Cross Platform DB Migration using RMAN

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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
• Golden Gate
  • Truly zero-downtime solution
  • Expensive.
  • RMAN Duplicate
    • Outage Time
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
Byte Order

 helyom

1234  
Left to Right

4321  
Right to Left

1 2 3 4

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

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

Endian.

Data Guard?

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

<table>
<thead>
<tr>
<th>PLATFORM_ID</th>
<th>PLATFORM_NAME</th>
<th>PLATFORM_IDs supported within the same Data Guard configuration when using Data Guard Redo Apply (Physical Standby)</th>
</tr>
</thead>
</table>
| 2           | Solaris[tm] OE (64-bit)  
Solaris Operating System (SPARC) (64-bit) | 2  
6 - See Support Note: 1982638.1 and Note: 414043.1                                                  |
| 3           | HP-UX (64-bit)  
HP-UX PA-RISC | 3  
4 - Oracle 10g onward, see Support Note: 395982.1 and Note: 414043.1                               |
Same Endian Format Bugs

- Possible bugs, e.g. 13104881 ORA-600 [6101] DATA CORRUPTION IN 11.2.0.2 WINDOWS TO LINUX STANDBY DUPLICATION
Transporting the tablespace TS1

Must be read only.

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**

[Diagram showing backup schedule]

- **Current**
  - Sun (Full)
  - Full
  - Full
  - Full
  - Full

- **Weekly**
  - Mon
  - Tue
  - Wed
  - Thu
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:
  ```sql
  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;
```
Cross Platform DB Migration Using RMAN

Incremental backup apply

Endian Conversion

Incremental backup apply
Convert Byte Order

- First, find the platform

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

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

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

<table>
<thead>
<tr>
<th>Source</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Take RMAN Image Copy</td>
<td></td>
</tr>
<tr>
<td>2 Copy to Target</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Convert Endian Format</td>
</tr>
<tr>
<td>4 Take Incremental Backup</td>
<td></td>
</tr>
<tr>
<td>5 Copy to target</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Convert Endian Format</td>
</tr>
<tr>
<td>7</td>
<td>Apply Incremental to the Image Copy</td>
</tr>
<tr>
<td>8 Make Tablespace Read Only</td>
<td></td>
</tr>
<tr>
<td>9 Take Final RMAN Incremental Backup</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Apply Incremental to Image Copy</td>
</tr>
<tr>
<td>11</td>
<td>Use Image Copy as Source for Transported Tablespace</td>
</tr>
</tbody>
</table>

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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 <-> Target System
Unix Pipe
Use NAS

Source System

NAS

Target System

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.

- 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

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Cross Platform DB Migration Using RMAN

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Apply the Incrementals

```sql
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.restorebackuppiece (done => l_done,
        params => null,
        outhandle => l_hdl,
        outtag => l_tag,
        failover => failover);
    dbms_backup_restore.restorecancel (true);
    dbms_backup_restore.devicedeallocate;
end;
/
```

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Repeat Until Day 0

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

D-Day
Export Stats

- Export the stats from the source
  ```sql
  begin
    dbms_stats.create_stat_table
    (<User1>, 'USER1_STATS');
  end;
  ```
- Repeat for all relevant users
- Alternative:
  ```sql
  dbms_stats.export_database_stats
  ('USER1_STATS', 'WHOLE_DB', user);
  ```
**Make Tablespaces Read Only**

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

**Export all Users, Roles, etc.**

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

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 tsname in (select tablespace_name
                      from dba_tablespaces
                     where tablespace_name not in ('SYSTEM','SYSAUX')
                         and contents = 'PERMANENT') loop
        execute immediate
            'alter tablespace ' || tsname.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
- The 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. Reinstate stats from the source
If NAS was used …

Source System

Target System

NAS
Create the DB on the SAN

**Source System**

**Target System**

NAS

SAN

RMAN Duplicate Database

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**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

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**Arup Nanda**
Thank You!

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