

数据库升级与数据迁移实战分享

DTCC

2015中国数据库技术大会

DATABASE TECHNOLOGY CONFERENCE CHINA 2015

大数据技术探索和价值发现



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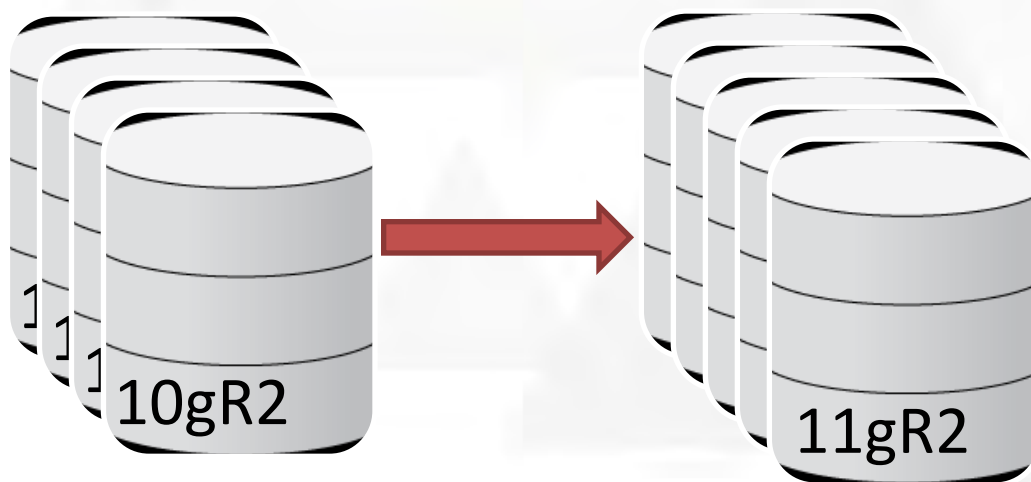
分享思路

- 数据库升级实战
 - 严谨，细心，运气
- 数据迁移实战
 - 挑战传统方法，艰难的技术推广





升级目标



	Full Support	Extended
11.2	Jan 2015	2018
11.1	Aug 2012	2015
10.2.0.5	July 2010	2015

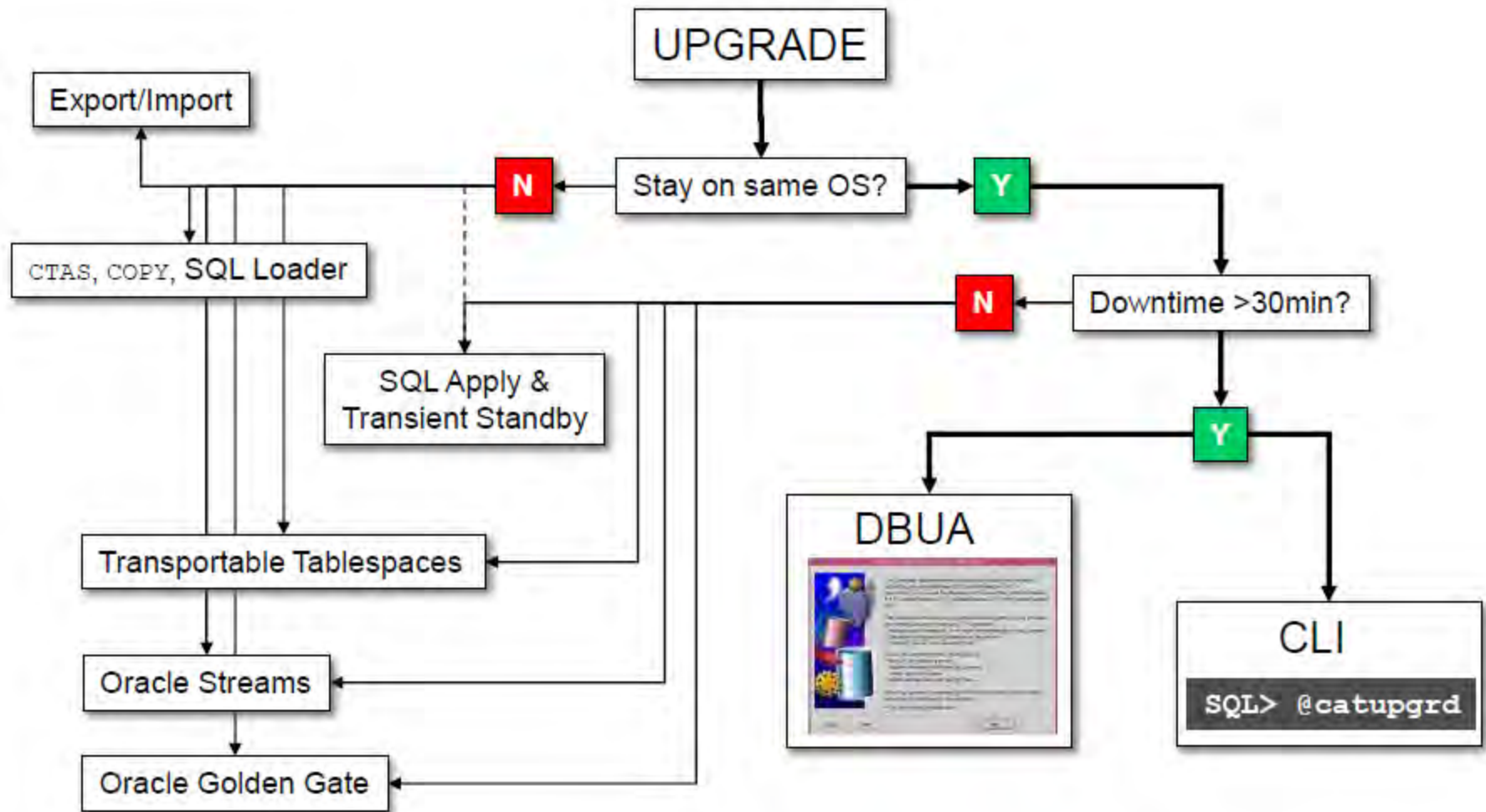


资源情况

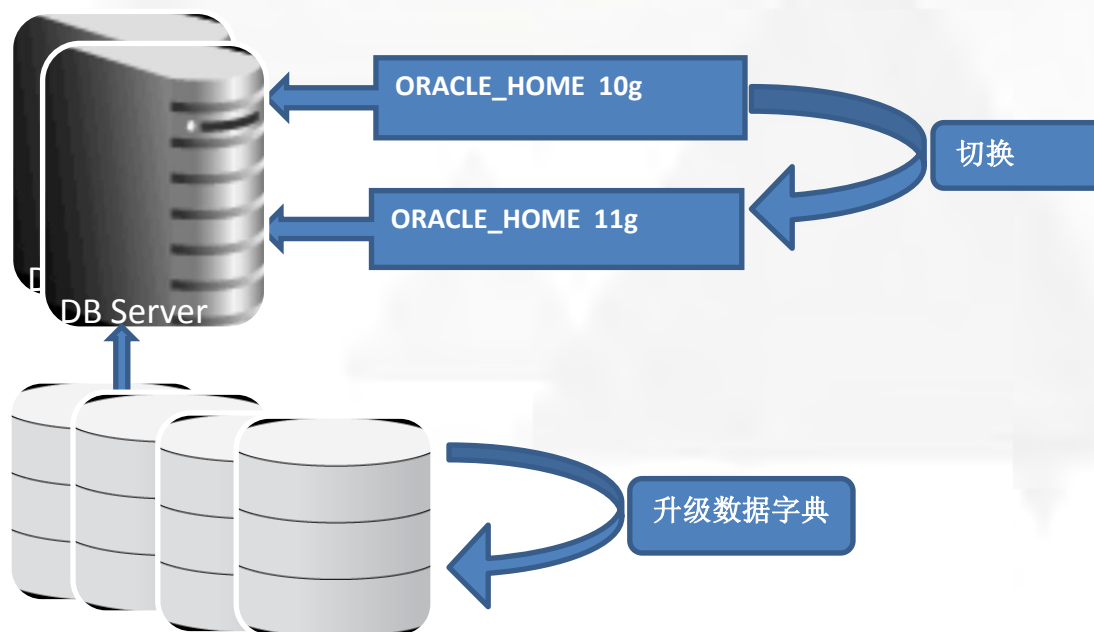
- 2台服务器,单实例数据库 4个,10gR2, T级
- Linux 2.6.18-308.el5 #1 SMP
 - x86_64 x86_64 x86_64 GNU/Linux
- OS Sockets / Cores / CPUs: **4 / 40 / 80**
 - CPU model name : Intel(R) Xeon(R) CPU E7- 4870 @ 2.40GHz
- OS Memory: **346 GB**
- 至少四轮以上的测试
- 开发测试部门,产品部规划
- 性能DBA,应用DBA,开发DBA
- 客户的DBA
- Oracle的支持



升级可选方案



手工升级流程图



升级流程规划图

	9:50	10:00	10:30	10:40						
PETUSG1										
PETMAE1										
					10:50	11:00	11:10	11:30	11:40	11:45
PETCUS1										
PETAEM1										

		9:50	10:00	10:30	10:50	11:10
并行1:	PETCUS1					
	PETUSG1					
并行2:	PETAEM1					
	PETMAE1					



升级中的挑战

- 过程需要完全可控
- 需要同时升级4个数据库实例
- 附加部分业务升级
- 3个小时内全部完成(1个小时的业务升级)
- 未知的突发情况



升级前的准备

安装11gR2 软件，部署PSU

./opatch lsinventory

Interim patches (1) :

Patch 16056267 : applied on Thu Oct 03 16:01:47 ICT 2013

Unique Patch ID: 15994298

Patch description: "Database Patch Set Update : 11.2.0.2.10 (16056267)"

Created on 12 Mar 2013, 10:08:56 hrs PST8PDT

Sub-patch 14727315; "Database Patch Set Update : 11.2.0.2.9 (14727315)"

Sub-patch 14275621; "Database Patch Set Update : 11.2.0.2.8 (14275621)"

Sub-patch 13923804; "Database Patch Set Update : 11.2.0.2.7 (13923804)"

Sub-patch 13696224; "Database Patch Set Update : 11.2.0.2.6 (13696224)"



升级前的参数优化

10g已有的隐含参数

parameter name	parameter value
<code>_optimizer_cost_model</code>	CPU
<code>_optimizer_skip_scan_enabled</code>	FALSE
<code>_optimizer_sortmerge_join_enabled</code>	FALSE
<code>_optimizer_use_feedback</code>	FALSE
<code>_optimizer_dynamic_sampling</code>	0
<code>_optimizer_join_elimination_enabled</code>	FALSE
<code>parallel_adaptive_multi_user</code>	FALSE
<code>parallel_execution_message_size</code>	65536

11g中过期的10g参数

<code>background_dump_dest</code>
<code>cursor_space_for_time</code>
<code>fast_start_io_target</code>
<code>log_archive_local_first</code>
<code>log_archive_start</code>
<code>max_enabled_roles</code>
<code>parallel_automatic_tuning</code>
<code>parallel_server</code>
<code>parallel_server_instances</code>
<code>plsql_debug</code>
<code>plsql_v2_compatibility</code>
<code>remote_os_authent</code>

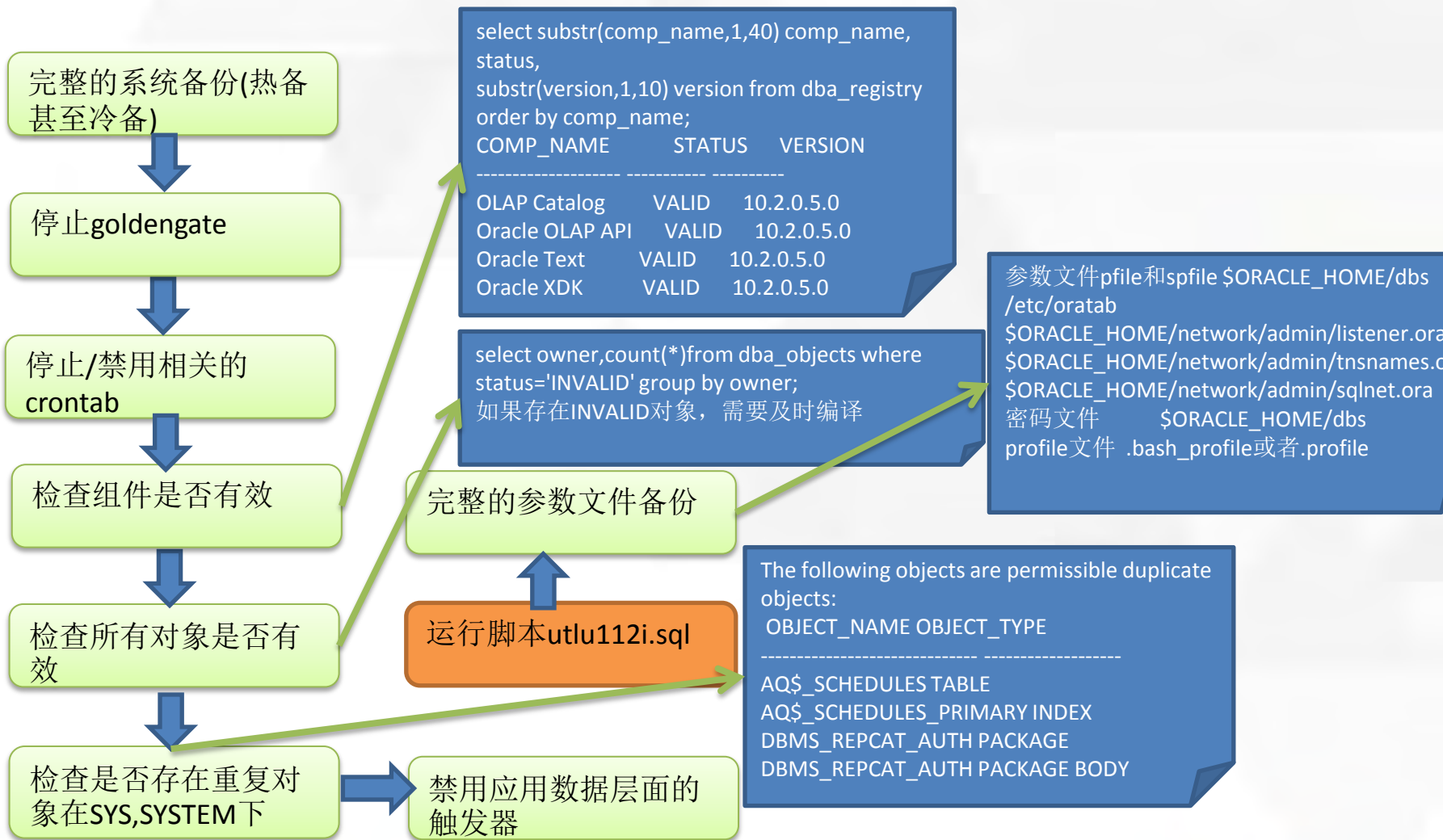


升级前的参数优化

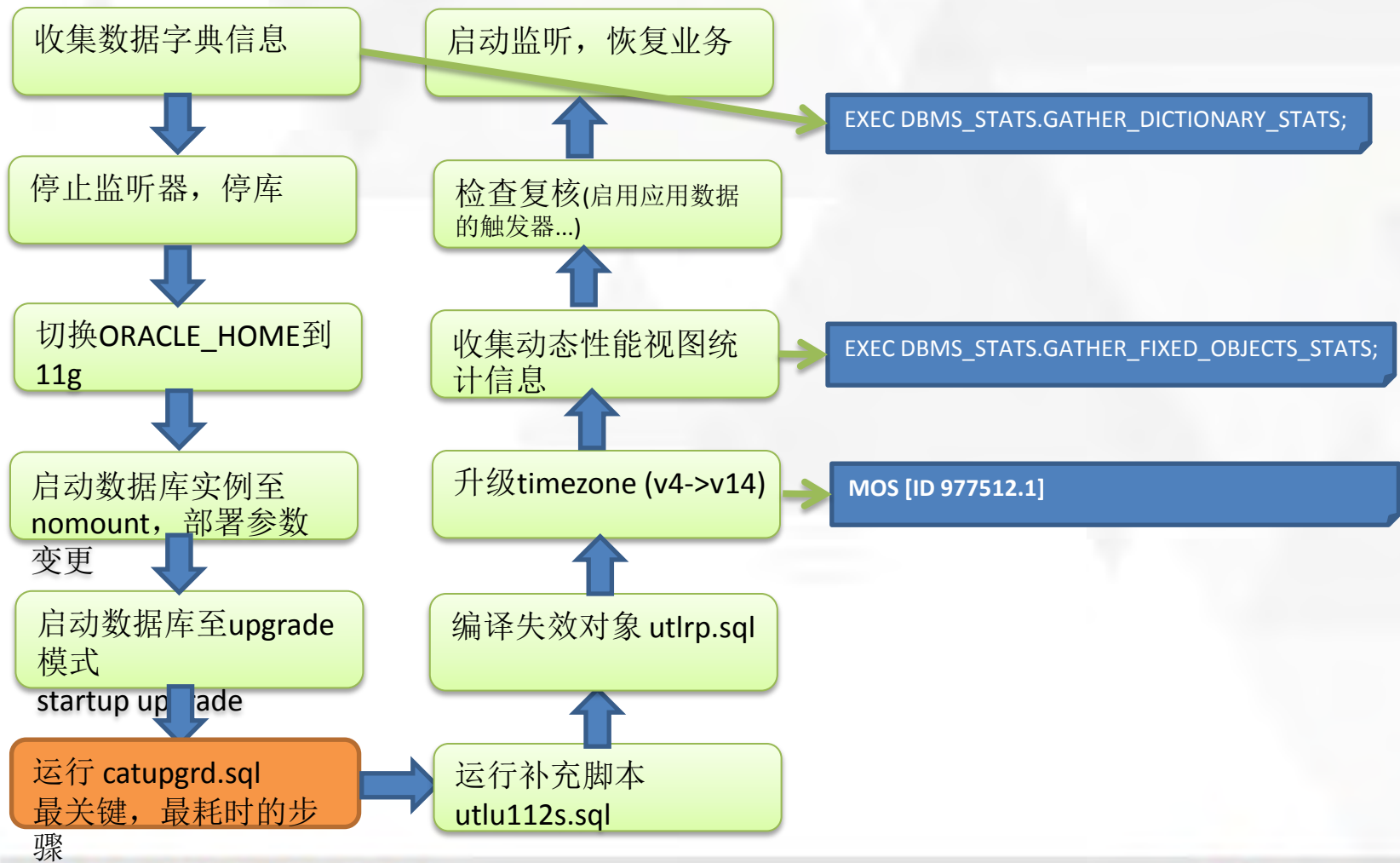
- 11g中新参数的选择
 - sec_case_sensitive_logon
 - sec_max_failed_login_attempts
 - result_cache_max_size
 - deferred_segment_creation
 - diagnostic_dest
 - db_unrecoverable_scn_tracking

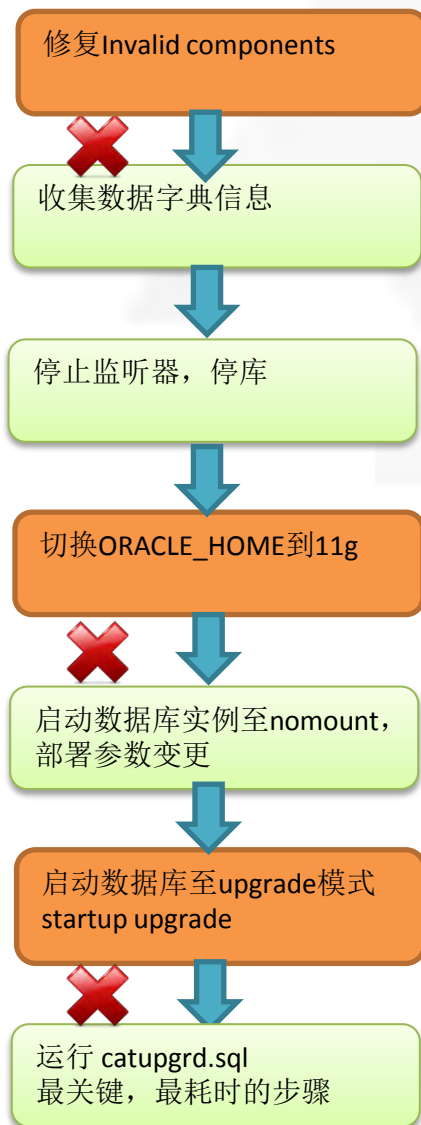


升级前的检查



升级流程图





```
SQL> BEGIN
2  IF dbms_registry.status('CATJAVA') IS NULL THEN
3    RAISE_APPLICATION_ERROR(-20000,
4      'CATJAVA has not been loaded into the database.');
```

```
5  END IF;
6  IF dbms_registry.is_loaded('CATJAVA') != 1 THEN

sqlplus / as sysdba
SP2-1503: Unable to initialize Oracle call
interface
```

```
startup upgrade
ORA-00600: internal error code, arguments:
[kccsbck_first], [1], [3125205511],
[], [], [], [], [], [], [], [],
```

解决方法:reload->remove>re-install

解决方法：最后还是先保证11g的环境下没有ora进程存在，然后切回10g的环境，看有没有ora的进程，如果有一定要停掉。然后再切回11g home, 就可以了。



升级中的问题分析

启动监听，恢复业务



检查复核(启用应用数据的触发器...)

收集动态性能视图统计信息

升级timezone (v4->v14)

编译失效对象 utlrp.sql

运行补充脚本 utlu112s.sql

查询user_synonyms持续近10分钟

重建USER_SYNONYMS

```
CREATE OR REPLACE FORCE VIEW "SYS"."USER_SYNONYMS" ("SYNONYM_NAME",  
"TABLE_OWNER", "TABLE_NAME", " DB_LINK") AS  
  select /*+ RULE */ o.name, s.owner, s.name, s.node  
  from sys.syn$ s, sys."_CURRENT_EDITION_OBJ" o  
  where o.obj# = s.obj#  
  and o.type# = 5  
  and o.owner# = userenv('SCHEMAID');
```

```
exp APP_ROLLBK/APP_ROLLBK file=test.dmp  
tables=AAAAA consistent=y
```

```
.. exporting table          AAAAA 76 rows exported
```

EXP-00008: ORACLE error 1466 encountered

ORA-01466: unable to read data - table definition has changed

Export terminated successfully with warnings.

alert日志报错:

Archived Log entry 6765 added for thread 1 sequence 6728 ID
0xb8c6d509 dest 1:

Tue Oct 08 04:51:01 2013

ORA-1466 (RO Tx began: 10/07/2013 21:51:00, Last DDL: 10/08/2013
02:07:25, Curr Time: 10/07/2013 21:51:00)

Tue Oct 08 06:04:15 2013



关于ORA-01466所做的尝试

```
expdp XXXX/XXX DIRECTORY=DATA_PUMP_DIR DUMPFILE=test.dmp tables=AAAAA  
consistent=y --->OK
```

```
export from schema1(without consistent=y)  
import into schema2  
export from schema2 with consistent=y  
还是有问题
```

检查物理时钟，时间都是同步的。

```
hwclock;date
```

```
Tue 08 Oct 2013 01:18:18 PM ICT -0.267508 seconds
```

```
Tue Oct 8 13:18:17 ICT 2013
```



ORA-01466的最终解决方案

解决方案: **PURGE RECYCLEBIN**

```
sqlplus / as sysdba
SQL> purge recyclebin ;
EXP-00008: ORACLE error 1466 encountered
ORA-01466: unable to read data - table definition has changed
Export terminated successfully with warnings.
```

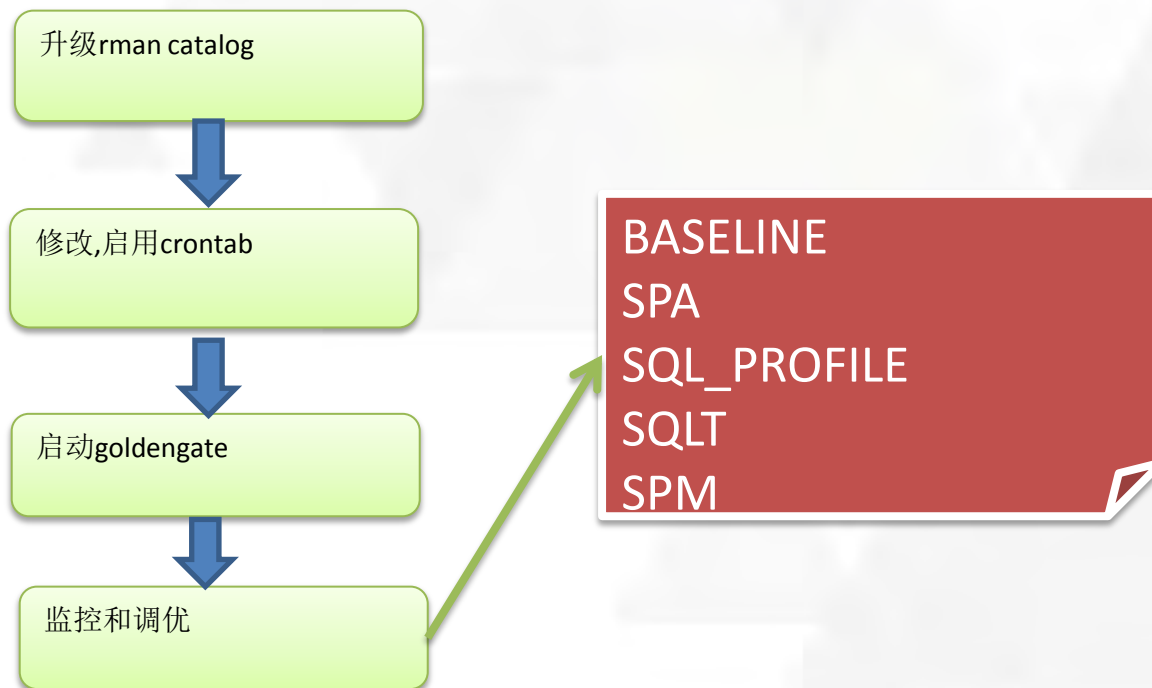
This is a time-based read consistency error for a database object, such as a table or index.

Either of the following may have happened: The query was parsed and executed with a snapshot older than the time the object was changed.

The creation time-stamp of the object is greater than the current system time. This happens, for example, when the system time is set to a time earlier than the creation time of the object.



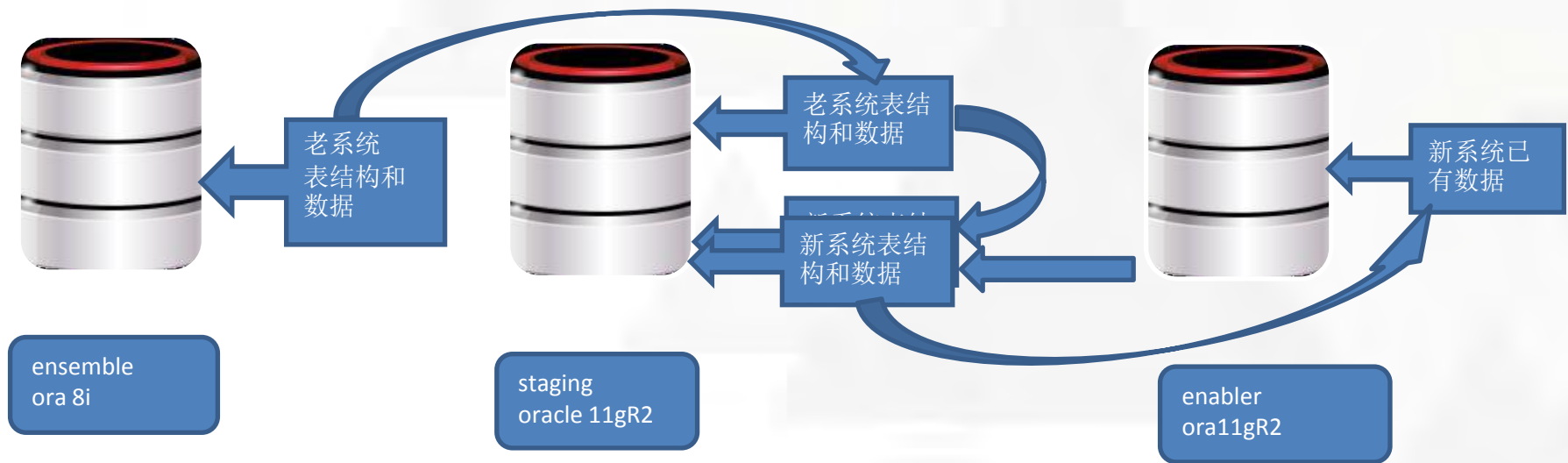
升级后的补充



Upgrade from/to	% Different execution plans
v9 -> v10	15.31%
v9 -> v11	30.05%
v10 -> v11	21.42%



数据迁移背景



已有的数据迁移方案

- perl+csv+sqlldr+datapump
- 脚本由公司资深专家编写
- 在其它项目中已经使用多次
- 数据抽取和加载的过程可控
- 经过多次验证，算是稳定的实现
- 成本低，不依赖第三方的付费服务
- sqlldr加载LOB数据类型的限制



其它升级方案的比较

➤ **insert /*+append */ into ... from db_link +nologging**
可以实现跨平台, 过度依赖网络和磁盘情况, 迁移的过程不好控制

➤ **standby (dataguard)**

切换时间极短

整个数据库的迁移. 不能实现数据的重组, 即业务数据的增量导入

➤ **stream/goldengate**

staging库是非归档模式, 实现过程相对复杂, 过度依赖网络和磁盘情况

➤ **表空间传输**

跨平台, 数据文件转换, 业务数据的增量导入无法实现



纠结的测试结果

- 需要单独安装perl-DBI模块
- datapump的性能考虑
- 生成大量的csv文件，基本不可读
- 潜在的乱码问题
- sqlldr遇到的数据问题
 - 主键冲突
 - ORA-00001: unique constraint (PRDAPPO.AR1_MEMO_PK) violated
 - 非空约束问题
 - ORA-01400: cannot insert NULL into ("PRDAPPO"."CL9_CRD_MNTR_TREAT"."ACT_RSN_CODE")
 - 外键数据问题/表插入数据的顺序
 - ORA-02291: integrity constraint (PRDAPPO.CH_OBJECT_ATTRIBUTES_1FK) violated



Datapump带来的问题

- Datapump的导入问题

- 约束导致的导入回退

- ORA-31693: Table data object
"PRDAPPO"."MO1_MEMO": "PMAX_AMAX_EMAX" failed to load/unload
and is being skipped due to error: ORA-00001: unique constraint
(PRDAPPO.MO1_MEMO_PK) violated Job
"PRDAPPO"."SYS_IMPORT_FULL_01" completed with 1 error(s) at
02:34:33

- undo的困扰

- ORA-31693: Table data object
"MIG_TEST"."MO1_MEMO": "P2_A1000_E3" failed to load/unload and
is being skipped due to error: ORA-29913: error in executing
ODCIEXTTABLEFETCH callout ORA-30036: unable to extend segment
by 8 in undo tablespace 'UNDOTBS1'



Datapump带来的问题

— 加载LOB数据的假并行

Elapsed Time (s)	Executions	Elapsed Time per Exec (s)	%Total	%CPU	%IO	SQL Id	SQL Module
3,553.36	0		1.01	35.03	10.32	6cz7m51m82vqg	Data Pump Worker

```
6cz7m51m82vqg  INSERT /*+ PARALLEL("MO1_MEMO", 1)+*/ INTO RELATIONAL("APPO"."MO1_MEMO" NOT
XMLTYPE) ("APP_ID", "ENTITY_KEY", "PERIOD_KEY", "MEMO_ID", "SYS_CREATION_DATE",
"SYS_UPDATE_DATE", xxxxxxxx, "ATTR10VALUE", "CLOB_IND", "MEMO_SYSTEM_TEXT_C")
SELECT "APP_ID", "ENTITY_KEY", "PERIOD_KEY", "MEMO_ID", "SYS_CREATION_DATE",
"SYS_UPDATE_DATE", xxxxxxxx, "ATTR10VALUE", "CLOB_IND", "MEMO_SYSTEM_TEXT_C"
FROM "ET$111D05F70001" KU$ LOG ERRORS INTO "APPO"."ERR$DP111D05F70001" REJECT
LIMIT UNLIMITED
```

使用imp加载CLOB数据的速度测试

```
SQL> select 620540/15/60 from dual;
620540/15/60
```

689.488889



让人提心吊胆的问题

- 数据问题总是在最后关头发现，没法提前进行比较
- 大分区表的加载性能问题
- 数据加载的过程可控性不够
- 数据修复总是紧急加急



被逼无奈的大胆尝试

	抽取开始时间	抽取结束时间	时长	产生的dump大小
sqlldr(exclude 2 tables) 68 tables	Tue Jul 15 13:28:15 ICT 2014	Tue Jul 15 13:42:32 ICT 2014	14 mins	150G
EXT_DATAPUMP 70 tables	Tue Jul 15 14:03:11 ICT 2014	Tue Jul 15 14:06:20 ICT 2014	3 mins	59G

	加载数据开始时间	加载数据结束时间	时长	产生归档文件大小
sqlldr(exclude 2 tables) 68 tables	Tue Jul 15 14:24:24 ICT 2014	Tue Jul 15 15:44:04 ICT 2014	80 mins	230G
EXT_DATAPUMP 70 tables	Tue Jul 15 17:06:51 ICT 2014	Tue Jul 15 17:50:04 ICT 2014	44 mins	139G



□ 希望

- 速度提升明显
- 完整的数据类型支持
- 解决乱码问题的困扰
- 稳定性和数据完整性
- 有质疑变为信任
- 压力变为动力

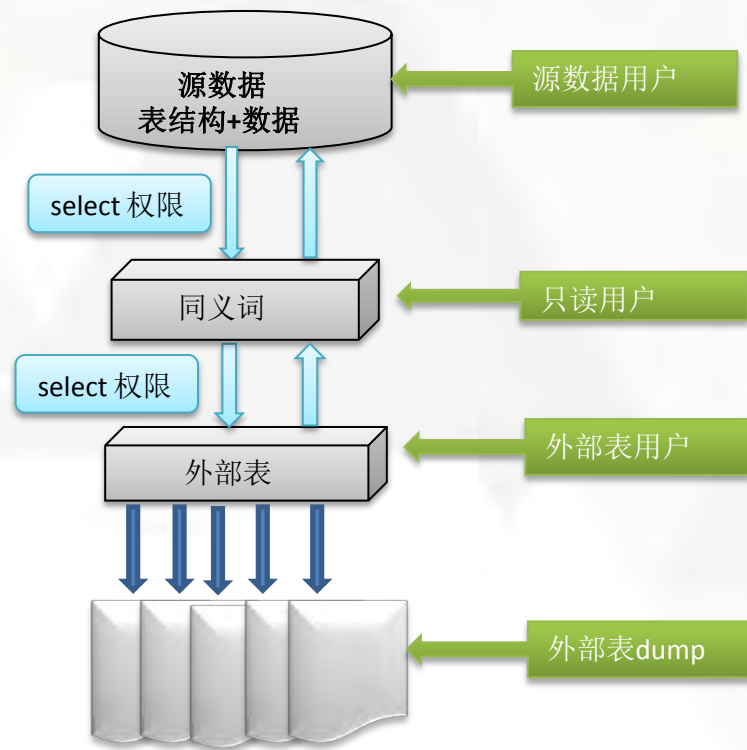
□ 顾虑

- 在其它项目中目前还没有尝试过
- 新技术的新鲜感，可能华而不实
- 技术是否成熟，稳定
- 数据是否会丢失
- 测试是否充分
- 数据安全性，引入不当操作（drop,alter）



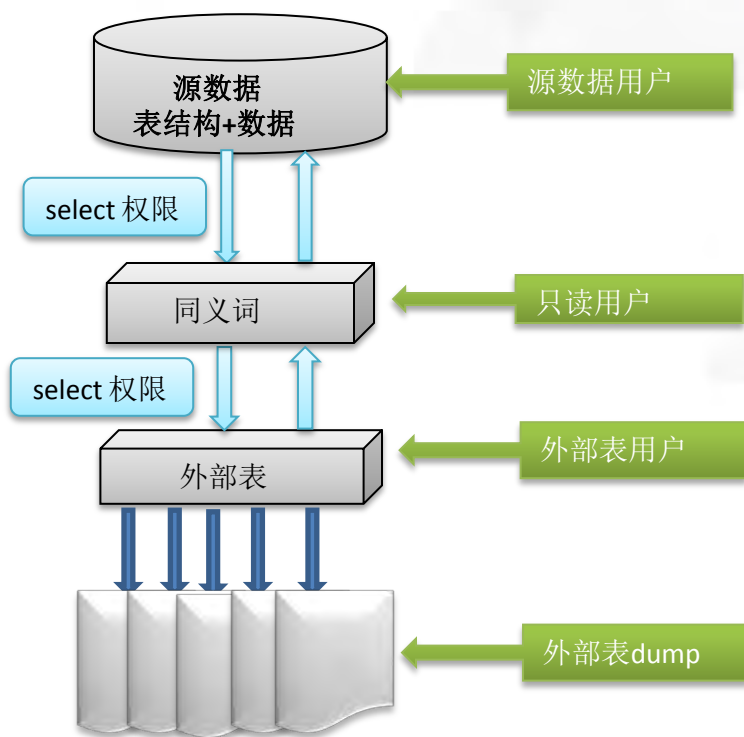
数据抽取示意图

```
CREATE TABLE MO1_MEMO_EXT  
  ORGANIZATION EXTERNAL  
(  
  TYPE ORACLE_DATAPUMP  
  DEFAULT DIRECTORY xxxxx  
  LOCATION (  
    'xxxx1.dmp','xxxx2.dmp')  
  )  
  parallel xx as  
  SELECT /*+ parallel(t xx) */  
    *  
  FROM 只读用户.MO1_MEMO;
```

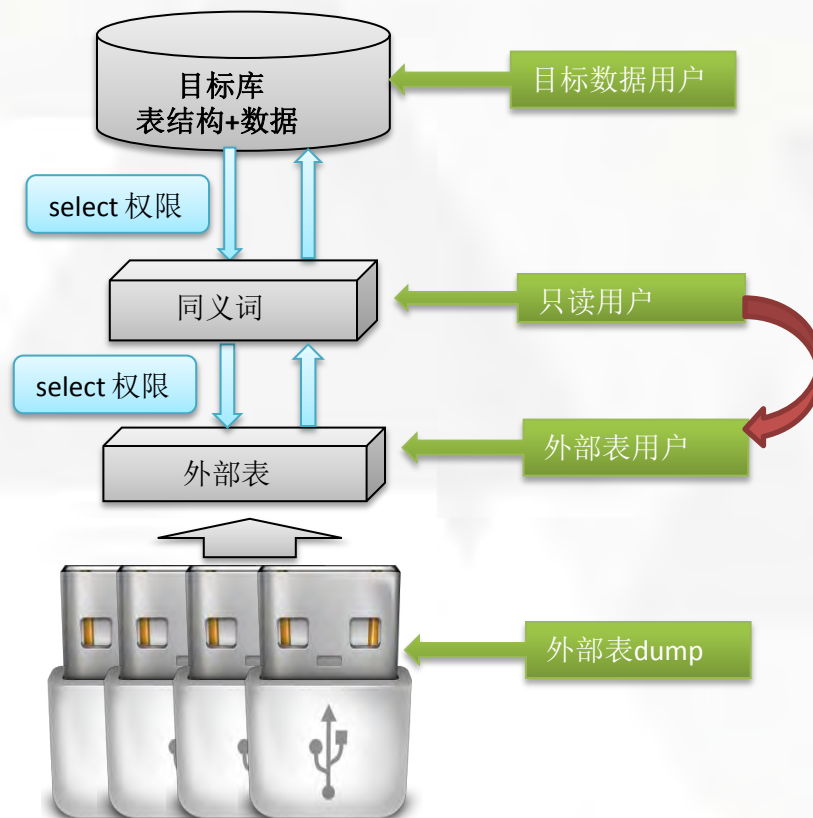


数据加载示意图

数据源

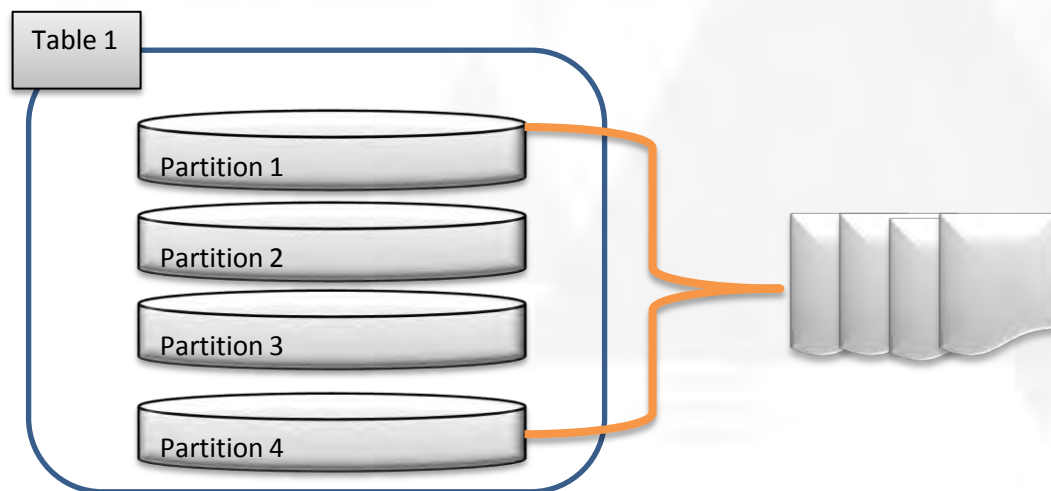


数据加载的流程



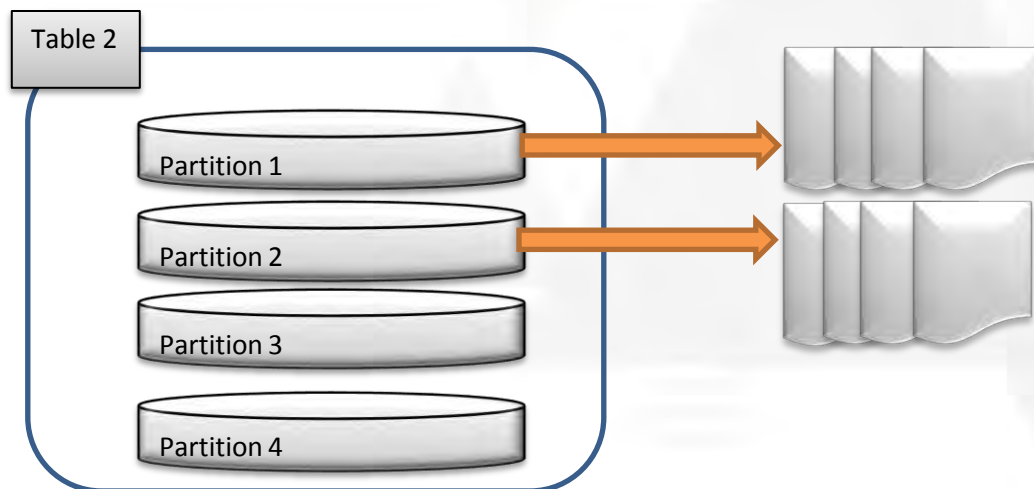
数据抽取的切分思路

full table+parallel



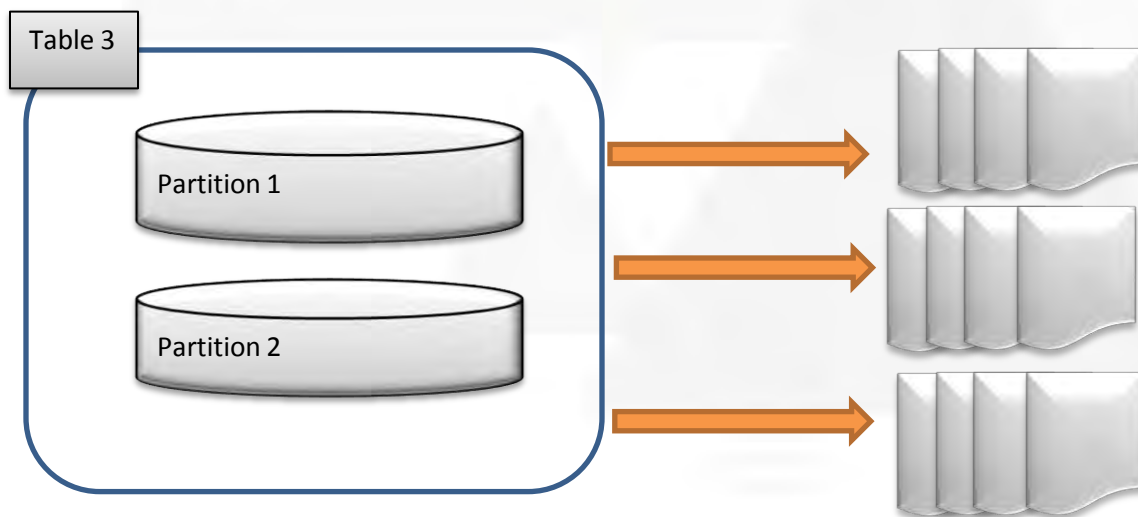
数据抽取的切分思路

partition+parallel



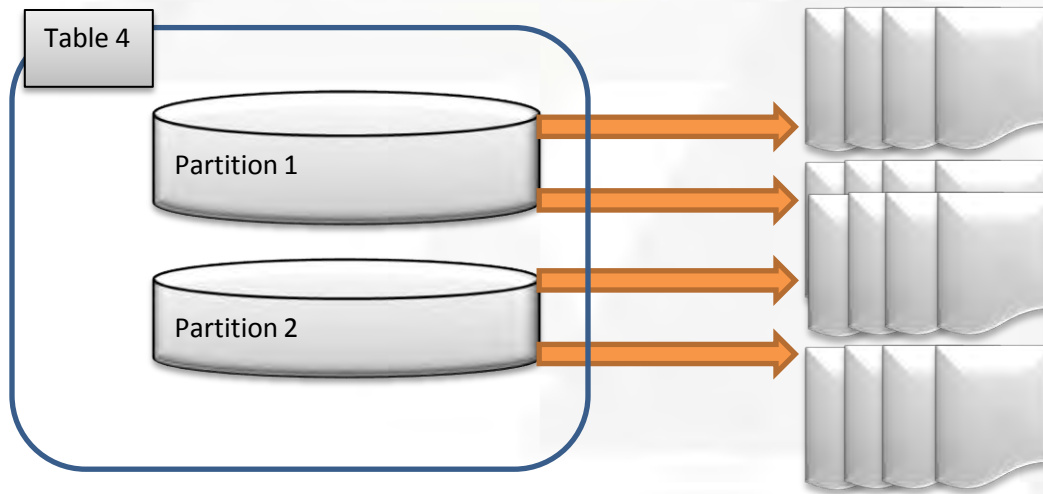
数据抽取的切分思路

full table+rowid+parallel

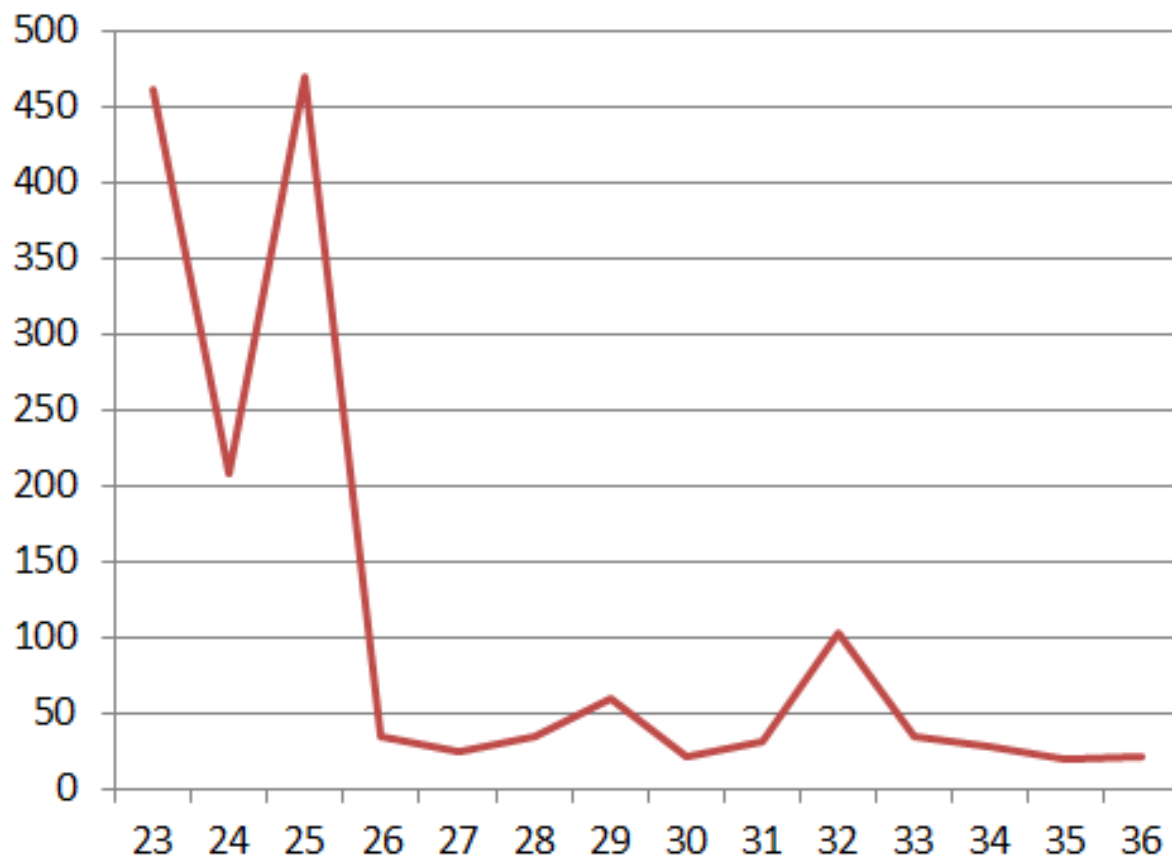


数据抽取的切分思路—rowid切分

partition+rowid+parallel



节外生枝 --严重的I/O问题



节外生枝

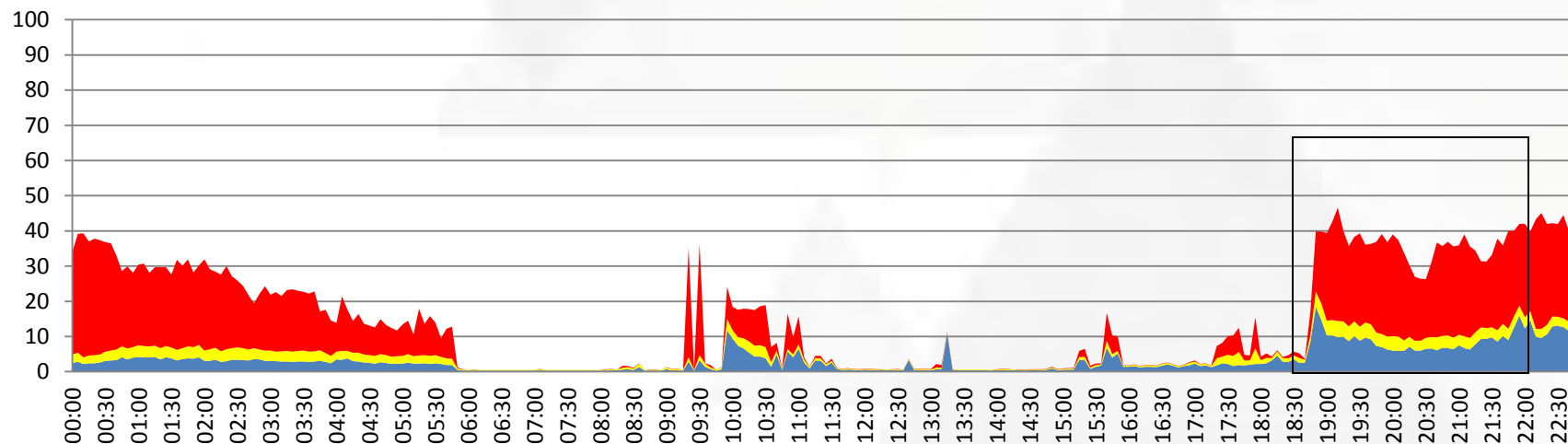
- 极度无奈的rollback
- 客户的发现
- 内部改进建议
- 持续进行新方案的性能测试
 - 演练中遇到的性能瓶颈
 - 客户和同事的质疑



存储问题之外的性能瓶颈

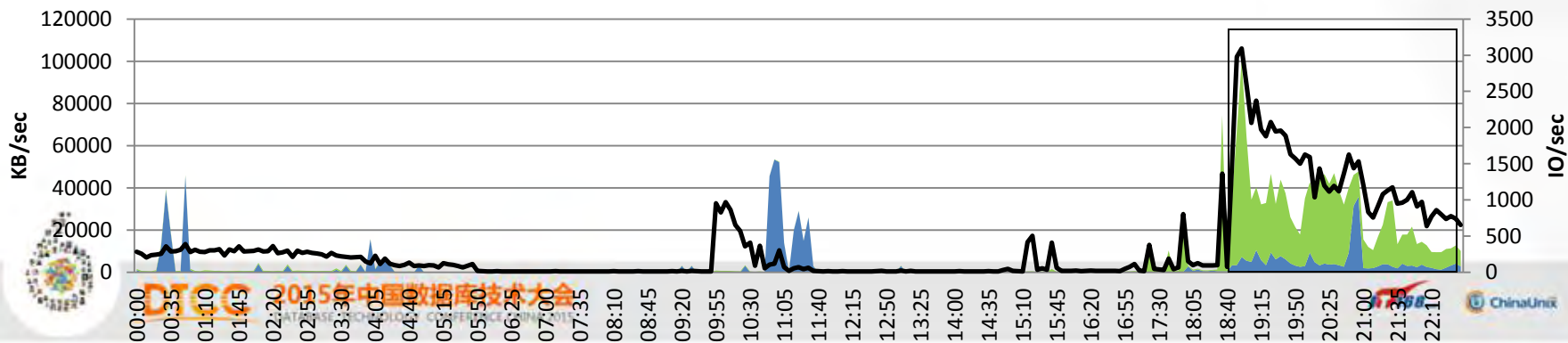
CPU Total ccbdbpt3 8/14/2014

■ User% ■ Sys% ■ Wait%

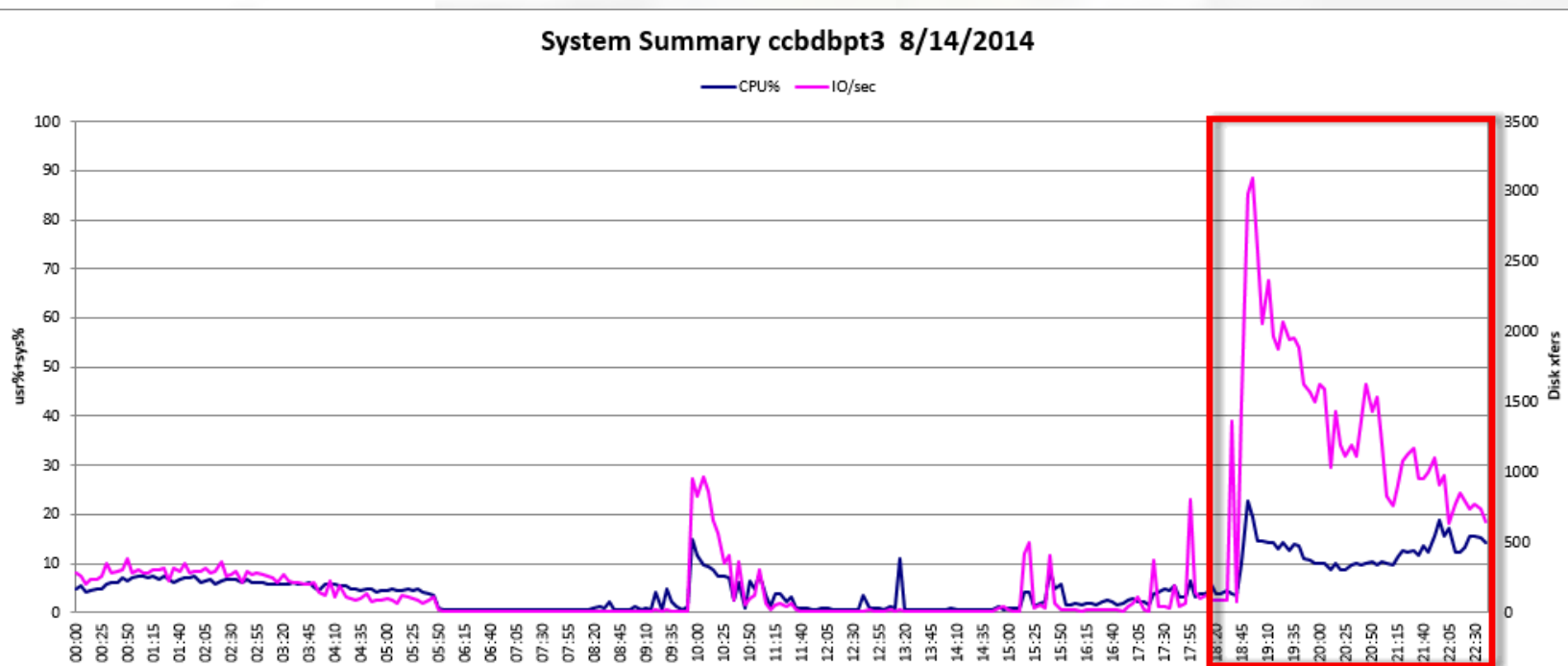


Disk total KB/s ccbdbpt3 - 8/14/2014

■ Disk Read KB/s ■ Disk Write KB/s — IO/sec



存储问题之外的性能瓶颈



性能测试中的排除法

```
_optimizer_use_feedback = FALSE
aq_tm_processes          = 0
Deprecated system parameters with specified values:
  background_dump_dest
  user_dump_dest
End of deprecated system parameter listing
Oracle instance running with ODM: Veritas 6.0.100.000 ODM Library, Version 2.0
Sun Aug 17 23:24:39 2014
PMON started with pid=2, OS id=20704
Sun Aug 17 23:24:39 2014
PSP0 started with pid=3, OS id=20729
```

> ps -ef|grep odm

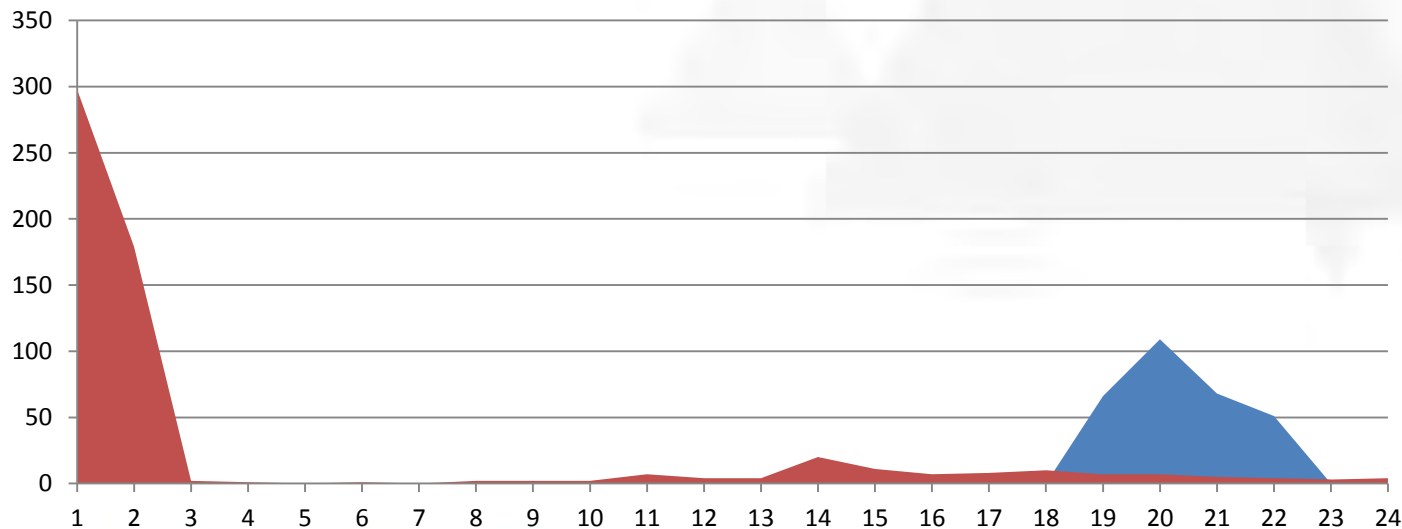
```
root   10615   1 0 Jul23 ?      00:00:17 [vxodm_ioreap]
root   10616   1 0 Jul23 ?      00:00:00 [vxodm_ioclean]
oraccbs1 24858 28913 0 12:58 pts/9   00:00:00 grep odm
```



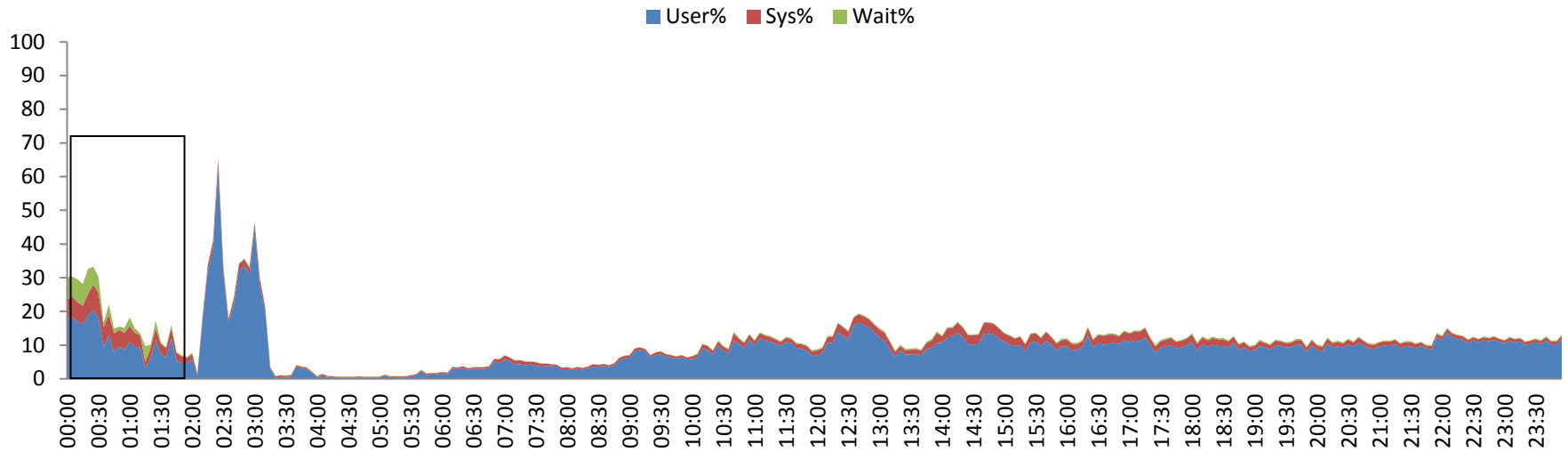
ODM性能的对比图

	时间																							
日期	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
2014.xx.13	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	1	0
2014.xx.14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	66	109	68	51	xxx	xxx

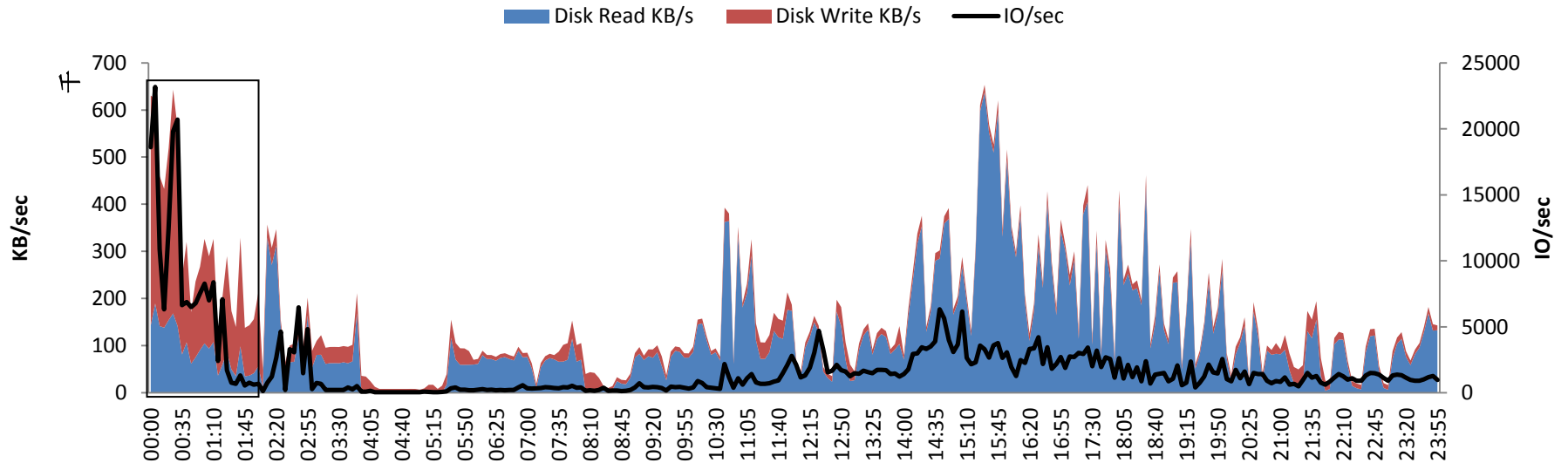
	时间																							
日期	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
2014.xx.16	1	0	3	3	22	1	0	1	4	3	2	2	4	4	3	4	4	4	3	4	4	2	1	86
2014.xx.17	298	179	2	1	0	1	0	2	2	2	7	4	4	20	11	7	8	10	7	7	5	4	3	4



CPU Total ccdbpr3 9/17/2014



Disk total KB/s ccdbpr3 - 9/17/2014



数据加载进度的控制

BL1_BILL_STATEMENT	3 of TOTAL	36 completed, --processing...	from split_par_5_appenddata.log
CM1_AGREEMENT_PARAM	52 of TOTAL	74 completed, --processing...	from split_par_9_appenddata.log
MO1_MEMO	58 of TOTAL	250 completed, --processing...	from split_par_2_appenddata.log
AR1_TRANSACTION_LOG	16 of TOTAL	28 completed, --processing...	from split_par_8_appenddata.log
AR1_CHARGES	31 of TOTAL	107 completed, --processing...	from split_par_4_appenddata.log
BL1_DOCUMENT	21 of TOTAL	74 completed, --processing...	from split_par_10_appenddata.log
BL1_INVOICE	23 of TOTAL	27 completed, --processing...	from split_par_7_appenddata.log
BL1_CHARGE	30 of TOTAL	126 completed, --processing...	from split_par_1_appenddata.log

```
> ksh check_status.sh
```

```
837 of 1548 has finished data append process
```

```
54.06 % finished
```



数据问题的修复

- DML ERROR LOG

```
SQL> EXEC DBMS_ERRLOG.create_error_log(dml_table_name =>  
'BL1_DOCUMENT',SKIP_UNSUPPORTED=>true,ERR_LOG_TABLE_NAME=>'BL1_  
DOCUMENT_DUPLICATION');  
PL/SQL procedure successfully completed.
```

```
SQL> insert into BL1_DOCUMENT select *from  
MIG_TMP.BL1_DOCUMENT_EXT_30 LOG ERRORS INTO  
BL1_DOCUMENT_DUPLICATION('duplicate data for BL1_DOCUMENT') REJECT  
LIMIT UNLIMITED;  
198842 rows created.
```

```
SQL> commit;  
Commit complete.
```



迁移需要注意的细节

- 1) 充分的测试,评估时间,总结经验,提升性能
- 2) 完整的备份策略
- 3) 网络（网络带宽和网络中断）
- 4) 完整的日志
- 5) 存储
- 6) 归档空间
- 7) 表级nologging
- 8) index级nologging
- 9) lob级nologging
- 10) foreign key
- 11) trigger的影响
- 12) goldengate的影响
- 13) 主键冲突数据排除
- 14) constraint级的数据不一致



IT168

ChinaUnif

ITPUB

Microsoft

THANKS