

# Cross Platform DB Migration using RMAN

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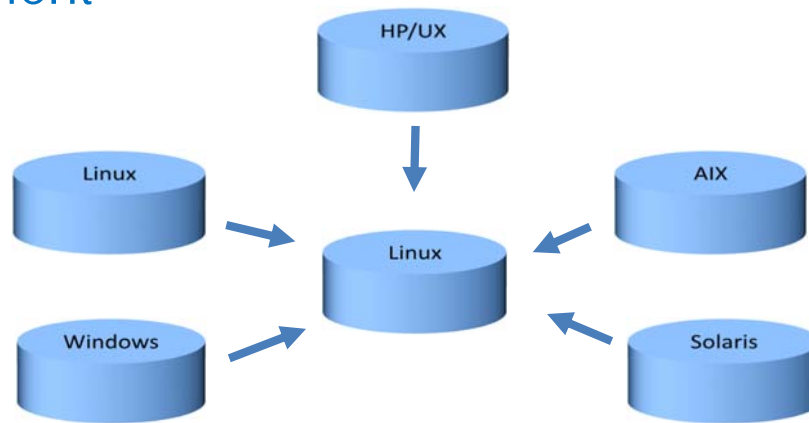
*Longtime Oracle Technologist*

DocID: P91101Date: 20160930

## Why This Session?

- Cross Platform DB Migration
  - Data Pump Export/Import
    - Outage Time
    - Space needed
  - Transportable Tablespace
    - Outage Time
  - Data Guard
    - Has to be same platform
  - RMAN Duplicate
    - Outage Time
- Golden Gate
  - Truly zero-downtime solution
  - Expensive.

## Requirement



## What to expect

- Cross-platform migration
- Without using GoldenGate
- Minimal downtime allowed


## What not to expect

- Not a general purpose migration discussion
- Not a prescription for every situation
- Feel free to copy and use the scripts; but use at your own risk

Data Guard


# Byte Order

שלום

1234  
  
*Left to Right*



$10^3$   $10^2$   $10^1$   $10^0$

4321  
  
*Right to Left*



$10^0$   $10^1$   $10^2$   $10^3$

Endian.

# Data Guard?

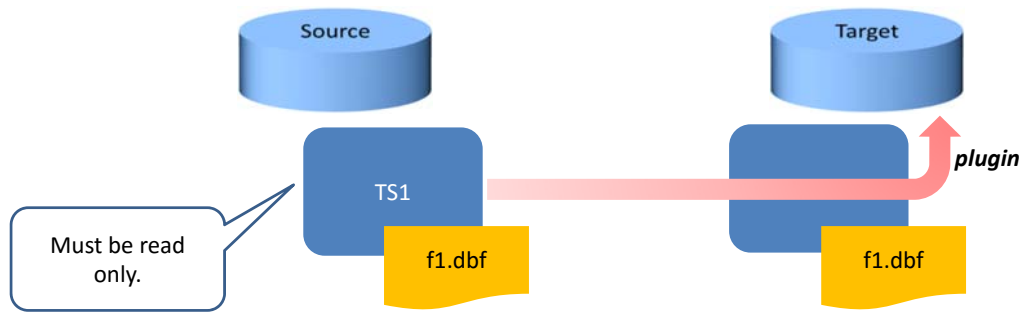
- Data Guard Support for Heterogeneous Primary and Physical Standbys in Same Data Guard Configuration (Doc ID 413484.1)

PLATFORM_ID	PLATFORM_NAME Release name	PLATFORM_IDs supported within the same Data Guard configuration when using Data Guard Redo Apply (Physical Standby)
2	Solaris[tm] OE (64-bit) Solaris Operating System (SPARC) (64-bit)	2 6 - See Support <a href="#">Note: 1982638.1</a> and <a href="#">Note: 414043.1</a>
3	HP-UX (64-bit) HP-UX PA-RISC	3 4 - Oracle 10g onward, see Support <a href="#">Note: 395982.1</a> and <a href="#">Note:414043.1</a>

## Same Endian Format Bugs

- Possible bugs, e.g. 13104881 ORA-600 [6101] DATA CORRUPTION IN 11.2.0.2 WINDOWS TO LINUX STANDBY DUPLICATION

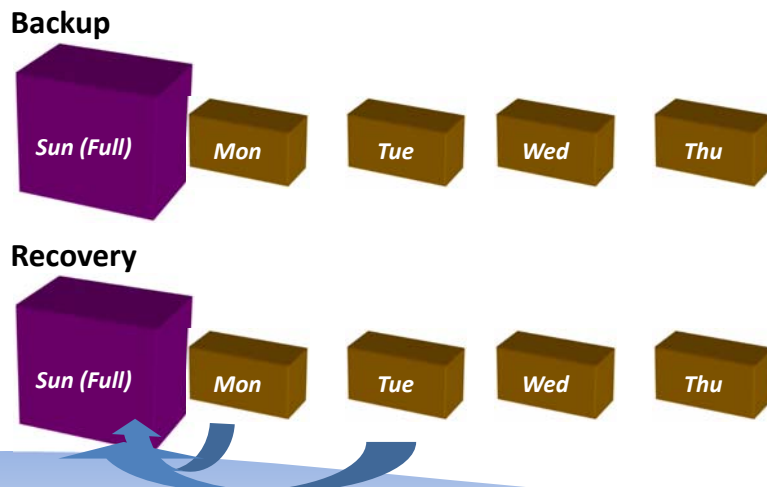
## Transportable Tablespace



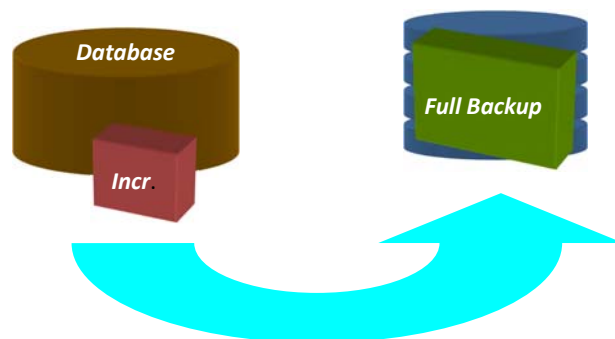
## Transporting the tablespace TS1

## RMAN Incremental Merge

# Default Recovery



# Merged Backup

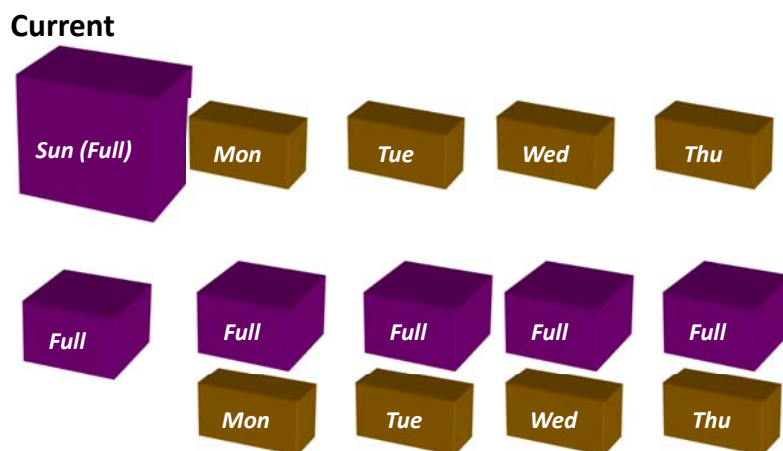


## Merge Backup

backup incremental  
level 1  
for recover of copy  
with tag weekly  
database;  
recover  
copy of database  
with tag weekly;

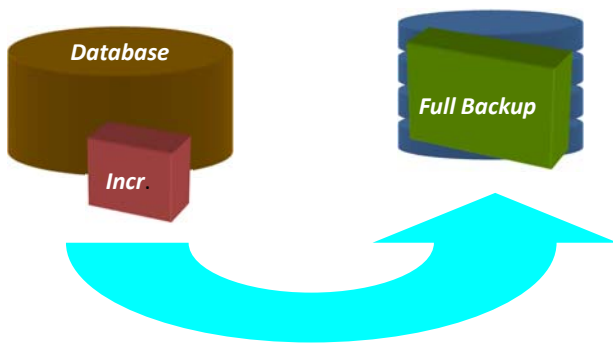


## Recovery Scenario





## Immediate Recovery



Use the image copy  
as main datafile

```
RMAN> switch datafile 5 to copy;
```

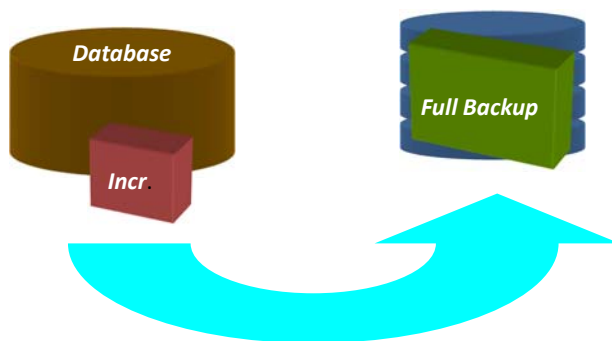
## BCT File

- Incremental backup still goes through the files to see which blocks changed
- Adds to time and performance
- Enter – Block Change Tracking

## BCT

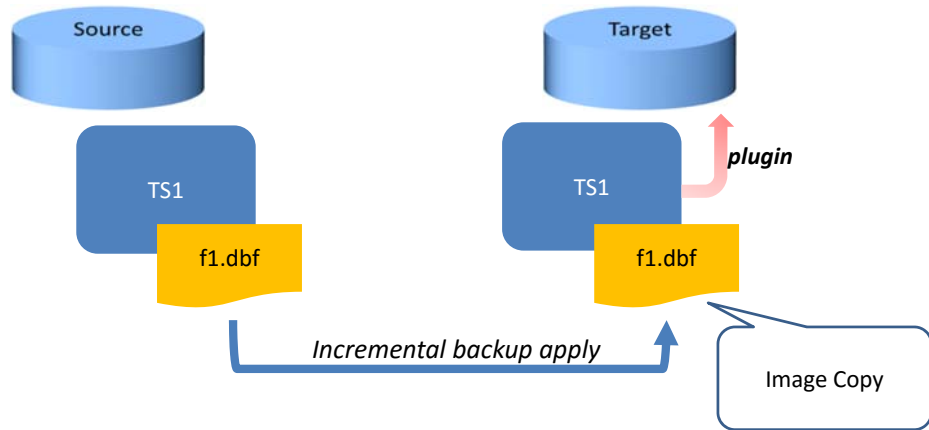
- Command:  
`alter database enable  
block change tracking using file  
'/home/oracle/orabackup/bct_prodb2.dbf';`
- Must be available to all instances of RAC.
- Size approx 10MB per 1 TB
- Test: `select * from v$block_change_tracking;`
- Ensure: `select used_change_tracking from  
v$backup_datafile;`

## Immediate Recovery

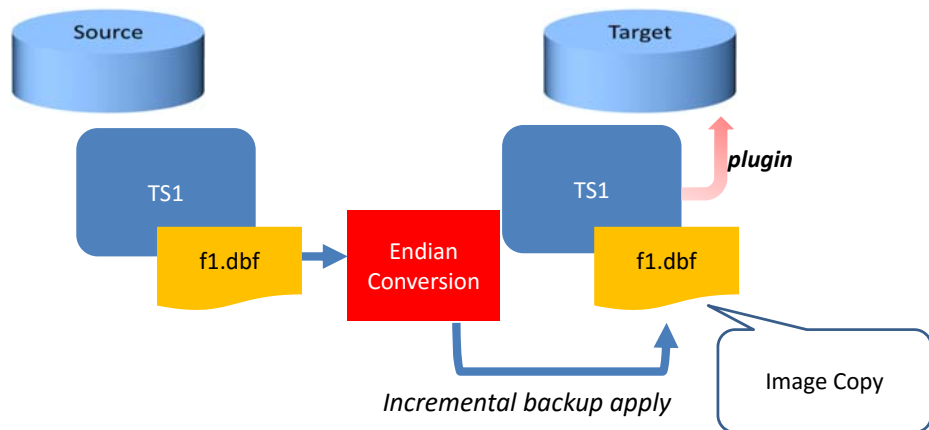


Use the image copy  
as main datafile

```
RMAN> switch datafile 5 to copy;
```



## Endian Conversion



# Convert Byte Order

- First, find the platform

```
SQL> select * from v$transportable_platform order by platform_id;
```

PLATFORM_ID	PLATFORM_NAME	ENDIAN_FORMAT
1	Solaris[tm] OE (32-bit)	Big
2	Solaris[tm] OE (64-bit)	Big
3	HP-UX (64-bit)	Big
4	HP-UX IA (64-bit)	Big
5	HP Tru64 UNIX	Little
6	AIX-Based Systems (64-bit)	Big
7	Microsoft Windows IA (32-bit)	Little
8	Microsoft Windows IA (64-bit)	Little
9	IBM zSeries Based Linux	Big
10	Linux IA (32-bit)	Little
11	Linux IA (64-bit)	Little
12	Microsoft Windows 64-bit for AMD	Little
13	Linux 64-bit for AMD	Little
15	HP Open VMS	Little
16	Apple Mac OS	Big

# RMAN Endian Conversion

- At source host (TS must be read only)

```
RMAN> convert tablespace users
```

```
2> to platform 'HP-UX (64-bit)'
```

```
3> format='/home/oracle/rman_bkups/%N_%f';
```

- At target

```
RMAN> convert tablespace users, maints
```

```
2> to platform 'HP-UX (64-bit)'
```

```
3> format='/home/oracle/rman_bkups/%N_%f'
```

```
4> parallelism = 5;
```

<http://www.oracle.com/technetwork/articles/sql/week16-10gdba-094518.html>

# Steps

	Source	Target
1	Take RMAN Image Copy	
2	Copy to Target	
3		Convert Endian Format
Loop	4	Take Incremental Backup
	5	Copy to target
	6	Convert Endian Format
	7	Apply Incremental to the Image Copy
Outage	8	Make Tablespace Read Only
	9	Take Final RMAN Incremental Backup
	10	Apply Incremental to Image Copy
	11	Use Image Copy as Source for Transported Tablespace

Steps

## Create a Target DB

- Create a database with all minimum tablespaces
- SYSTEM, SYSAUX, etc.
- No user tablespaces

## Export Metadata

- Export all metadata from source system

```
expdp ... dumpfile=metadata_full.dmp full=y
content=metadata_only
exclude=user,role,role_grant,profile
exclude=table_statistics exclude=index_statistics
```
- Excluding users, roles, profiles, etc. (will do later)
- Excluding statistics
  - Exporting stats are time consuming
  - more so during import



## Take an Image Copy Backup

- RMAN Image Copy
- We divided the files into multiple sets.

```
RMAN> backup as copy tag 'set001' datafile  
11,12,13,14 format '/imgbak1/file%f.bkp;
```

- Parallelize the image copy creation process
- Restart if something fails

## Pipe the Image Copy

*Source System*



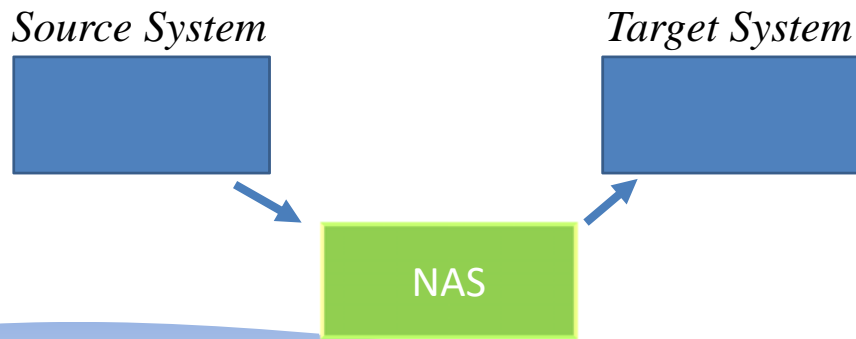
Unix Pipe



*Target System*



## Use NAS



## Convert the Image Copy

- On the target system
- If the endian format is different

```
RMAN> datafile '/imgbk1/users01.dbf'  
  2> format='/db/users01.dbf'  
  3> parallelism = 16;
```
- No need to restore anything, yet.
- This becomes the Level 0 Image Copy



## Prepare for Incremental

- Incremental from “what”?
  - There is already another backup (the regular one)
- RMAN incremental has a “from SCN” clause.
  - <http://arup.blogspot.com/2009/12/resolving-gaps-in-data-guard-apply.html>
- Find the checkpoint SCN#  
`select min(checkpoint_change#) from v$datafile;`
- Record MIN-CKPT-NO.

## Backup Incremental

- Backup incremental:  
`backup incremental  
from scn <MIN-CKPT-NO>  
tablespace 'TS1'  
format '/incbk1/%U';`
- The name doesn't matter; the location does.

# Convert Endian-ness

- If needed, as shown earlier

## Apply the Incrementals

```
declare
  l_dev varchar2(4000);
  l_hdl varchar2(4000);
  l_tag varchar2(4000);
  l_done Boolean;

begin
  l_dev := sys.dbms_backup_restore.deviceallocate;
  dbms_backup_restore.applysetdatafile
    (check_logical=>false, cleanup=>false);

  dbms_backup_restore.applydatafileto (
    dfnumber      => 42,
    toname        => '/dbloc/f42.dbf',
    fuzziness_hint => 0,
    max_corrupt   => 0,
    islevel0      => 0,
    recid         => 0,
    stamp         => 0
  );

  dbms_backup_restore.restoresetpiece
  (
    handle => '/incbk1/bk42.bkp',
    tag    => null,
    fromdisk => true,
    recid  => 0,
    stamp  => 0
  );

  dbms_backup_restore.restorebackuppiece
  (
    done      => l_done,
    params    => null,
    outhandle => l_hdl,
    outtag    => l_tag,
    failover  => failover
  );

  dbms_backup_restore.restorecancel (true);
  dbms_backup_restore.devicedeallocate;
end;
/
```

## Repeat Until Day 0

- Take Incremental Backup
- Convert at Target
- Apply to Image Copy

D-Day

## Export Stats

- Export the stats from the source

```
begin
  dbms_stats.create_stat_table
    (<User1>, 'USER1_STATS');
end;
```
- Repeat for all relevant users
- Alternative:

```
dbms_stats.export_database_stats
  ('USER1_STATS', 'WHOLE_DB', user);
```

Outage Starts





## Make Tablespaces Read Only

- On the Source Database

```
begin
  for tname in (
    select tablespace_name
    from dba_tablespaces
    where tablespace_name not in ('SYSTEM','SYSAUX')
    and contents = 'PERMANENT'
  ) loop
    execute immediate
      'alter tablespace '||tname.tablespace_name
      ||' read only';
  end loop;
end;
/
```



## Export all Users, Roles, etc.

- Take a datapump export of all users, roles, grants, etc.

```
expdp ... full=y
include=user,role,role_grant,profile
```

- Copy over to the target system



## Take Metadata Export

- Metadata export of all user tablespaces  
`expdp ... exclude=table_statistics  
exclude=index_statistics dumpfile=transport.dmp`
- Excluding the stats since we take them separately

## 11 Final Incremental

- Take a final incremental backup
- Apply it to the Image Copy at the target system
- Now the Image copy is up to date.

## 12 Create Users

- Create or users, roles, privileges, profiles, etc.

```
impdp ... full=y  
include=user,role,role_grant,profile
```

## 13 Plug the TS'es in

- Import all transportable tablespaces.

```
impdp dumpfile=transport.dmp  
transport_datafiles='/db/f42.dbf', '/db/f43.dbf', ...
```

- Note the location of the files
- It's the image copy location

## 14 Make it Read Write

- The plugged in TS'es are all Read Only  
begin

```
  for tname in (
    select tablespace_name
    from dba_tablespaces
    where tablespace_name not in ('SYSTEM','SYSAUX')
    and contents = 'PERMANENT'
  ) loop
    execute immediate
      'alter tablespace '||tname.tablespace_name
      ||' read write';
  end loop;
end;
/
```

## 15 Import Rest of the Objects

- Import all other objects

– Except stats

```
impdp ... dumpfile=full.dmp full=y
exclude=table_statistics
exclude=index_statistics
```



## 16 Adjust Sequences

- Sequence caches could have been used
- Options
  1. Drop all sequences and import them from source
    1. Recompile all objects
    2. Increment the values to use up to the cache value

## 17 DB Links

- DB links point to different hosts
- They may not be open for firewalls
- Check and adjust as needed

## 18 Recompile Invalid Objects

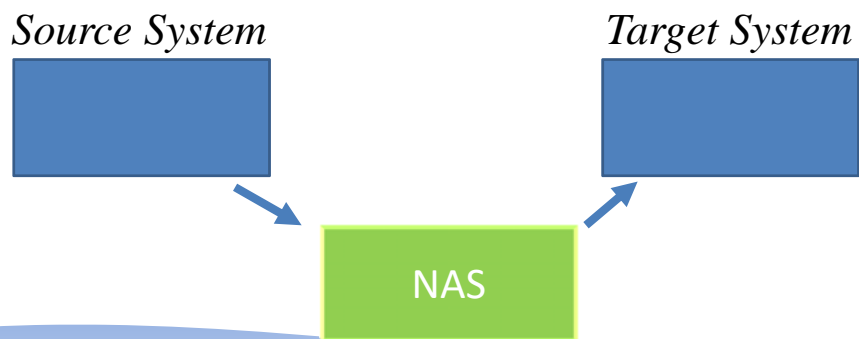
- Some objects may have become invalid
- Compile them  
SQL> @\$OH/rdbms/admin/utlrp.sql

## 19 Gather Stats

- Optimizer stats are not present, yet
- Options:
  1. Gather fresh stats
  2. Reinstatate stats from the source



If NAS was used ...



## Create the DB on the SAN

*Source System*



*Target System*



NAS

RMAN Duplicate  
Database



SAN

## Valuable Tips

- Convert endian format at the target; not the source
  - Doesn't affect the source's CPU
- Maximize parallelism in RMAN convert operation
- Importing statistics as a part of full export takes about 10X longer
  - Better off re-gathering stats
- Watch out for DB link invalidations due to new source host
  - Firewalls may need to be adjusted, ports need to be open
- Don't skip sequence adjustment



# *Thank You!*

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