DATA SOFTECH INC.

Complete Database Solution Provider

ORACLE 11g Database Replay

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Principal Consultant

Agenda

- Why DB Replay
- DB Replay Overview
- System Architecture
- Supported Workloads
- Capture the Workload
- Pre-Processing the Capture Workload
- Replay the Workload
- Analyze the Data
- Replay Setup using Enterprise Manager
- Replay Setup using API's
- Q&A

Why Database Replay

- System changes
  - Need Hardware Upgrade like CPU, Memory
  - Need Database/Operating System Upgrades
  - Storage Changes like filesystem to ASM or vice-versa
  - Microsoft to Linux or OS migrations
- Configuration changes
  - Single Instance to Multi-node RAC
  - Schema/Parameters
  - Patches
- Identify, analyze and fix potential instabilities before making changes to production
- Save Time and Money
- More thorough testing which is missed in most of the testing
- Provide Real world testing without real-life testers

DB Replay Overview

- Recreate actual production database workload in QA environment
- DB Replay components or Phases
  - Backup the Production/Source Database
    -> User RMAN or other Backup Approach
  - Configure EM Console as it is recommended option
    -> emca -config dbcontrol db -repos recreate
  - Capturing Phase
    -> Start the Capture process
    -> Apply/start the Load/Apps
    -> Stop the Capture Process
  - Move the Captured Workload on OS to Test Server
  - Pre-processing Phase
  - Restore the backup on Test Database
  - Replay Phase
  - Analysis
    -> Error or Data Divergence

DB Replay – Workload Capture .....Contd.

Prerequisites for Capturing Database Workload

- Backup the Database
  - -> RMAN
  - -> Imp/exp
  - -> Snapshot Standby
  - -> Point-in-time recovery using a target SCN
- Allocate physical space for Recording

  $ mkdir -p /home/capture_dir

  SQL> CREATE DIRECTORY "captdir" AS '/home/capture_dir'

  -> Make sure you have enough space to store the Captured Workload files
- Configure Enterprise Manager DB Console

Points of Consideration before Capturing Database Workload

- Disk Storage based on time of Recoding
- Performance Overhead
- Memory Overhead : 64K per session

DB Replay – Workload Capture .....Contd.

Capture the Workload in Production

- Start the Capturing process
  - -> Using Enterprise Manager
  - -> Using APIs
    - DBMS_WORKLOAD_CAPTURE.START_CAPTURE
- Start the Application to apply real Load on the System
- Stop the Capturing process
  - -> Using Enterprise Manager
  - -> Using APIs
    - DBMS_WORKLOAD_CAPTURE.FINISH_CAPTURE
- Transfer the Data for processing to test system

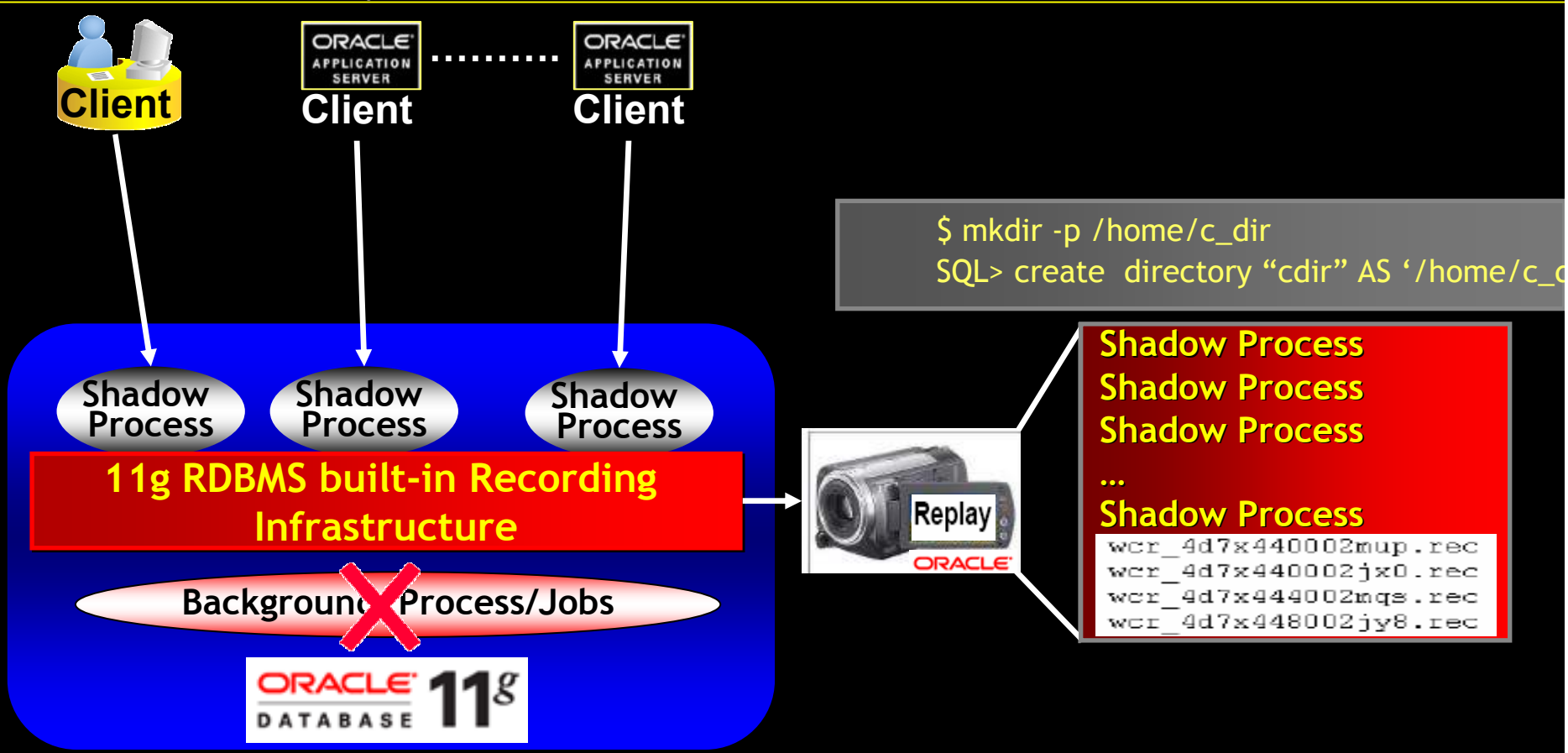
DB Replay – Workload Capture .....Contd.

```
SQL> select name,          directory,      status, start_time,
            end_time,      duration_secs,          dir_path
     from dba_workload_captures

NAME        DIRECTORY  STATUS          START_TIME END_TIME DURATION   DIR_PATH
----------  ---------- --------------- ---------- -------- ---------- --------------------
capture07   API_DIR    IN PROGRESS     26-JUL-07                      /home/oracle/api_dir
```

You will see the END_TIME is null as Capture is still running as shown by STATUS column

```
SQL> select name,          directory,      status, start_time,
            end_time,      duration_secs,          dir_path
     from dba_workload_captures

NAME        DIRECTORY  STATUS          START_TIME END_TIME DURATION   DIR_PATH
----------  ---------- --------------- ---------- -------- ---------- --------------------
capture07   API_DIR    COMPLETED       26-JUL-07  26-JUL-07 6913        /home/oracle/api_dir
```

DB Replay – Workload Capture Flow….Contd.



DB Replay – Workload Capture .....Contd.

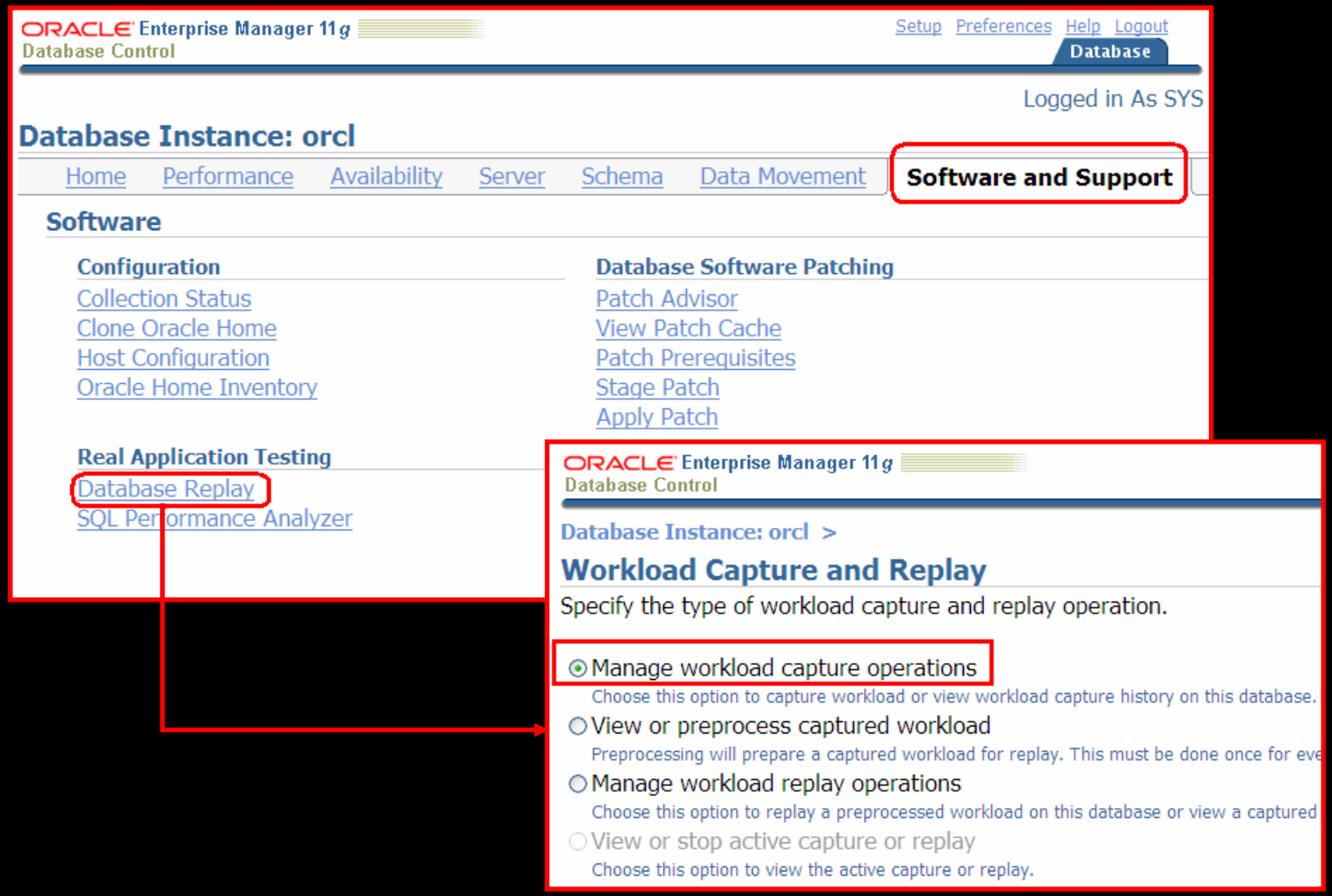
What is supported for Workload

- All DDL,DML and PL/SQL statements along with binds
- Lobs
- Login and Logoffs
- Local Transactions

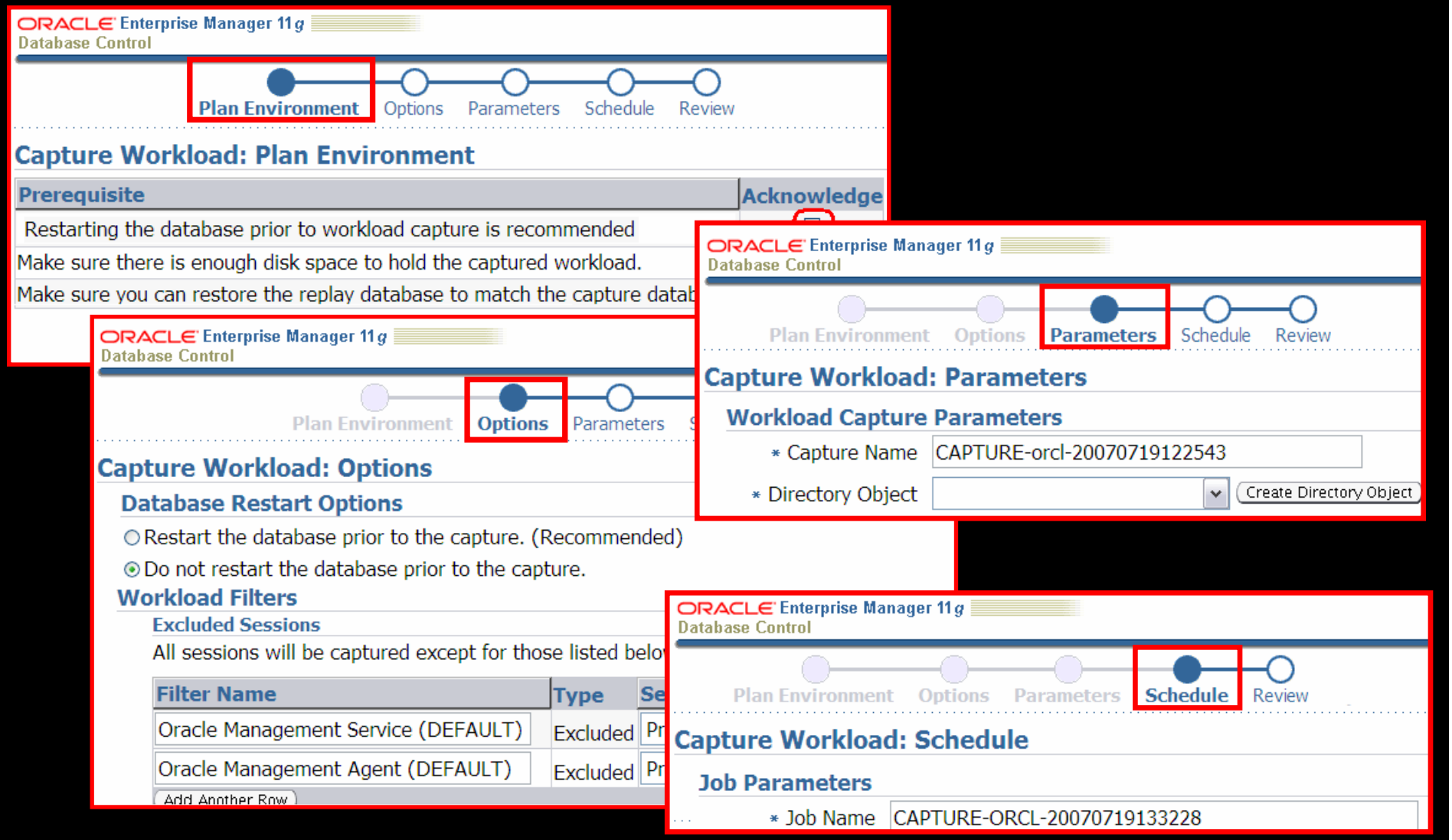
What is supported for Workload

- Direct Path Load using Sql*Loader
- Export and Import
- Oracle Streams
- Flashback
- Distributed Transactions(these transactions are replayed as Local transaction)

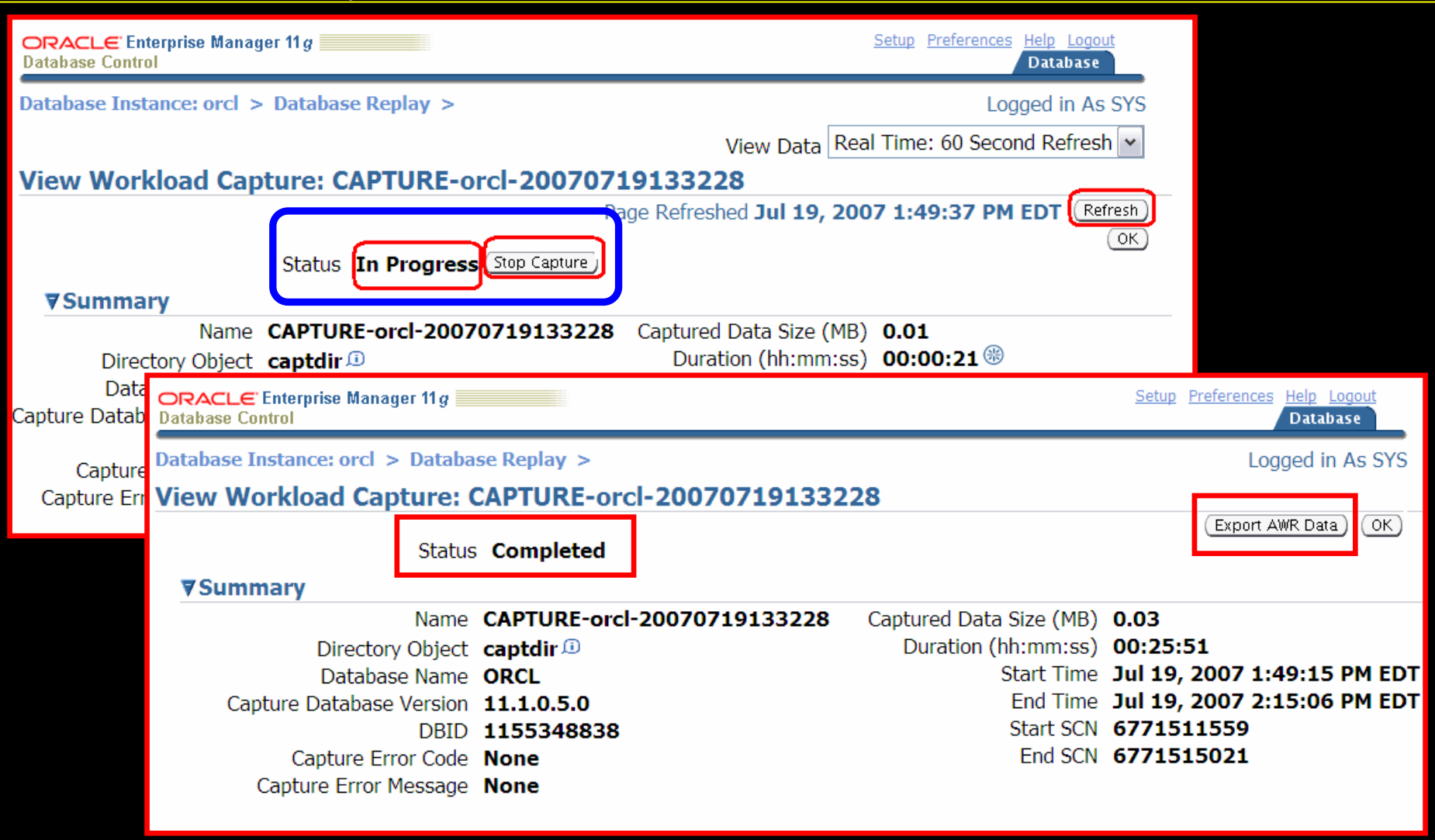
DB Replay – Workload Capture-EM……Contd.



DB Replay – Workload Capture-EM……Contd.



DB Replay – Workload Capture-EM……Contd.



DB Replay – Workload Capture –API….Contd.

Starting a Workload Capture

```
[db02pn]$ mkdir /home/oracle/api_dir

SQL> create directory api_dir as '/home/oracle/api_dir';

Directory created.

SQL> BEGIN
  2  DBMS_WORKLOAD_CAPTURE.START_CAPTURE (name => 'capture07',
  3  dir => 'API_DIR',
  4  NO_RESTART_MODE => TRUE);
  5  END;
  6  /
```

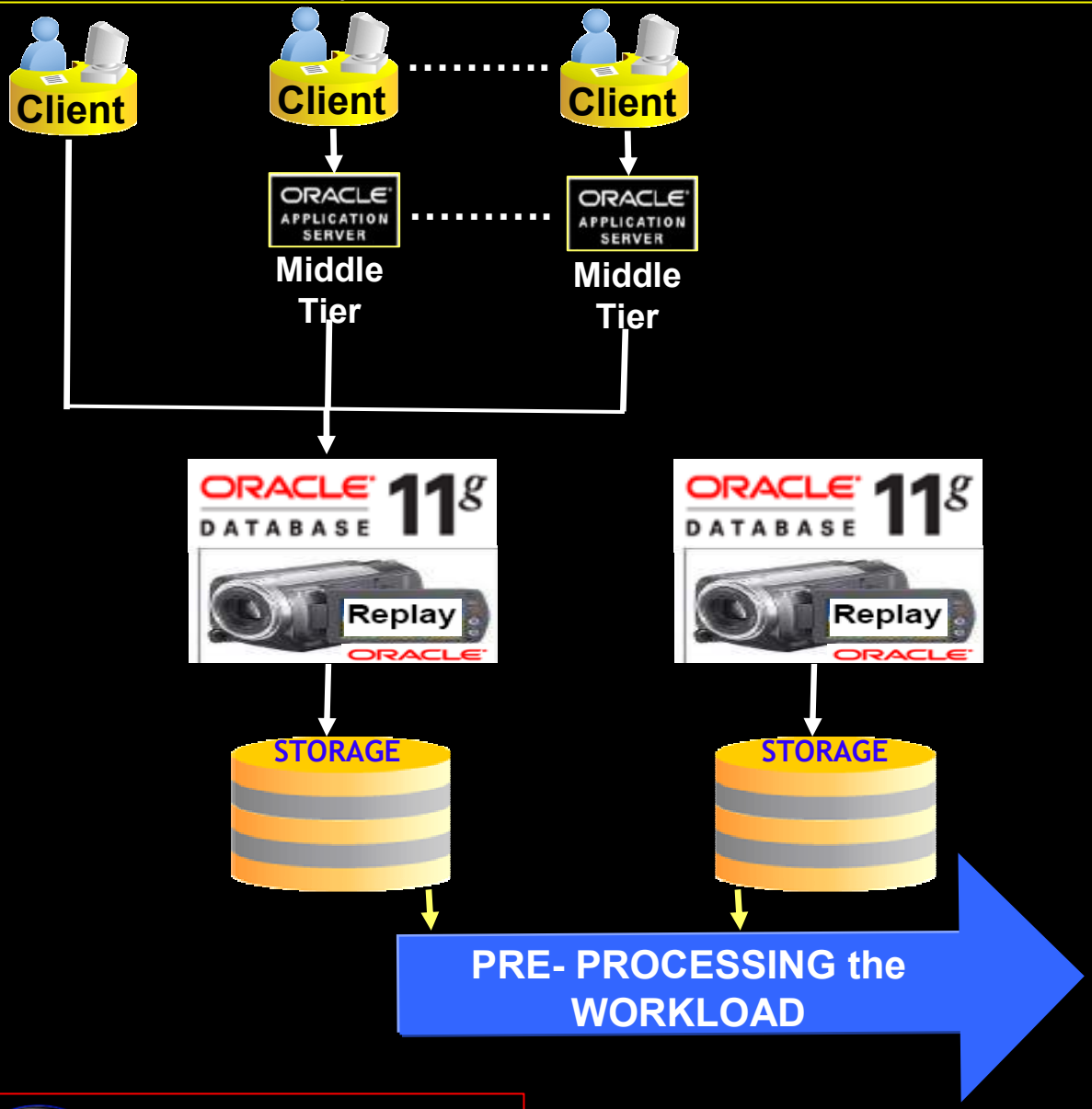
Stopping a Workload Capture

```
SQL> BEGIN
  2 DBMS_WORKLOAD_CAPTURE.FINISH_CAPTURE ();
  3 END;
  4 /
PL/SQL procedure successfully completed
```

DB Replay – Workload Capture .....Contd.

```
[oracle@capture_dir]$ ls -ltr
total 13492
-rw-r-----  1 oracle oinstall       0 Jul 19 13:49 wcr_rec_00001.start
-rw-r-----  1 oracle oinstall    1348 Jul 19 13:49 wcr_4d7x440002mup.rec
-rw-r-----  1 oracle oinstall     928 Jul 19 13:49 wcr_4d7x440002jx0.rec
-rw-r-----  1 oracle oinstall    1140 Jul 19 13:49 wcr_4d7x444002mqs.rec
-rw-r-----  1 oracle oinstall     928 Jul 19 13:49 wcr_4d7x448002jy8.rec
-rw-r-----  1 oracle oinstall    1127 Jul 19 13:49 wcr_4d7x448002k49.rec
-rw-r-----  1 oracle oinstall    1128 Jul 19 13:49 wcr_4d7x44h002k2m.rec
-rw-r-----  1 oracle oinstall    1126 Jul 19 13:49 wcr_4d7x45s002k84.rec
-rw-r-----  1 oracle oinstall     913 Jul 19 13:49 wcr_4d7x460002ksw.rec
-rw-r-----  1 oracle oinstall    1128 Jul 19 13:49 wcr_4d7x460002kma.rec
-rw-r-----  1 oracle oinstall    1124 Jul 19 13:49 wcr_4d7x460002km8.rec
-rw-r-----  1 oracle oinstall    1128 Jul 19 13:49 wcr_4d7x46n002k4c.rec
-rw-r-----  1 oracle oinstall    1140 Jul 19 13:49 wcr_4d7x46w002k4g.rec
-rw-r-----  1 oracle oinstall    2604 Jul 19 13:50 wcr_4d7x49n002mxp.rec
-rw-r-----  1 oracle oinstall    2402 Jul 19 13:50 wcr_4d7x49s002mxt.rec
-rw-r-----  1 oracle oinstall    1128 Jul 19 13:50 wcr_4d7x4ah002k9p.rec
-rw-r-----  1 oracle oinstall    1128 Jul 19 13:50 wcr_4d7x4ah002k47.rec
-rw-r-----  1 oracle oinstall    1835 Jul 19 13:53 wcr_4d7x54c002n60.rec
-rw-r-----  1 oracle oinstall    2501 Jul 19 13:58 wcr_4d7x65h002nb7.rec
-rw-r-----  1 oracle oinstall    2925 Jul 19 13:58 wcr_4d7x65h002nba.rec
-rw-r-----  1 oracle oinstall    1836 Jul 19 13:58 wcr_4d7x69s002nd3.rec
-rw-r-----  1 oracle oinstall    1751 Jul 19 13:58 wcr_4d7x6an002nf9.rec
-rw-r-----  1 oracle oinstall    1833 Jul 19 14:03 wcr_4d7x7gc002np1.rec
-rw-r-----  1 oracle oinstall    1836 Jul 19 14:08 wcr_4d7x8ns002nzz.rec
```

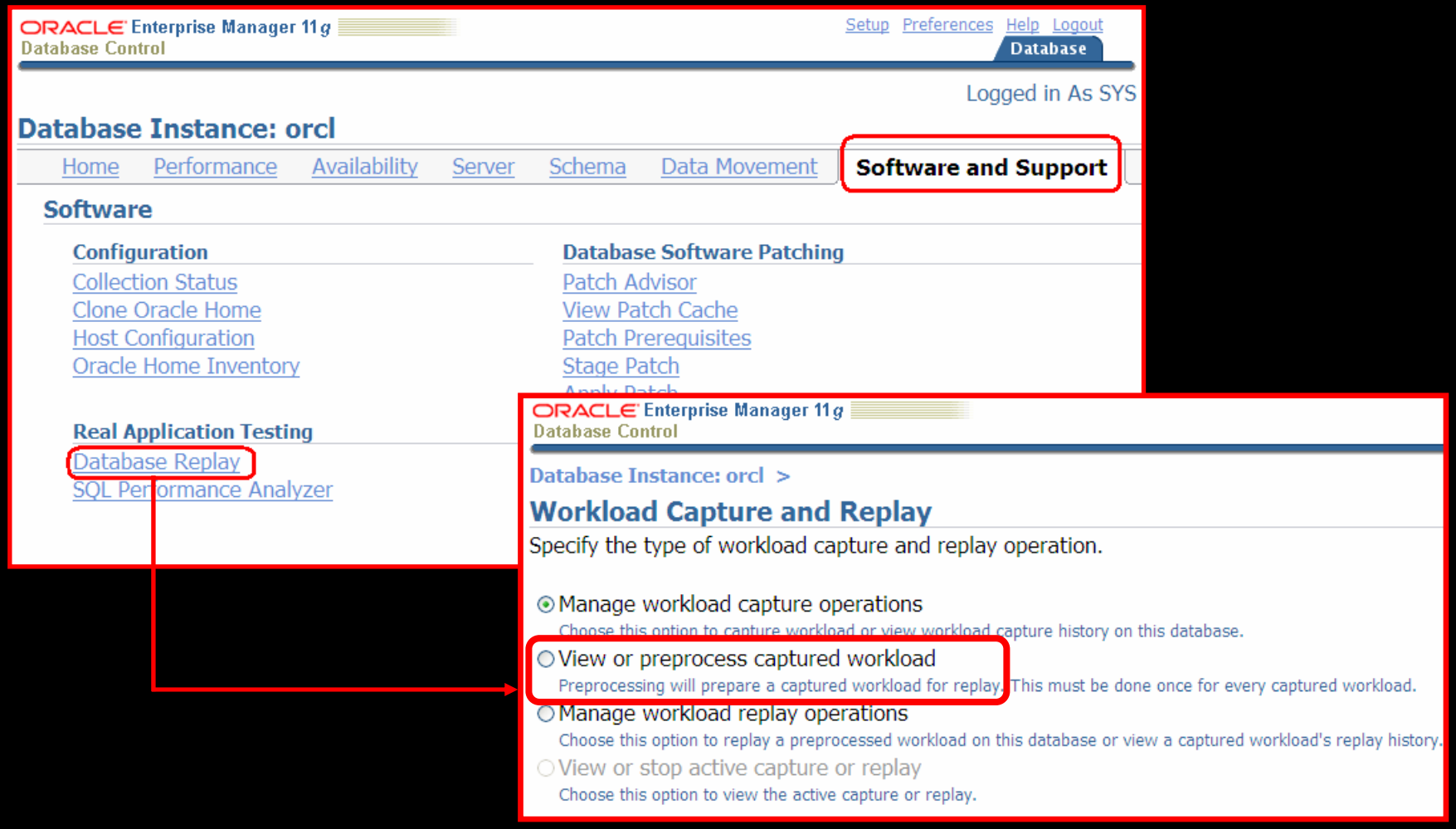
DB Replay – Workload Capture Flow….Contd.



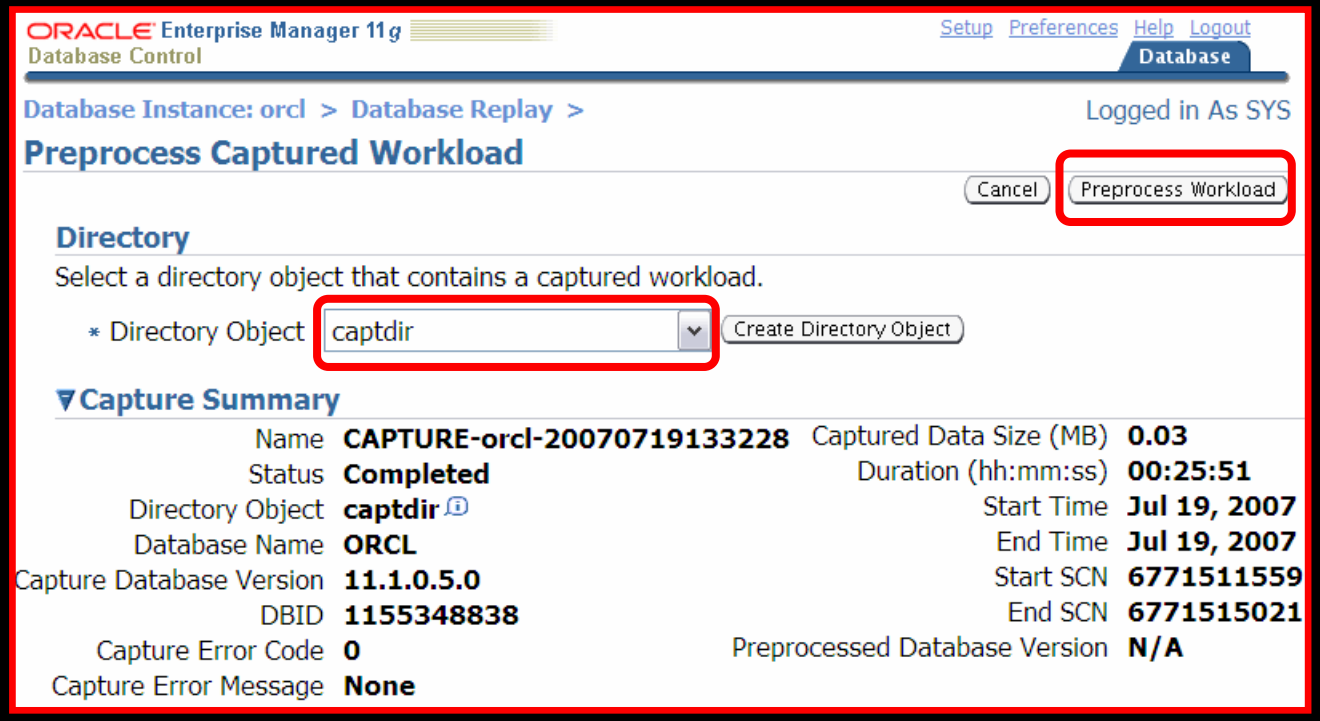
DB Replay – PreProcessing Workload

- It transforms the captured workload data into Replay files
- It will create all necessary metadata for Replay
- Only required once for every captured workload
- This is resource intensive process and so avoid it in production system
- It should be done on system running same DB version as of Replay system
- Make sure Files are moved to the Instance directory where it is processed.
  - For RAC – Move captured workload from all instances to single place for preprocessing
  - Use single instance for Preprocessing in RAC environment
- It is recommended to use Replay system for preProcessing else you need to move all processed files to Replay system
- EM is recommended tool for preProcessing or use APIs

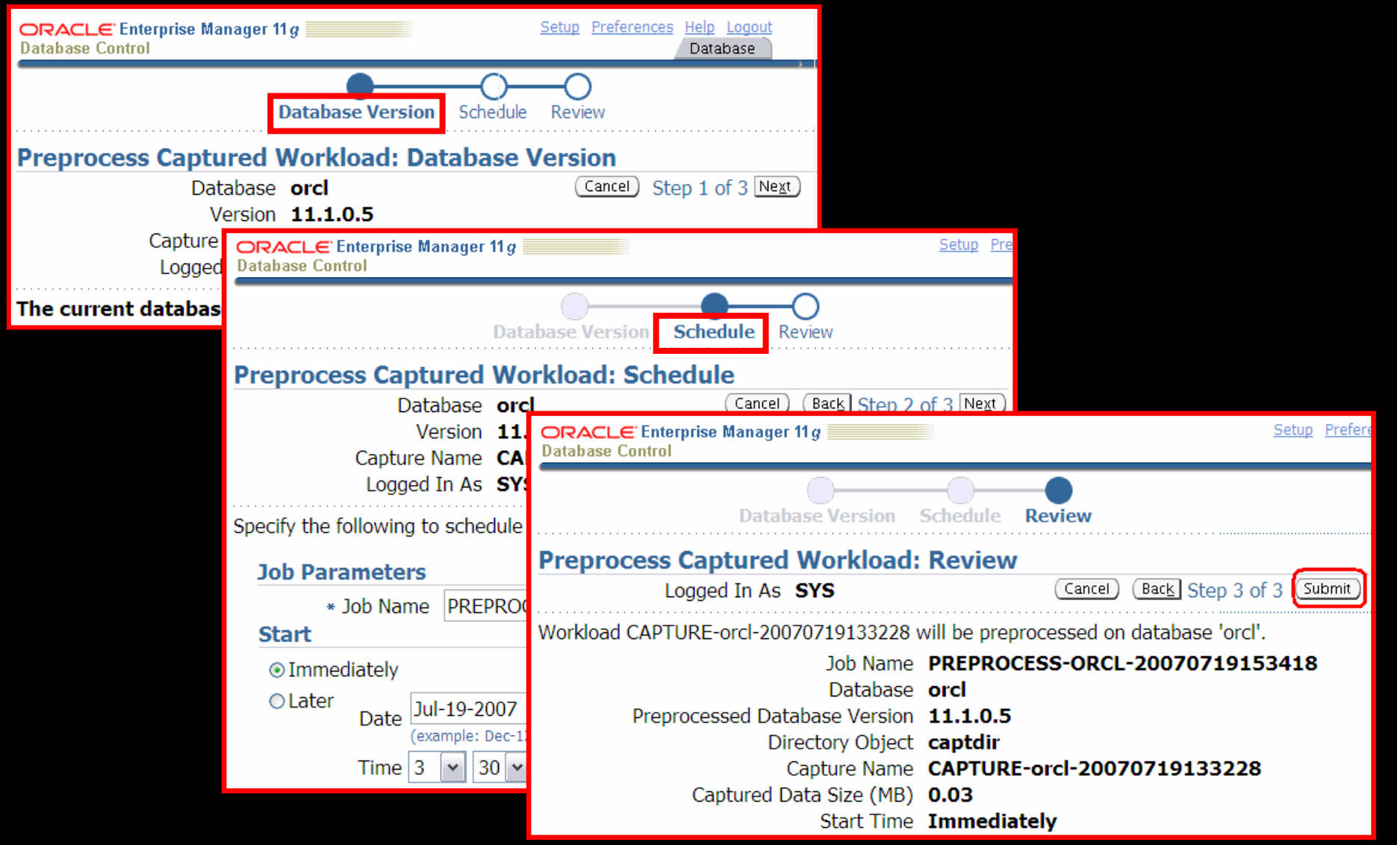
DB Replay – PreProcessing Workload…..Contd.



DB Replay –PreProcessing Workload…..Contd.



DB Replay – PreProcessing Workload…..Contd.



DB Replay – PreProcessing Workload…..Contd.

PREPROCESSING A CAPTURED WORKLOAD USING APIS

To preprocess a captured workload, use the PROCESS_CAPTURE procedure:

```
SQL> BEGIN
  2 DBMS_WORKLOAD_REPLAY.PROCESS_CAPTURE (capture_dir => 'API_DIR');
  3 END;
  4 /
PL/SQL procedure successfully completed.
```

```
-rw-r--r--  1 oracle oinstall    4782 Jul 26 22:33 wcr_login.pp
-rw-r-----  1 oracle oinstall   36864 Jul 26 22:33 wcr_seq_data.extb
-rw-r-----  1 oracle oinstall   53248 Jul 26 22:33 wcr_scn_order.extb
-rw-r--r--  1 oracle oinstall      35 Jul 26 22:33 wcr_process.wmd
-rw-r-----  1 oracle oinstall   12288 Jul 26 22:33 wcr_conn_data.extb
```

DB Replay Phases

- DB Replay components or Phases
  - ✓ - Backup the Production/Source Database
  - ✓ - Configure EM Console as it is recommended option
  - ✓ - Capturing Phase
  - ✓ - Move the Captured Workload on OS to Test Server
  - ✓ - Pre-processing Phase
  - - Restore the backup on Test Database
  - - Replay Phase
  - - Analysis

DB Replay – Replay Workload

- When the captured workload is processed, it can be replayed in any database running the same or higher Oracle version

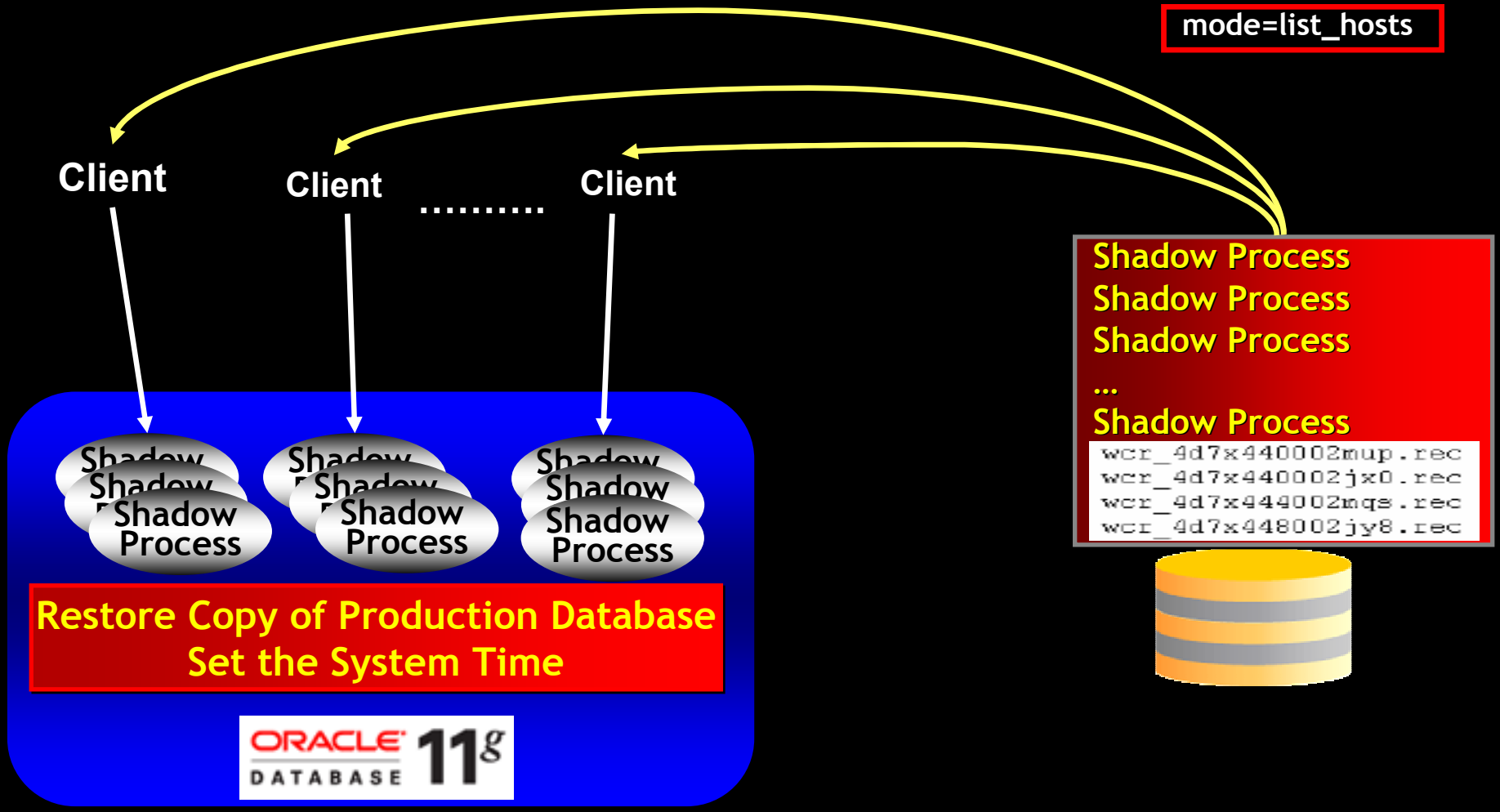
Replay Process Steps

- Set up the Test System
  - Restore the Database taken before the start of Capture process
  - Reset the System time as it was at the start of Capture process
- Perform the change that prompted the replay usage
  - Upgrade OS or Database
  - Apply Patches
  - Make OS change
  - Move to RAC or vice-versa
- Replay the Processed Capture Workload
  - Using EM / APIs

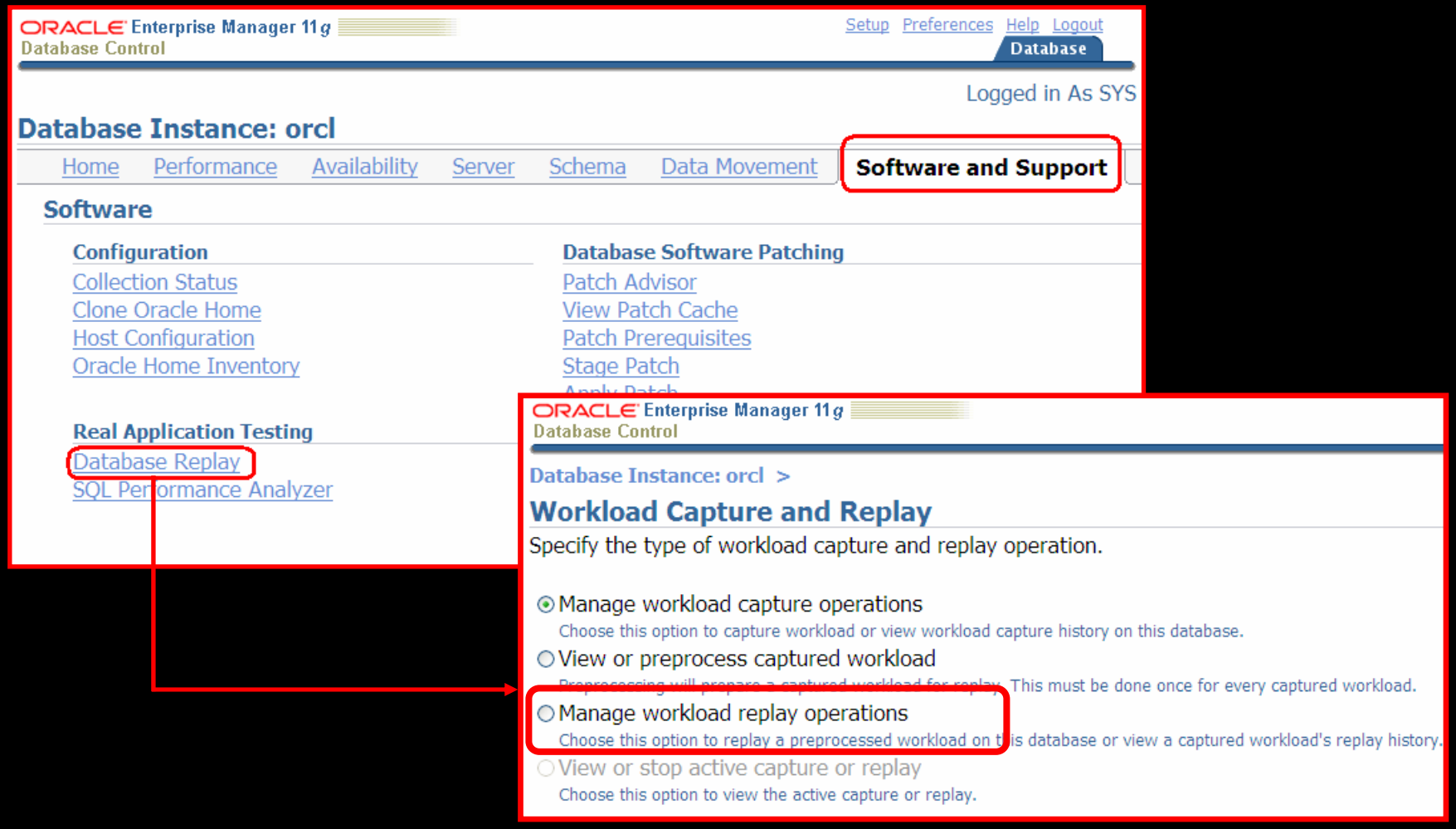
DB Replay – Replay Workload

wrc system/welcome1 mode=calibrate replaydir=/home/replay

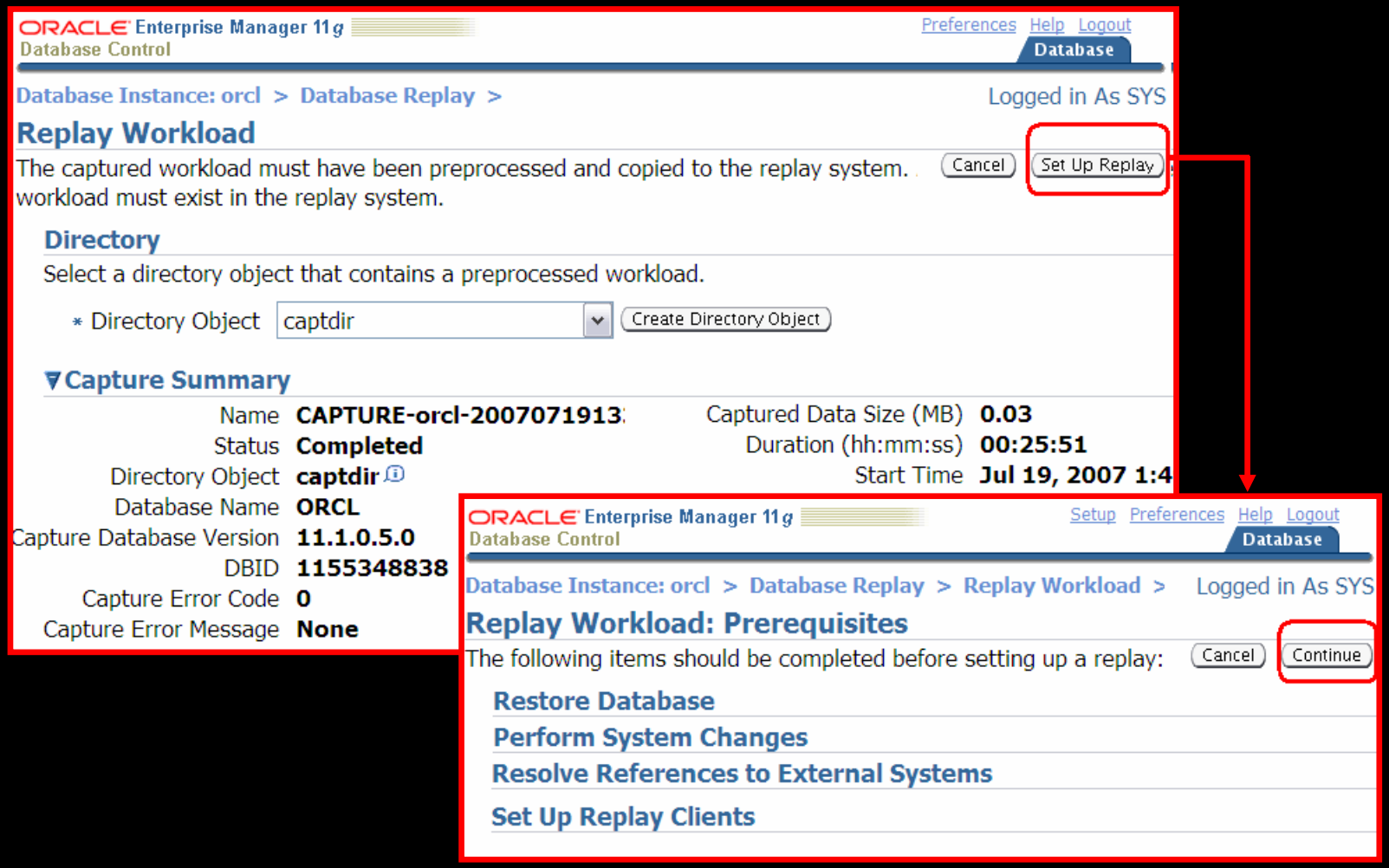
mode=list_hosts



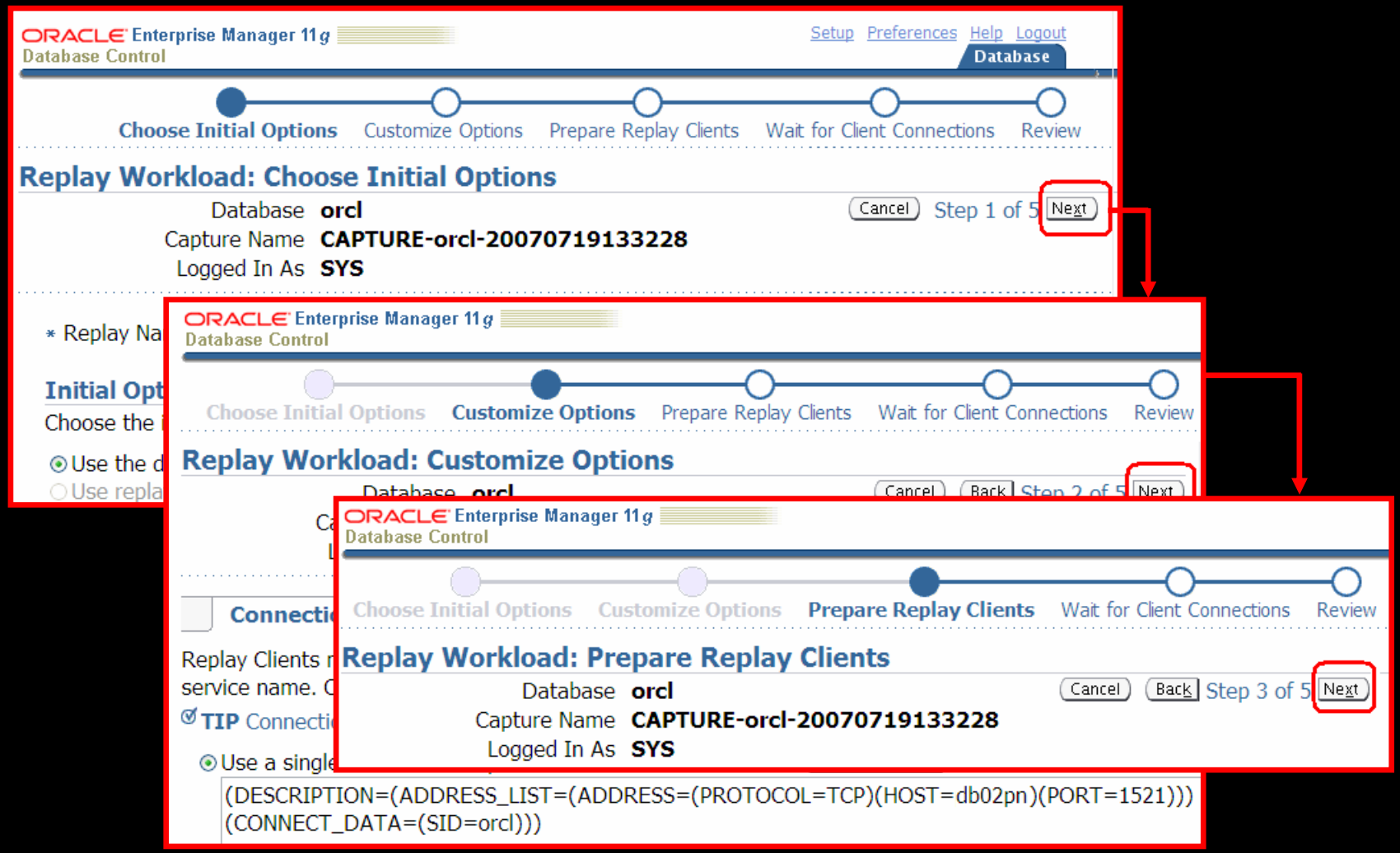
DB Replay – Replay Workload-EM……Contd.



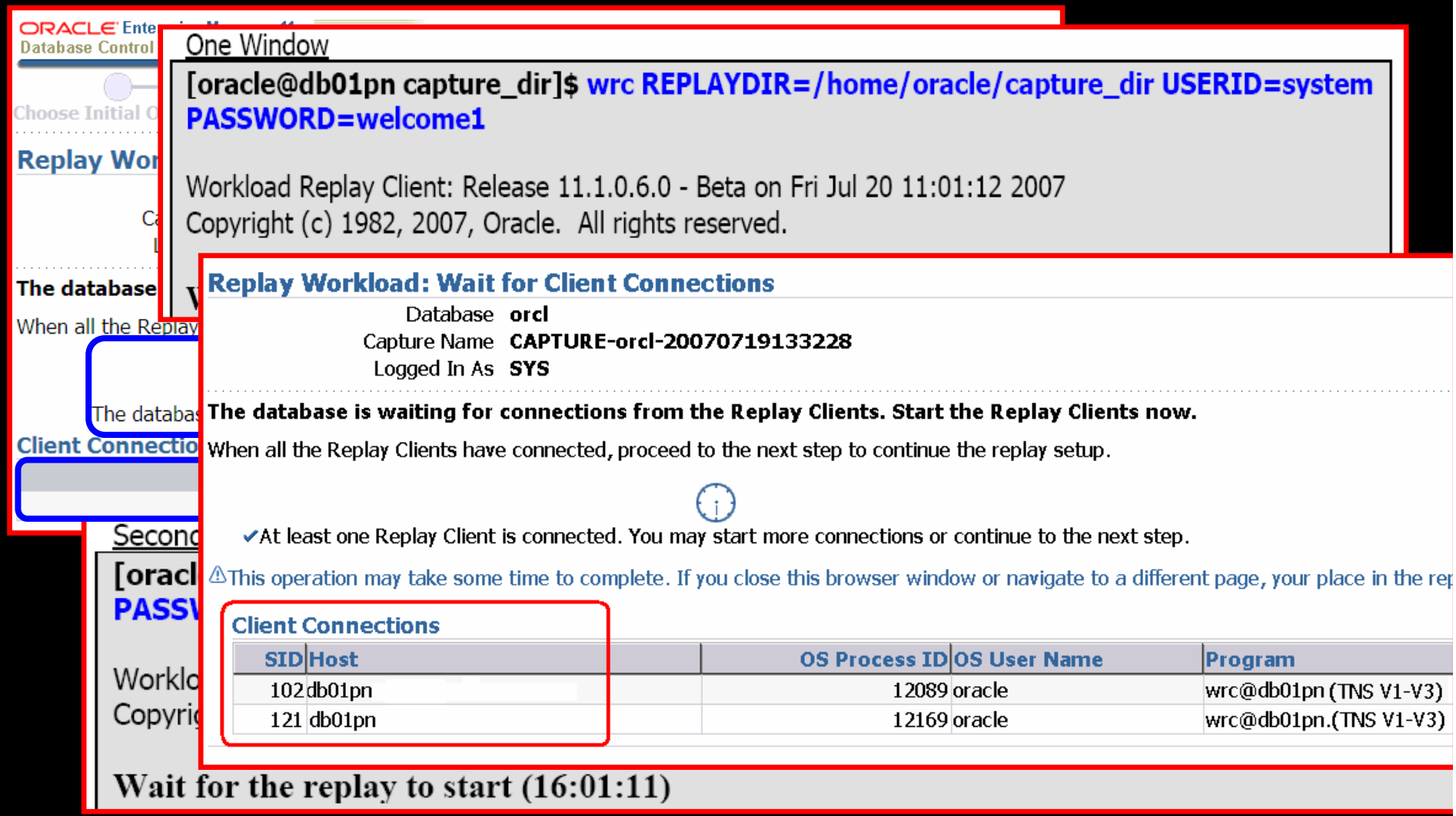
DB Replay – Replay Workload-EM…..Contd



DB Replay – Replay Workload-EM…..Contd



DB Replay – Replay Workload-EM…..Contd



DB Replay – Replay Workload-EM.....Contd.

One Window

```
[oracle@db01pn capture_dir]$ wrc REPLAYDIR=/home/oracle/capture_dir USERID=system
PASSWORD=welcome1

Workload Replay Client: Release 11.1.0.6.0 - Beta on Fri Jul 20 11:01:12 2007
Copyright (c) 1982, 2007, Oracle.  All rights reserved.

Wait for the replay to start (16:00:21)
Replay started (16:02:49)
```

Second Window

```
[oracle@db01pn capture_dir]$ wrc REPLAYDIR=/home/oracle/capture_dir USERID=system
PASSWORD=welcome1

Workload Replay Client: Release 11.1.0.6.0 - Beta on Thu Jul 19 14:18:23 2007
Copyright (c) 1982, 2007, Oracle.  All rights reserved.

Wait for the replay to start (16:01:11)
Replay started (16:03:19)
```

DB Replay – Replay Workload-EM.....Contd.

ORACLE Enterprise Manager 11g
Database Control

Database Instance: orcl > Database Replay >

Confirmation
The workload replay has started.

View Workload Replay: REPLAY-orcl-20070719155329

Status **In Progress** Stop Replay

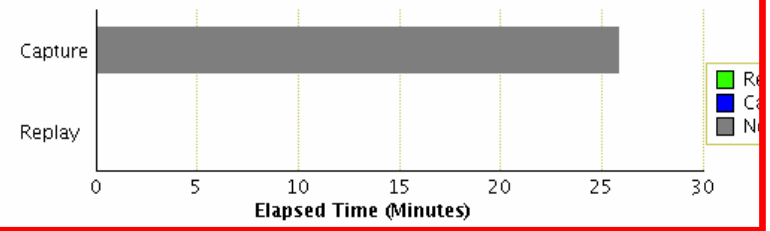
Summary

Replay Name **REPLAY-orcl-20070719155329**
Directory Object **captdir**
Database Name **ORCL**
DBID **1155348838**
Replay Error Code **N/A**
Replay Error Message **None**

Workload Profile | Connection Mappings | Replay Parameters

Network Time (hh:mm:ss) **N/A**
Think Time (hh:mm:ss) **N/A**
Clie
Clients Finis

Elapsed Time Comparison



ORACLE Enterprise Manager 11g
Database Control

Database Instance: orcl > Database Replay > Replay Workload >

View Workload Replay: REPLAY-orcl-20070719155329

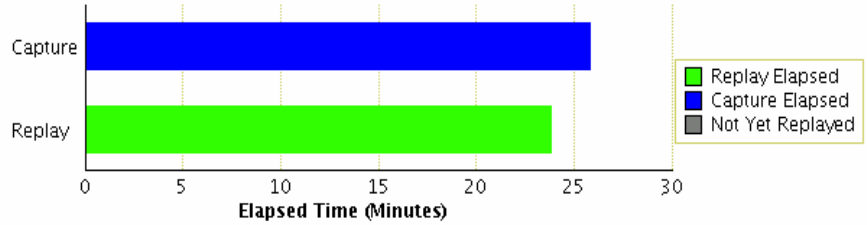
Summary

Replay Name **REPLAY-orcl-20070719155329**
Status **Completed**
Directory Object **captdir**
Database Name **ORCL**
DBID **1155348838**
Replay Error Code **N/A**
Replay Error Message **None**

Workload Profile | Connection Mappings | Replay Parameters | Report

Network Time (hh:mm:ss) **00:00:00**
Think Time (hh:mm:ss) **00:00:00**
Clients **1**
Clients Finished **1**

Elapsed Time Comparison



DB Replay – Replay Workload-API

Initializing Replay Data

To initialize replay data, use the INITIALIZE_REPLAY procedure:

```
SQL> BEGIN
  2  DBMS_WORKLOAD_REPLAY.INITIALIZE_REPLAY (replay_name => 'REPLAY07',
  3  replay_dir => 'API_DIR');
  4 END;
  5 /
PL/SQL procedure successfully completed
```

Setting Workload Replay Options

After the replay data is initialized, you need to prepare the workload replay on the replay system.

```
SQL> BEGIN
  2  DBMS_WORKLOAD_REPLAY.PREPARE_REPLAY (replay_name => 'REPLAY07',
  3 replay_dir => 'API_DIR',
  4 synchronization => TRUE);
  5 END;
  6 /
PL/SQL procedure successfully completed
```

```
SQL>select id,name,directory,status,prepare_time,start_time,end_time,dir_path from
dba_workload_replays  where id=22 ;

ID NAME     DIRECTORY STATUS PREPARE_TIME     START_TIME END_TIME   DIR_PATH
-- -------- --------- ------- -------------   ---------- ---------- -----------
22 REPLAY07 API_DIR   PREPARE 26/07/2007 22:46:58              /home/oracle/api_dir
```

DB Replay – PreProcessing Workload…..Contd.

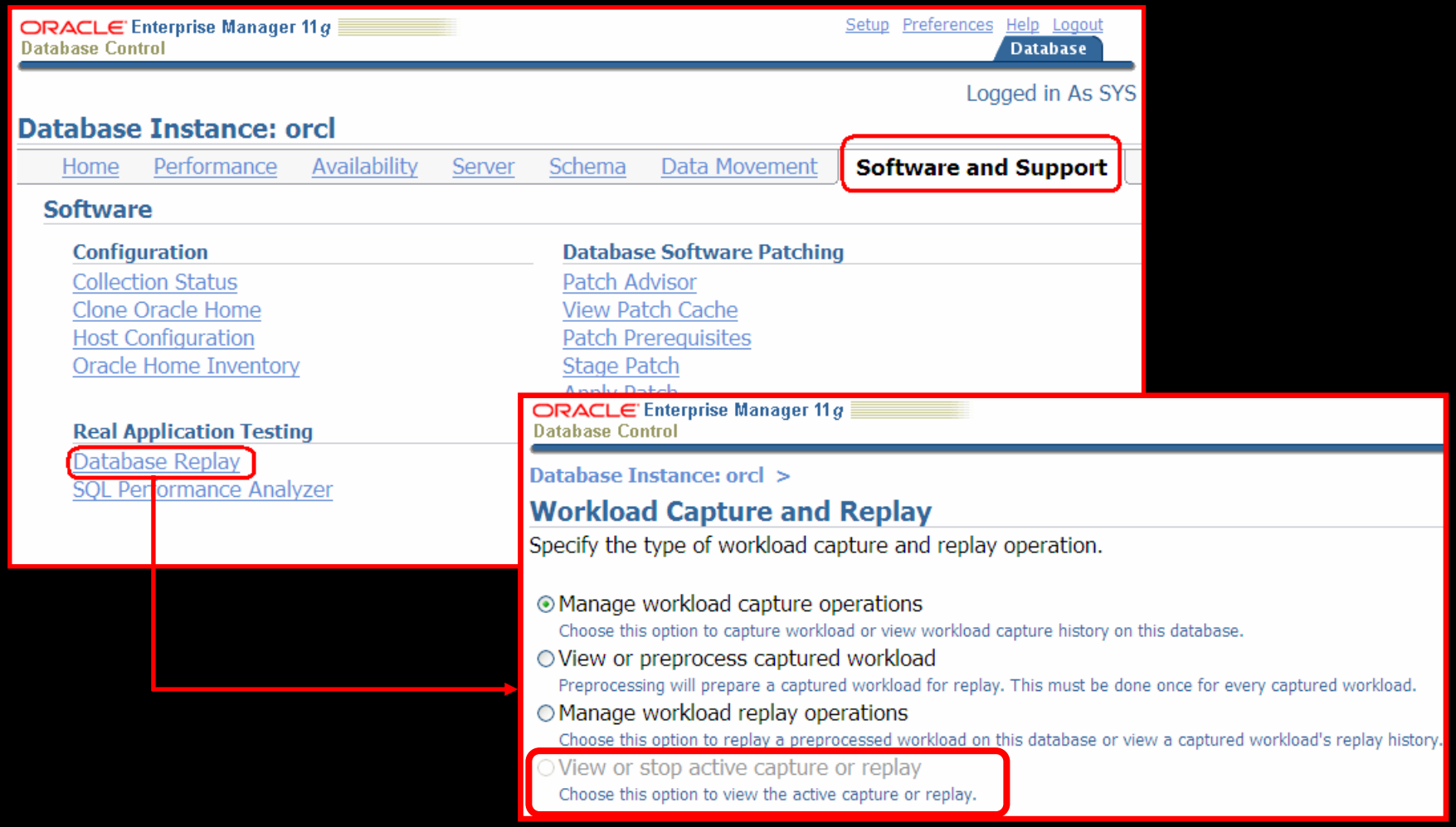
START THE AGENT

```
[db01pn]$ wrc REPLAYDIR=/home/oracle/api_dir USERID=system PASSWORD=welcome1

Workload Replay Client: Release 11.1.0.6.0 - Beta on Thu Jul 26 22:48:36 2007
Copyright (c) 1982, 2007, Oracle.  All rights reserved.
Wait for the replay to start (22:48:36)


SQL> select   sid,            logon_user,
              Logon_time,     event,
              program
      from V$WORKLOAD_REPLAY_THREAD
SID   LOGON_USER LOGON_TIME          EVENT                        PROGRAM
------ ---------------- ------------------------  ------------------------------  ----------------------------------------
124   SYSTEM       26/07/2007 22:48:36   WRR: replay client notify   wrc@db01pn(TNS V1-V3)
```

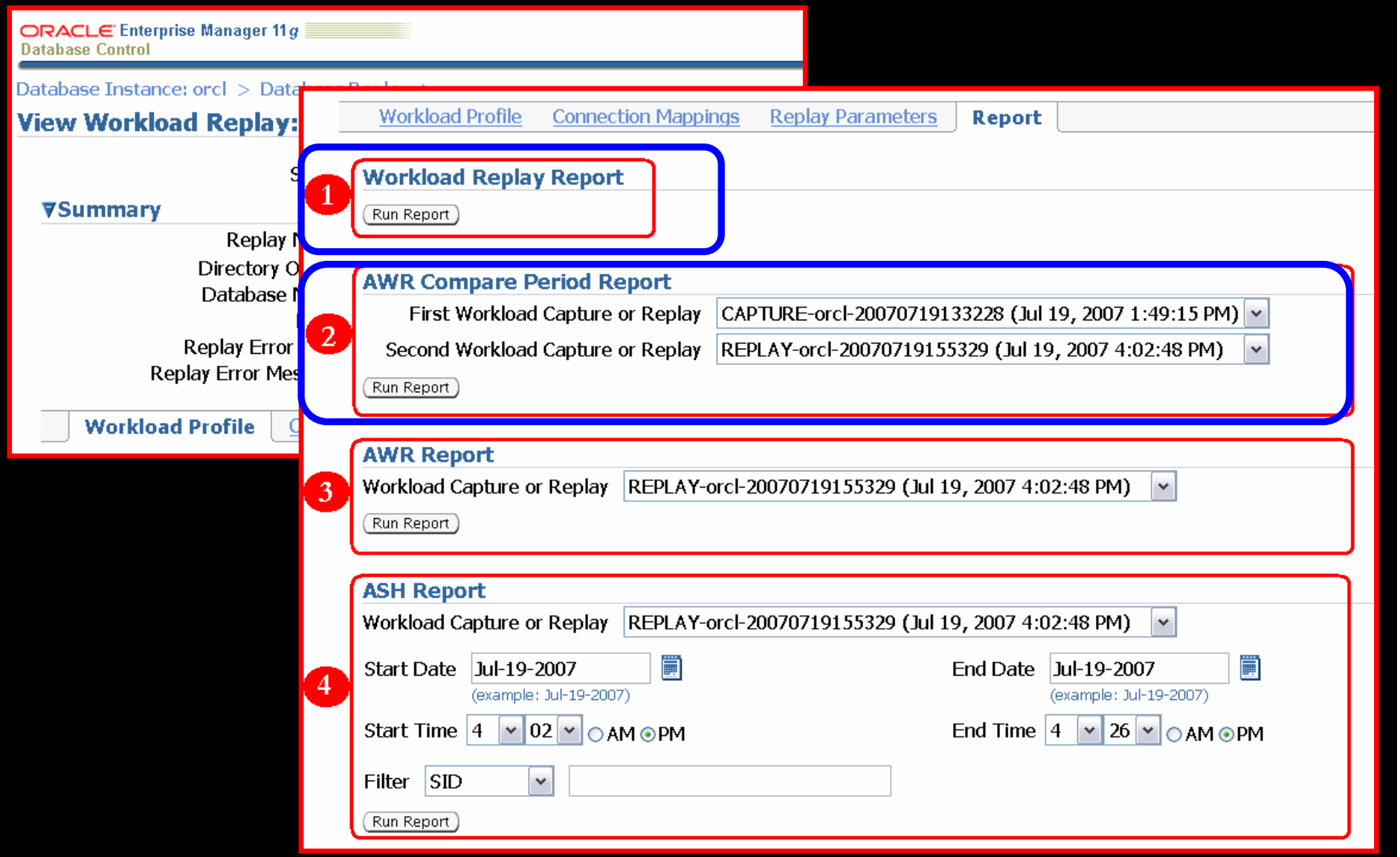
STARTING A WORKLOAD REPLAY

```
SQL>BEGIN
  2 DBMS_WORKLOAD_REPLAY.START_REPLAY ();
  3 END;
  4 /

SQL>select id,name,directory,status,prepare_time,start_time,end_time,dir_path from
dba_workload_replays  where id=22 ;

 ID NAME        DIRECTORY STATUS     PREPARE_TIME    START_TIME  END_TIME  DIR_PATH
 -- -------- -------- ----------- -------------     ----------  ---------- -------
 22 REPLAY07 API_DIR  IN PROGRESS 26/07/07 22:46:58  26/07/07 23:00:15
/home/oracle/api_dir
```

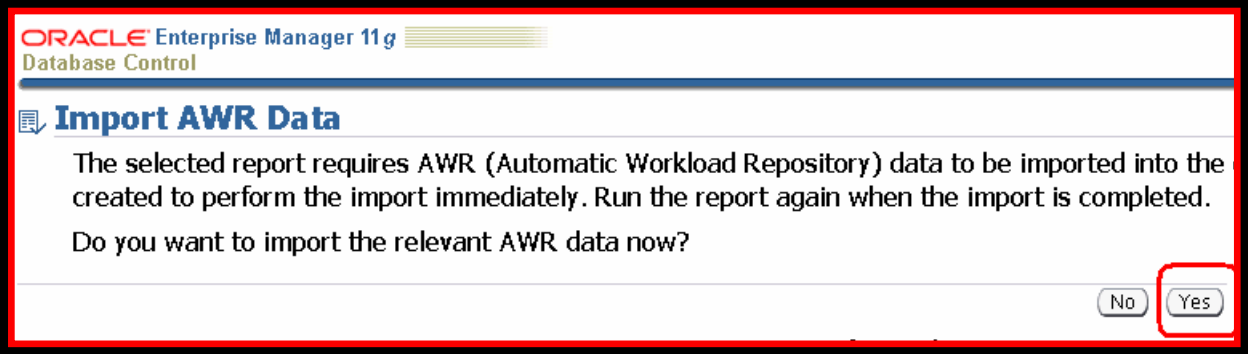
DB Replay – Analyze Workload-EM……Contd.



DB Replay – Analyze Workload .....Contd.



DB Replay – Analyze Workload .....Contd.



DB Replay – Analyze Workload - Report

WORKLOAD REPOSITORY COMPARE PERIOD REPORT

Snapshot Set	DB Name	DB Id	Instance	Inst num	Release	Cluster	Host	Std Block Size
First (1st)	ORCL	1908040294	orcl	1	11.1.0.6.0	NO	db02pn	8192
Second (2nd)	ORCL	752664103	orcl	1	11.1.0.6.0	NO	db01pn	8192

Snapshot Set	Begin Snap Id	Begin Snap Time	End Snap Id	End Snap Time	Avg Active Users	Elapsed Time (min)	DB time (min)
1st	216	19-Jul-07 13:49:15 (Thu)	217	19-Jul-07 14:15:04 (Thu)	0.03	25.82	0.86
2nd	16	19-Jul-07 14:18:53 (Thu)	17	19-Jul-07 14:42:48 (Thu)	0.01	23.91	0.16
%Diff					*-66.67*	*-7.40*	*-81.38*

DB Replay – Analyze Workload Report

Host Configuration Comparison

	1st	2nd	Diff	%Diff
Number of CPUs:	4	4	0	0.00
Number of CPU Cores:	2	2	0	0.00
Number of CPU Sockets:	2	2	0	0.00
Physical Memory:	16238M	16238M	0M	0.00
Load at Sta				
Load at End				
%User Time				
%System Ti				

System Configuration Comparison

	1st	2nd	Diff
SGA Target:	0	0	0M
Buffer Cache:	784M	1,504M	720M

Report Details

- Time Model Statistics
- Operating System Statistics
- Wait Events
- Service Statistics
- SQL Statistics
- Instance Activity Statistics
- IO Stats
- Advisory Statistics
- Wait Stats
- Undo Statistics
- Latch Statistics
- Segment Statistics
- Dictionary Cache Statistics
- Libarary Cache Statistics
- Memory Statistics
- Streams Statistics

Top Timed Events

- Events with a "-" did not make the Top list in this set of snapshots, but are d

1st											
Event	Wait Class	Waits	Time(s)	Avg Time(ms)	%DB time	Event	Wa				
CPU time			13.97		27.13	CPU time					
log buffer space	Configuration	4	4.00	1,000.06	7.77	db file sequential read	User I/O	478	0.68	1.42	7.05
control file parallel write	System I/O	552	2.29	4.15	4.45	control file parallel write	System I/O	509	0.59	1.16	6.17
os thread startup	Concurrency	36	1.17	32.40	2.26	db file scattered read	User I/O	106	0.29	2.72	3.00

QUESTIONS
&
ANSWERS

DATA SOFTECH INC.
Complete Database Solution Provider

THANKS

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