and faster than exporting and importing all the data from the Tru64 UNIX database to the target system.

This paper, which is targeted at IT professionals with Tru64 UNIX, HP-UX, and Oracle administration expertise, documents the migration process and includes several sample migration scenarios with instructions. The scenarios are the results of testing heterogeneous transportable tablespaces in the HP Oracle lab.

Some of the steps involved in pre-migration activities are mentioned, such as installing Oracle and building HP-UX Logical Volume Manager (LVM) volume groups. However, this paper does not go into detail on these steps, but assumes that you have sufficient expertise to understand the concepts discussed, such as:

- **HP-UX administration:** Creating LVM volume groups and logical volumes, account/user administration, HP-UX software/patch installation, and remote login administration (`/etc/rhosts` and `.rhosts`)
- **Tru64 UNIX administration:** Account/user administration, Tru64 UNIX software/patch installation, and remote-login administration (`/etc/rhosts` and `.rhosts`)
- **Oracle database:** Creating, laying out, configuring, and backing up a database

Migration process summary

To be able to migrate an Oracle database from Tru64 UNIX to HP-UX using heterogeneous transportable tablespaces, the database on the Tru64 UNIX system must be **Oracle 10g (10.x)** or later. If you are using an earlier version of the database, you will first need to upgrade to at least Oracle 10g (10.x) before migrating the database to the HP Integrity server.

It should also be noted that the transportable tablespaces feature does not support materialized views, replication, function-based indexes, scoped references, and 8.0 compatible advanced queues. If you use any of these features, you will not be able to use transportable tablespaces to migrate the specific tablespaces that contain any of these features. You should look at the new Oracle data pump feature for an alternative migration path for the affected tablespaces.

The migration process of an existing Oracle database from a Tru64 UNIX system to an HP Integrity server can be summarized as follows¹:

1. Make a full backup of the database (preferably an offline backup if possible)
2. Prepare the target system, including HP-UX installation, Serviceguard extension for Real Application Cluster (RAC) installation (for a RAC database), and Oracle 10g installation. Also, create LVM structure and file systems (if necessary).
3. Create and configure a new database (only the necessary system tablespaces should be configured, that is, `SYSTEM`, `SYSAUX`, `UNDO`, and so on) on the target system.
4. Check that all the tablespaces that will be transported are self-contained.
5. Switch the tablespaces you want to migrate to `READ ONLY` mode on the Tru64 UNIX system in preparation for copying the database files.
6. Export the metadata for the tablespaces you want to migrate on the Tru64 UNIX system.
7. Copy the Oracle 10g tablespaces metadata and database files from the Tru64 UNIX system to the target system.

¹ The steps may differ slightly depending on the nature of your Oracle installation.

8. Convert the database files with `RMAN` on the target system.
9. “Plug” in the converted database files into the Oracle10g database on the target (this is done by importing the metadata exported on the Tru64 UNIX system).
10. Switch the `READ ONLY` tablespaces to `READ WRITE` mode on the target system.

If you want to continue to use the Tru64 UNIX-based tablespaces, the tablespaces can either be put offline or in `READ WRITE` mode.

If you plan to use the Tru64 UNIX-based database in parallel with your migrated database, you will need to set up some kind of replication to keep the target system database up-to-date with the Tru64 UNIX database. Take a look at the Oracle Streams feature to accomplish this. Refer to the Database for Oracle transition module for additional information on this and other database transition matters:

<http://www.hp.com/go/transition-modules>

The three scenarios

This paper includes instructions for three different Oracle database scenarios:

- **Single-instance Oracle** (non-clustered) implemented using regular *file systems*
- **Single-instance Oracle** (non-clustered) implemented using *raw volumes* on Tru64 UNIX system and *raw volumes* on the target system (LVM logical volumes without file systems)
- **Clustered Oracle** (Oracle10g RAC) implemented using the *cluster file system* on the Tru64 UNIX systems and *raw volumes* on the target systems (LVM logical volumes without file systems)

This paper does not discuss clustered Oracle with a clustered file system on the target system because this combination is not yet supported with HP-UX. In addition, this paper does not consider the case of raw volumes implemented with so-called “hard partitions” (non-LVM raw disks) as this approach is very rarely used.

Minimize downtime

The `RMAN` data file conversion is much faster than exporting and importing the database using the `exp` and `imp` Oracle tools. It should be noted however, that the `RMAN` conversion is **not** an “in-place” conversion. You will need intermediate storage to hold both the Tru64 UNIX and HP-UX versions of the data files until the conversion has completed. At that point, you may remove the Tru64 UNIX version of the file on the target system, freeing up the intermediate storage.

Performance – before and after

Before getting into the details of the migration, you may be wondering how your existing database will perform on the new server. It has been well documented that application programs will perform better when they are recompiled into native object code. Does this “native advantage” apply to data as well? Is there a performance advantage in rebuilding and then importing the Tru64 UNIX database so it is “native” on a target system? Great news: the answer is no. There is no need to rebuild your database.

A possible exception: If your database is fragmented. If you export and import the database, you will get rid of the fragmentation in the data files; this will not be so when utilizing the `RMAN` conversion.

Migration process step-by-step

Note: The following steps are a guide for users experienced with HP-UX, Tru64 UNIX, and Oracle administration concepts. If you have sufficient familiarity with HP-UX and Tru64 UNIX commands, you should be able to understand the steps that follow. If you need more detail, refer to the man page for the command in question. Unless otherwise specified, all the following HP-UX and Tru64 UNIX commands must be performed when logged in to the system as the `oracle` user.

1. Ensure that the database on the Tru64 UNIX system is at Oracle Version 10g. If the database is at a previous version, upgrade it to Oracle Version 10g.
2. Prepare the target systems for Oracle migration:
 - a. Install HP-UX 11i v2 and any recommended patches as the root user.
 - b. For a clustered (RAC) installation, install Serviceguard extension for Real Application Clusters (eRAC). Configure the multinode cluster using standard Serviceguard procedures. This is done as the root user.
 - c. As the root user, create the user and corresponding group account on the HP-UX server to ensure the Oracle owner and dba group are set correctly. It is unnecessary to keep the UID and GID the same as on the Tru64 UNIX server unless you plan to use NFS.
 - d. Verify that Oracle10g has been installed on the HP-UX server.

If Oracle10g is not installed, install it at this point. If you are installing a RAC (clustered) database, make sure to install the Real Application Clusters option. Remember, your Serviceguard cluster must be running when installing the Oracle RAC option. As part of the Oracle installation, create an empty database as well.

- e. If your database is implemented on raw volumes, do the following as the root user:
 - i. Create the LVM structure, which will be used to hold the database.
 - ii. Create the volume group directories (for example, `mkdir /dev/vgora`) and the LVM "group" files (`mkknod /dev/vgora/group . . .`) using standard LVM procedures.
 - iii. Create the volume groups and logical volumes using standard LVM procedures (`vgcreate` and `lvcreate`).
 - f. If your Oracle database is implemented using file systems, create the file systems (`newfs`) and mount points (for example, `mkdir /oracle/oradata`). You will need to be logged in as the root user to perform this step.
 - g. Remember to create the necessary temporary file system space to hold the copied data files for the RMAN conversion process.
3. Check that all the tablespaces to be transported are self-contained with the following commands:

```
sqlplus "/ as sysdba"
SQL> EXECUTE DBMS_TTS.TRANSPORT_SET_CHECK('TS_NAME1,TS_NAME2,...',
TRUE);
SQL> SELECT * FROM TRANSPORT_SET_VIOLATIONS;
```

Note: Resolve **all** violations **before** continuing to the next step.

4. Create a directory database object on both the Tru64 UNIX and the target system using the following command:

```
sqlplus "/ as sysdba"
SQL> CREATE DIRECTORY TRANSPORT_DUMP_DIR AS '/oracle/tmp';
SQL> QUIT;
```

5. Switch the tablespaces you want to migrate to READ ONLY mode on the Tru64 UNIX system using the following command:

```
sqlplus "/ as sysdba"
SQL> ALTER TABLESPACE <TS_NAME> READ ONLY;
SQL> QUIT;
```

6. Export the tablespace metadata for the tablespaces you want to migrate using the following command:

```
expdp TRANSPORT_TABLESPACES=(TS_NAME1,TS_NAME2,...) \
TRANSPORT_FULL_CHECK=Y \
DIRECTORY=TRANSPORT_DUMP_DIR DUMPFILE=OraHTTS.dmp
```

7. Copy the database data files for all the tablespaces that correspond to the exported metadata to the target system using whatever method is most appropriate for your environment.

For example, for a raw-volume implementation, you might prefer to copy the raw volumes to tape and then restore the tape on the target system. If both the Tru64 UNIX and target systems are on the same network, you could use `dd` through a network pipe to the target system, as in this example:

```
dd if=/dev/vol/oradg/oradbvol1 | rsh IPF1 "dd
of=/oracle/tmp/oradbvol1"
```

(Repeat the `dd` command for each additional LSM volume to be copied. Note that you do not copy the data file directly to the raw space, as you still need to convert the data file.)

You could also use a network pipe if your database is file system-based. For example, to copy all the files from the `/oracle/oradata` directory on the Tru64 UNIX system to the `/oracle/tmp` directory on the target system called `IPF1`, issue the following commands while logged in to the Tru64 UNIX system (be sure to type these correctly—especially the blank spaces, which delimit the parentheses):

```
cd /oracle/oradata
tar cf - . | ( rsh IPF1 "cd /oracle/tmp ; tar xpf -" )
```

8. On the target system, for databases implemented on raw volumes, verify that the asynchronous I/O driver is properly configured and Oracle is using it. While the database is up, the `fuser /dev/async` command should indicate that the Oracle db-writer process (`ora_dbw0_SID`) has `/dev/async` open. For further details on setting up HP asynchronous I/O, see Oracle Metalink document ID 139272.1.
9. Convert the data files to the format required for the target system running HP-UX using the following command:

```
rman TARGET /
RMAN> CONVERT DATAFILE
'/oracle/tmp/oradbvol1', '/oracle/tmp/oradbvol2'
RMAN> FROM PLATFORM = 'HP Tru64 UNIX'
RMAN> DB_FILE_NAME_CONVERT = ('/oracle/tmp', '/dev/vgora/')
PARALLELISM 2;
RMAN> EXIT;
```

10. Plug the converted data files into the database on the target system using the following command:

```
impdp DUMPFILE=OraHTTS.dmp \
DATAFILES=/dev/vgora/oradbvol1, \
/dev/vgora/oradbvol2
```

11. Change the tablespaces to READ WRITE mode.

```
sqlplus "/ as sysdba"
SQL> ALTER TABLESPACE <TS_NAME> READ WRITE;
SQL> QUIT;
```

12. Repeat steps 5 through 11 for all the tablespaces that need to be migrated.

Sample migrations

Single-instance Oracle on file systems

This is an example of migrating a file-system-based, single-instance database on a Tru64 UNIX system to a target system running HP-UX 11i v2.

Source Tru64 UNIX environment:

- Single-node HP AlphaServer server running Tru64 UNIX 5.1B-1 Patch Kit 3 operating system
- Oracle10g database
- Database implemented using AdvFS file systems

1. Install the Oracle 10g software on the target system and create an empty database with the same SID as the Tru64 UNIX server was created.

In the Oracle-home directory on the target system, set up the shell's environment file (.profile) to create the ORACLE_SID environment variable using the same SID as on the Tru64 UNIX system. (In the steps that follow, the Oracle Home on the Tru64 UNIX system is \$oh-t64; on the target system, it is \$oh-ipf.)

2. On both the Tru64 UNIX server and the target system, define the following directory database object for the data pump utilities to use:

```
sqlplus "/ as sysdba"
SQL> CREATE DIRECTORY TRANSPORT_DUMP_DIR AS '/oracle/tmp';
SQL> QUIT;
```

3. Put the tablespaces you want to transport in READ ONLY mode on the Tru64 UNIX system:

```
sqlplus "/ as sysdba"
SQL> ALTER TABLESPACE MY_TABLESPACE READ ONLY;
SQL> QUIT;
```

4. Export the tablespaces metadata for the transport operation:

```
expdp TRANSPORT_TABLESPACES=(MY_TABLESPACE) \
TRANSPORT_FULL_CHECK=Y \
DIRECTORY=TRANSPORT_DUMP_DIR DUMPFILE=MyTableSpace.dmp
```

5. Use the rcp command to copy the data files that comprise the MY_TABLESPACE tablespace to the target system:

```
rcp -r $oh-t64/oradata/my_tablespace.dbf \
ipf-node:$oh-ipf/tmp/my_tablespace.dbf
rcp -r $oh-t64/tmp/MyTableSpace.dmp \
ipf-node:$oh-ipf/tmp/MyTableSpace.dmp
```

(FTP can also be used.)

6. Convert the data files to the native format for the target system running HP-UX. Use the Oracle rman command (executed on the target system) to convert the data files:

```
rman TARGET /
RMAN> CONVERT DATAFILE '/oracle/tmp/my_tablespace.dbf'
RMAN> FROM PLATFORM = 'HP Tru64 UNIX'
RMAN> DB_FILE_NAME_CONVERT = ('/oracle/tmp',
'/oracle/oradata');
RMAN> EXIT;
```

7. Remove the Tru64 UNIX data files on the target system as follows:

```
rm -f $oh-ipf/tmp/my_tablespace.dbf
```

8. Plug in the converted data files into the database on the target system with the following command (executed on the target system):

```
impdp DUMPFILE=MyTableSpace.dmp DIRECTORY=TRANSPORT_DUMP_DIR \
DATAFILES=/oracle/oradata/my_tablespace.dbf
```

9. Enable the tablespace for writing (executed on the target system):


```
sqlplus "/ as sysdba"
SQL> ALTER TABLESPACE MY_TABLESPACE READ WRITE;
SQL> QUIT;
```
10. Repeat steps 3 through 9 for each additional tablespace that still needs to be copied over from the Tru64 UNIX cluster.

You now have a running database with all the data from the tablespaces copied from the Tru64 UNIX system. When all the necessary tablespaces have been migrated to the target system, you can either shut down the Tru64 UNIX database system or configure the Tru64 UNIX system to propagate all the new changes to the target system using the Oracle Streams feature.

Single-instance Oracle on raw volumes

This is an example of migrating a single-instance raw-volume database from Tru64 UNIX to a target system running HP-UX 11i v2.

Source Tru64 UNIX environment:

- Single-node HP AlphaServer server running Tru64 UNIX Version 5.1B-1 Patch Kit 3 operating system
- Oracle10g
- Database implemented using "raw" LSM logical volumes (no file systems) to "raw" LVM logical volumes

1. Install the Oracle 10g software on the target system and create an empty database with the same SID as the Tru64 UNIX server).

In the Oracle-home directory on the target system, set up the shell's environment file (`.profile`) to create the `ORACLE_SID` environment variable using the same SID as on the Tru64 UNIX system. (In the steps that follow, Oracle Home on the Tru64 UNIX system is `$oh-t64`; on the target system, it is `$oh-ipf`.)

2. On both the Tru64 UNIX server and the target system, define the following directory database object for the data pump utilities to use:

```
sqlplus "/ as sysdba"
SQL> CREATE DIRECTORY TRANSPORT_DUMP_DIR AS '/oracle/tmp';
SQL> QUIT;
```

3. Put the tablespaces you want to transport in `READ ONLY` mode on the Tru64 UNIX system:

```
sqlplus "/ as sysdba"
SQL> ALTER TABLESPACE MY_TABLESPACE READ ONLY;
SQL> QUIT;
```

4. Export the tablespaces metadata for the transport operation:

```
expdp TRANSPORT_TABLESPACES=(MY_TABLESPACE) \
      TRANSPORT_FULL_CHECK=Y \
      DIRECTORY=TRANSPORT_DUMP_DIR DUMPFILE=MyTableSpace.dmp
```

5. Copy the data files that comprise the `MY_TABLESPACE` tablespace to the target system. Use `dd` piped to `rsh` to copy the data files in raw mode:

```
dd /dev/vol/oradg/mytsvol | gzip -9 | \
  rsh ipf-node '( gunzip | dd of=$oh-ipf/tmp/myts.dbf )'
```

Use `rcp` to copy the dump file:

```
rcp $oh-t64/tmp/MyTableSpace.dmp ipf-node:$oh-
ipf/tmp/MyTableSpace.dmp
```

(FTP can also be used.)

6. Convert the data files to the native format for the target system running HP-UX. Use the Oracle `rman` command (executed on the target system) to convert the data files:


```
rman TARGET /
      RMAN> CONVERT DATAFILE '/oracle/tmp/myts.dbf'
      RMAN> FROM PLATFORM = 'HP Tru64 UNIX'
      RMAN> DB_FILE_NAME_CONVERT = ('/oracle/tmp/myts.dbf',
      '/dev/vgora/lvol112');
      RMAN> EXIT;
```
7. Remove the Tru64 UNIX data files from the target system as follows:


```
rm -f $oh-ipf/tmp/myts.dbf
```
8. Plug in the converted data files into the database on the target system with the following command (executed on the target system):


```
impdp DUMPFILE=MyTableSpace.dmp DIRECTORY=TRANSPORT_DUMP_DIR \
      DATAFILES=/dev/vgora/lvol112
```
9. Enable the tablespace for writing (executed on the target system):


```
sqlplus "/ as sysdba"
      SQL> ALTER TABLESPACE MY_TABLESPACE READ WRITE;
      SQL> QUIT;
```
10. Repeat steps 3 through 9 for each additional tablespace that needs to be copied over from the Tru64 UNIX system.

You now have a running database with all the data from the tablespaces copied from the Tru64 UNIX system. When all the necessary tablespaces have been migrated to the target system, you can either shut down the Tru64 UNIX database system or configure the Tru64 UNIX system to propagate all the new changes to the target system using the Oracle Streams feature.

Multiple-instance Real Application Clusters

Source Tru64 UNIX environment:

- Two-node cluster running Tru64 UNIX Version 5.1B Patch Kit 3 operating system
 - Oracle 10g with the Real Application Clusters option
 - Database implemented using Cluster File System (CFS)
1. On both nodes of the target cluster, install HP-UX 11i v2 and Serviceguard eRAC. Configure the two-node cluster per the installation instructions for eRAC and then start up the cluster (using `cmruncl`) as the root user.
 2. Install the Oracle 10g software on both nodes of the target cluster (selecting the Real Applications option) and create an empty RAC database with the same SIDs as the Tru64 UNIX cluster database.

In the Oracle-home directories on the target cluster, set up the shell's environment file (`.profile`) to create the `ORACLE_SID` environment variable using the same SIDs as on the Tru64 UNIX cluster. (In the steps that follow, Oracle Home on the Tru64 UNIX cluster is `$oh-t64`; on the target cluster it is `$oh-ipf`.)
 3. On both the Tru64 UNIX cluster and the target cluster, define the following directory database object for the data pump utilities to use:


```
sqlplus "/ as sysdba"
      SQL> CREATE DIRECTORY TRANSPORT_DUMP_DIR AS '/oracle/tmp';
      SQL> QUIT;
```
 4. Put the tablespaces you want to transport in `READ ONLY` mode on the Tru64 UNIX cluster:


```
sqlplus "/ as sysdba"
      SQL> ALTER TABLESPACE MY_TABLESPACE READ ONLY;
      SQL> QUIT;
```

5. Export the tablespaces metadata for the transport operation:


```
expdp TRANSPORT_TABLESPACES=(MY_TABLESPACE) \
      TRANSPORT_FULL_CHECK=Y \
      DIRECTORY=TRANSPORT_DUMP_DIR DUMPFILE=MyTableSpace.dmp
```
6. Use the `rcp` command to copy the data files that comprise the `MY_TABLESPACE` tablespace to the target cluster:


```
rcp -r $oh-t64/oradata/my_tablespace.dbf \
      ipf-nodel:$oh-ipf/tmp/my_tablespace.dbf
rcp -r $oh-t64/tmp/MyTableSpace.dmp \
      ipf-nodel:$oh-ipf/tmp/MyTableSpace.dmp
```

(FTP can also be used.)
7. Convert the data files to the native format for the target system running HP-UX. Use the Oracle `rman` command (executed on the target system to which you copied the files in the previous step) to convert the data files:


```
rman TARGET /
      RMAN> CONVERT DATAFILE '/oracle/tmp/my_tablespace.dbf'
      RMAN> FROM PLATFORM = 'HP Tru64 UNIX'
      RMAN> DB_FILE_NAME_CONVERT =
      ('/oracle/tmp/my_tablespace.dbf',
      '/dev/vgora/lvol12');
      RMAN> EXIT;
```
8. Remove the Tru64 UNIX data files on the target system as follows:


```
rm -f $oh-ipf/tmp/my_tablespace.dbf
```
9. Plug in the converted data files into the database on the target system with the following command (executed on the target cluster):


```
impdp DUMPFILE=MyTableSpace.dmp DIRECTORY=TRANSPORT_DUMP_DIR \
      DATAFILES=/dev/vgora/lvol12
```
10. Enable the tablespace for writing (executed on the target cluster):


```
sqlplus "/ as sysdba"
      SQL> ALTER TABLESPACE MY_TABLESPACE READ WRITE;
      SQL> QUIT;
```
11. Repeat steps 4 through 10 for each additional tablespace that needs to be copied over from the Tru64 UNIX cluster.

You now have a running database with all the data from the tablespaces copied from the Tru64 UNIX cluster. When all the necessary tablespaces have been migrated to the target cluster, you can either shut down the Tru64 UNIX database cluster or configure the Tru64 UNIX cluster to propagate all the new changes to the target system using the Oracle Streams feature.

For more information

For additional information and assistance, contact:

transition.modules@hp.com

For more information about the Alpha RetainTrust program and other sources of support, go to:

<http://www.hp.com/go/alpha-retaintrust/>

For technical and planning information about transition subjects, go to:

<http://www.hp.com/go/tru64transition/>

<http://www.hp.com/go/transition-modules>

For information regarding the Tru64 UNIX roadmap, go to:

http://h30097.www3.hp.com/unix/downloads/tru64_unix_roadmap.ppt

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5982-5472EN, 05/2004

