

Migrating to 12c: 300 DBs in 300 days.

What we learned

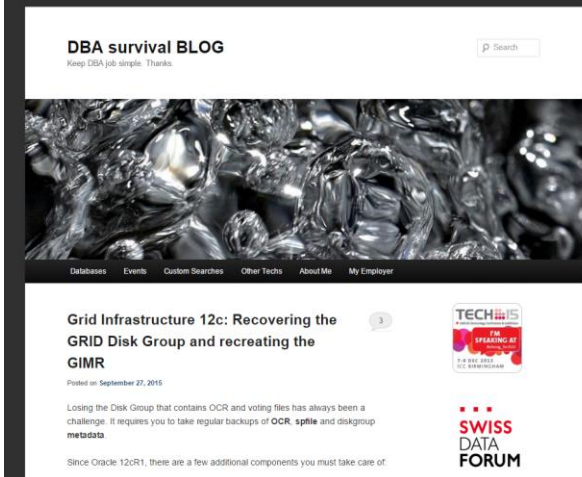
Ludovico Caldara
Oracle ACE Director
Trivadis AG




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About Ludovico Caldara



- 17 Years DBA (Not Only Oracle)
 - I do it everywhere (even Windows)
- RAC ATTACK Ninja & co-writer
-  **RAC SIG** President, SOUG & ITOUG Board
Real Application Clusters
Special Interest Group
- OCP (11g, 12c, MySQL) & OCE
- Italian living in Switzerland



<http://www.ludovicocaldara.net>



@ludodba




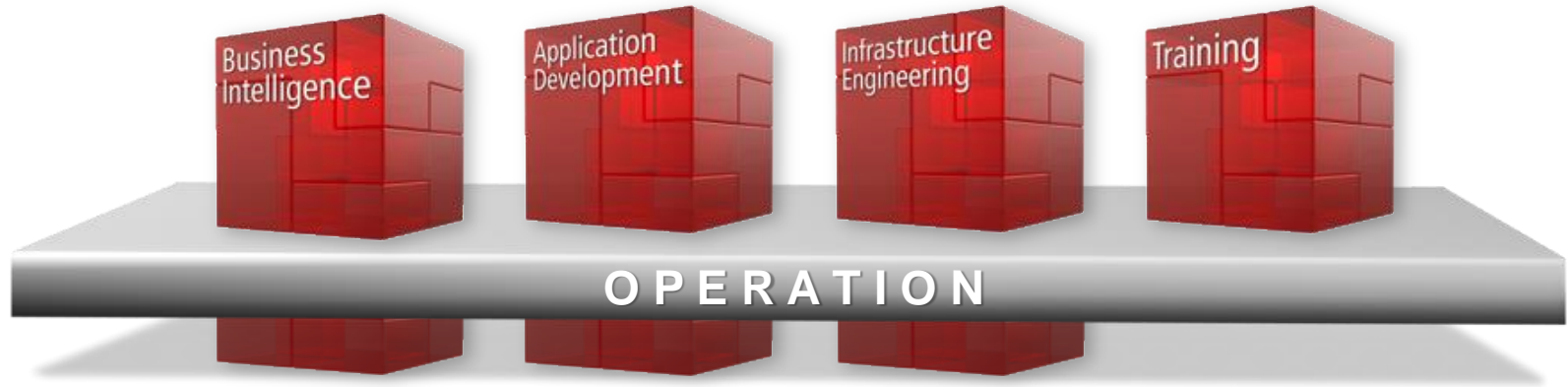
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■ Our company.

Trivadis is a **market leader in IT consulting, system integration, solution engineering** and the provision of **IT services** focusing on **ORACLE®** and  **Microsoft** technologies in Switzerland, Germany, Austria and Denmark. We offer our services in the following strategic business fields:



Trivadis Services takes over the interactive operation of your IT systems.

■ With over 600 specialists and IT experts in your region.

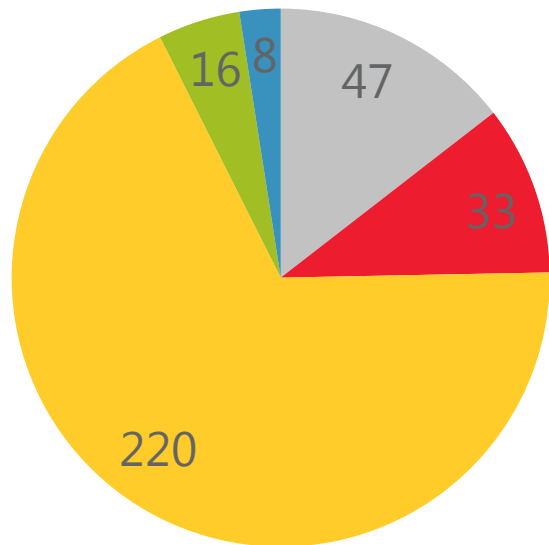


- 14 Trivadis branches and more than 600 employees
- 200 Service Level Agreements
- Over 4,000 training participants
- Research and development budget: CHF 5.0 / EUR 4 million
- Financially self-supporting and sustainably profitable
- Experience from more than 1,900 projects per year at over 800 customers

A small introduction

■ The customer numbers - Instances

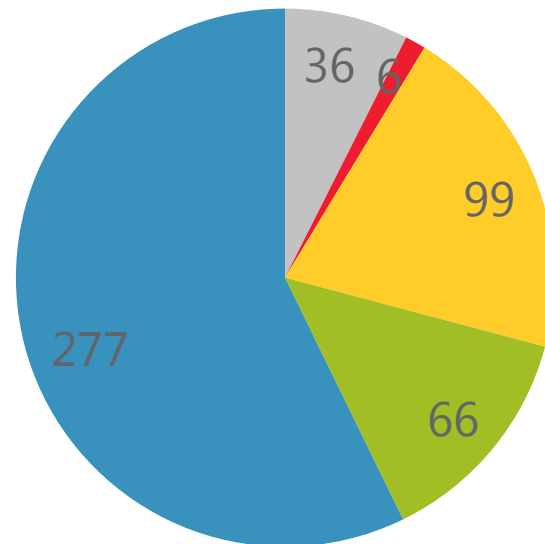
28.01.2015



TOTAL: 324



28.08.2016



TOTAL: 484

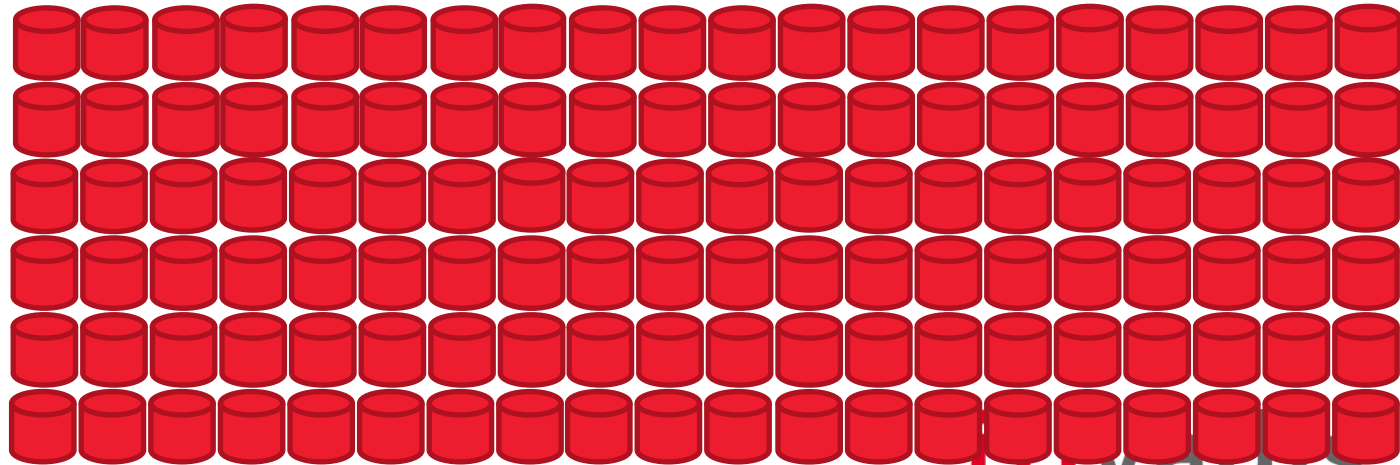
DISCLAIMER: not really 300 DB in 300 days, but you get the idea ☺

■ The customer numbers - DBAs

■ 4 Oracle DBAs (+1 😊)

■ 484 Oracle instances

■ Ratio of 121 instances per DBA



■ 111 Instances per DBA

■ No Additional DBAs for the migration project.

How is it possible?

■ Avoid Zoos



■ Avoid Zoos



- #MakeStandardsGreatAgain

Follow @trumpDBA

- Have a single platform for all the Oracle Databases (Linux being the most obvious) *
- Reduce the number of versions and patches *
- All databases are equal in front of the DBA *
- Rock-solid naming conventions

* whenever possible

■ Avoid Frankensteins



■ Avoid Frankensteins

...even if they look innocuous!



- Trivia quiz: Does it create a Frankenstein?

Granting DBA to technical accounts

■ Trivia quiz: Does it create a Frankenstein?

Using Public Synonyms

- Trivia quiz: Does it create a Frankenstein?

Using DB Links

■ Trivia quiz: Does it create a Frankenstein?

Using Java Stored procedures

- Trivia quiz: Does it create a Frankenstein?

Using External Tables

■ Trivia quiz: Does it create a Frankenstein?

Setting hidden («underscore») parameters

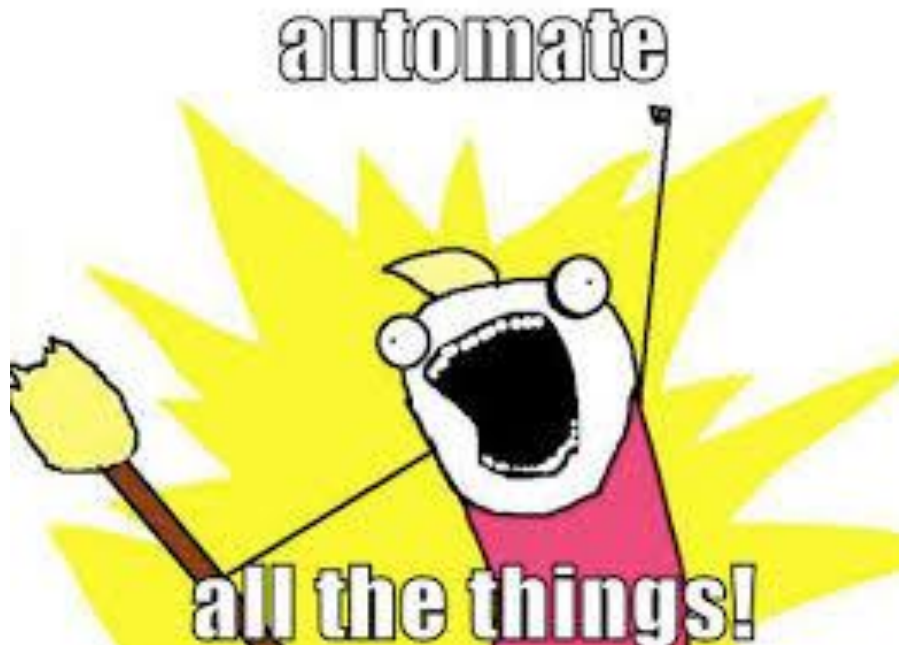
■ Trivia quiz: Does it create a Frankenstein?

Using `/*+ hints */`

- Trivia quiz: Does it create a Frankenstein?

Using SQL Plan Management

■ Automate all the things!



■ Automate all the things!

- Database creation/deletion
- Database patching
- Duplicate, Database refresh
- Export/Import of schemas
- User management
- Tablespace creation/extension
- **Database upgrades**

July 2013: So there is a new GA version?

■ Phases of the migration project

1. Evaluate
2. Homologate
3. Plan
4. Migrate
5. Maintain / Follow-up

■ Evaluate (Jan 2014 – Aug 2014)

- What are the New Features?
- Does the licensing model change?
- Any concern regarding the roadmap?
- Any deprecated/desupported features?

■ The new feature list is long and impressive

■ Database New Features Guide

<http://docs.oracle.com/database/121/NEWFT/toc.htm>

■ New Features of Oracle Database 12c for DBAs

<http://www.trivadis.com/en/training/new-features-oracle-database-12c-dbas-o-nf12c-dba>

■ The new feature list is long and impressive



■ Evaluate (Jan 2014 – Aug 2014)

Non-CDB, Singletenant, or Multitenant?

■ Evaluate (Jan 2014 – Aug 2014)

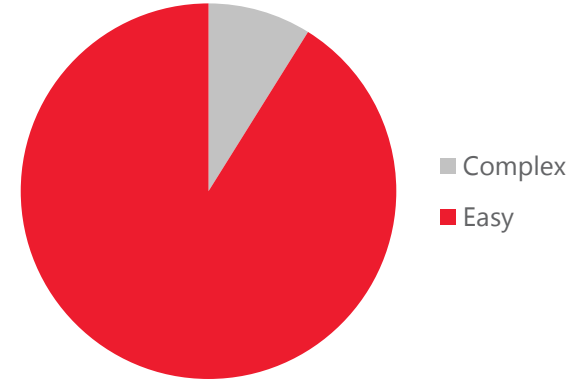
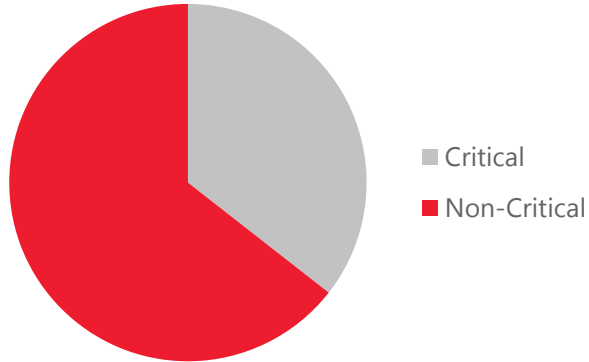
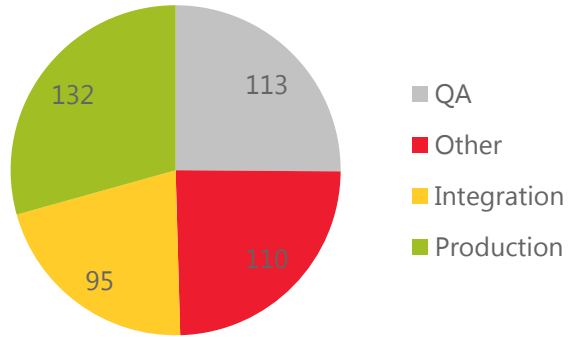
Non-CDB, ~~Single tenant~~, or ~~Multitenant~~?

Not compatible with Multitenant in 12.1:
ILM & Streams (among others)

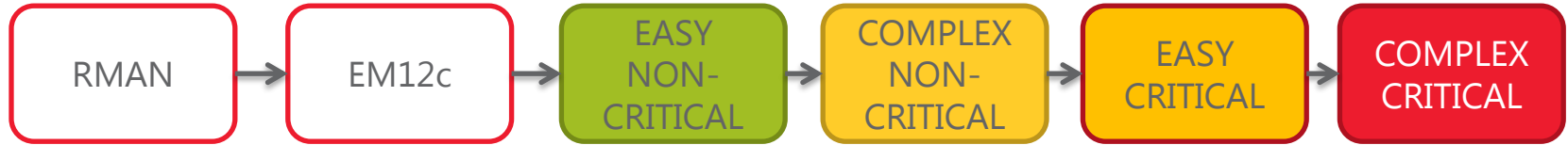
■ Homologate (Aug 2014 – Nov 2014)

- Do my scripts work without any change with the new release?
 - All automation scripts (create, duplicate, etc)
 - Performance related scripts (statistics gathering, etc.)
 - Backup and Recovery procedures
 - Monitoring with EM12c

Plan (Nov 2014 – Dec 2014)



■ Plan (Nov 2014 – Dec 2014)



■ Plan (Nov 2014 – Dec 2014)

INTEGRATION

QA

PRODUCTION

■ Plan (Nov 2014 – Dec 2014)

INTEGRATION

QA

PRODUCTION

■ QA First!

- Let the developers integrate changes with the current release
- Allow refreshes from Production to Integration
- If the deployment works in Integration **and** QA, it will work in Prod
- **Do performance/regression tests here!**

■ Plan (Nov 2014 – Dec 2014)

INTEGRATION

QA

PRODUCTION

■ When integration is upgraded

- The developers cannot deploy in production
- The production must be upgraded soon
- Make sure you tested correctly in QA

■ Plan (Nov 2014 – Dec 2014)

INTEGRATION

QA

PRODUCTION

■ When upgrading the production

– Be ready to react ;-)

Migrate. How?

■ There is the guide, and there is the gold mine

Database Upgrade Guide

<https://docs.oracle.com/database/121/UPGRD/toc.htm>

Upgrade your Database - NOW!

<https://blogs.oracle.com/UPGRADE/>

It's a mine: find the diamonds on your own!



Slides Download Center

Comprehensive

Upgrade, Migrate & Consolidate to Oracle Database 12c

Refreshed 3-MAR-2016

Why you need to upgrade NOW!

Upload: 09-DEC-2015

Upgrade Best Practices - 12c

(latest update on 8-NOV-2014)

Upgrade Methods

(Refresh: 8-NOV-2014)

What's New with Upgrades to 12c?

Upload: 8-NOV-2014

Webcast for ISVs Apr-2015:

Why Upgrade to Oracle 12c?

Upload: 21-APR-2015

■ Upgrade path

Database Upgrade Assistant?

Manual Upgrade?

Export/Import?

■ First, obvious choice: **Use DBUA**

Why?

- Partially automated
- Easy to script
- OK for dedicated databases and inter-related consolidated schemas

■ First, obvious choice: **Use DBUA**

Additional steps required. Our migration script actually:

- Increases the SGA +512Mb
- Executes some pre-upgrade steps
- Saves the object states
- Checks Data Guard synchronization
- Checks for Materialized View refreshes
- Does other sanity checks (pending distributed transactions, DF in backup mode, etc)
- Checks for the successful execution of the last archive backup
- Purges DBA_RECYCLEBIN
- ... continue...

■ First, obvious choice: **Use DBUA**

- Gathers dictionary stats
- Saves the oratab
- Blackouts the target in EM12c
- **Launches the dbua** (see next page)
- Checks the upgrade logs
- **Runs datapatch -verbose**
- Changes the LDAP entry if necessary
- Changes the ORACLE_HOME for the target in EM12c
- Checks and eventually registers the DB with the RMAN catalog
- Restores and modifies the oratab

■ First, obvious choice: **Use DBUA**

```

${NEW_ORACLE_HOME}/bin/dbua -silent \
-sid $ORACLE_SID \
-oracleHome ${ORACLE_HOME} \
-sysDBAUserName sys \
-sysDBAPassword $SYS_PASSWORD \
-recompile_invalid_objects true \
-upgradeTimezone \
-listeners LISTENER_12C \
-createGRP true \
-emConfiguration NONE \
-newRecoveryArea $NEW_FRA \
-newRecoveryAreaSize $NEW_FRA_SIZE \
-initParam $INIT_PARAMS >> ${outfile}

```

■ Second choice: **Use expdp/impdp**

Why?

- Schema-consolidated databases

2015 – 2016: The migration phase

■ Many databases? Find a good project manager

The project manager:

- Mediates with the application owner or final users
- Solicits the developers/editors to validate the new version
- Keeps track of the evolution
- Fixes dates and agrees downtimes
- Buys pizzas when the DBAs upgrade a database in the evening

■ October 2015

Extended Support Fee for Oracle 11.2.0.4 waived until May 31, 2017 - Extended Support until Dec 2020

By Mike Dietrich-Oracle on Oct 17, 2015

https://blogs.oracle.com/UPGRADE/entry/no_extra_fee_for_extended

■ Waived Extended Support impact

- None, if you don't tell it anyone ;-)
- You can follow the upgrade roadmap with less stress

Performance?

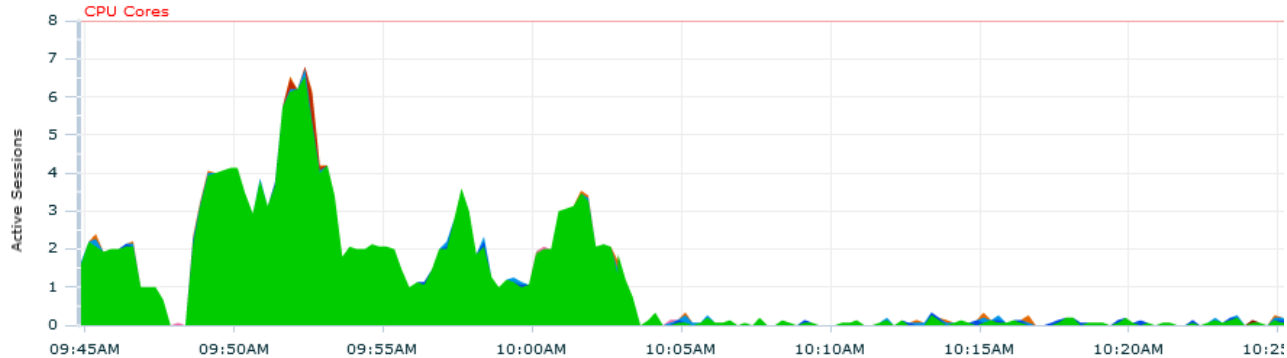
■ Performance in 12c

- Overall high performance improvement
- But servers changed for this project
 - not an apple to apple comparison

■ Guess what?

Top Activity

Drag the shaded box to change the time period for the detail section below.



Detail for Selected 5 Minute Interval

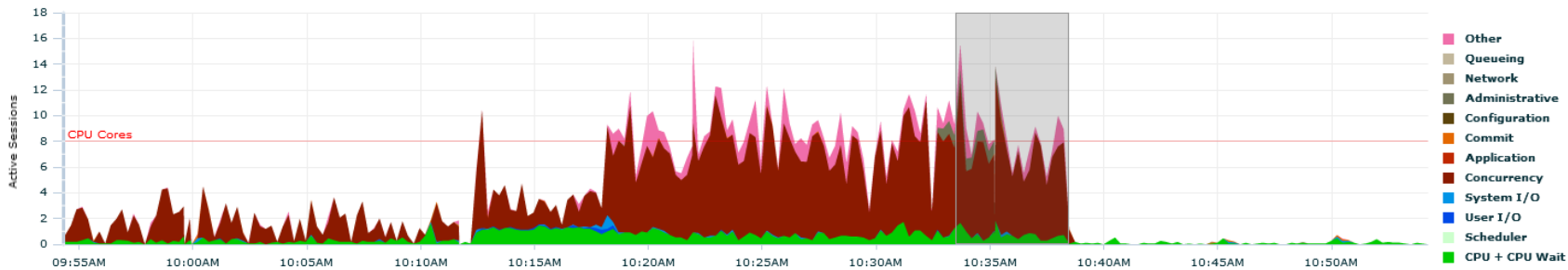
Start Time Oct 23, 2015 10:25:40 AM

■ Guess what?

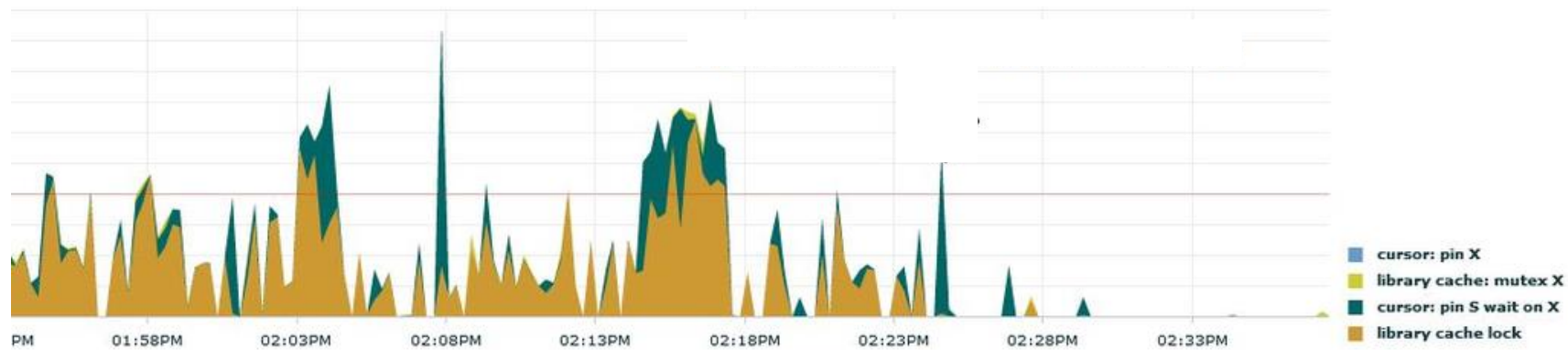
Top Activity

Drag the shaded box to change the time period for the detail section below.

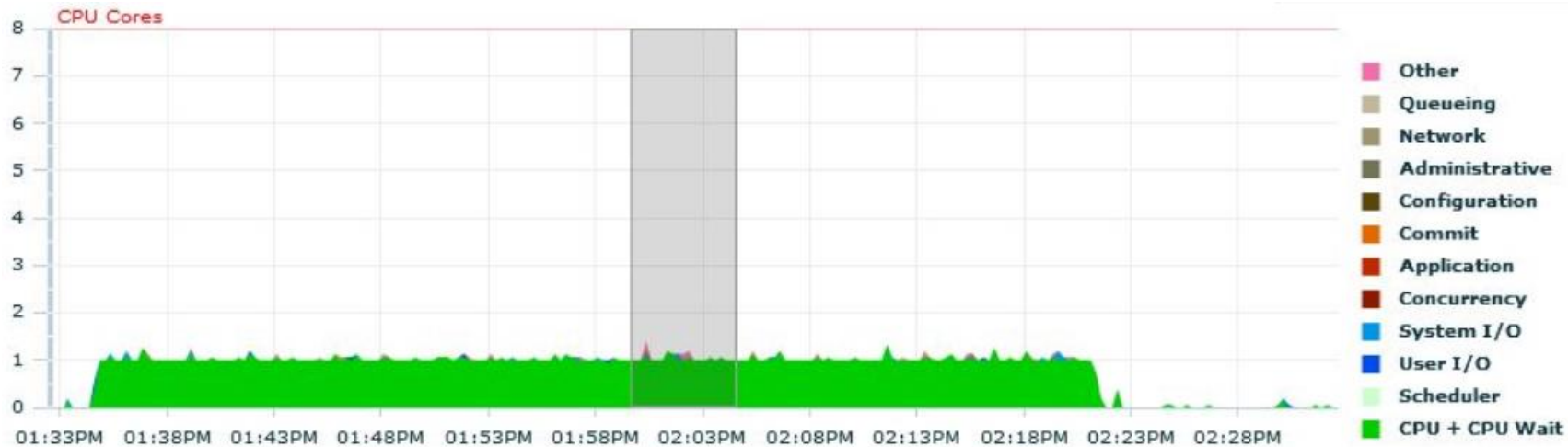
View C



■ Guess what?



■ Guess what?



■ The big mess with SQL Plan Directives



Christian Antognini @ChrisAntognini · 17 set 2014

This afternoon I created 3 SR related to the management of **SQL plan directives**. A feature with a huge impact in #DB12c. #OracleDatabase #SPD



Also Extensions Created Because of SQL Plan Directives Can Invalidate Packages



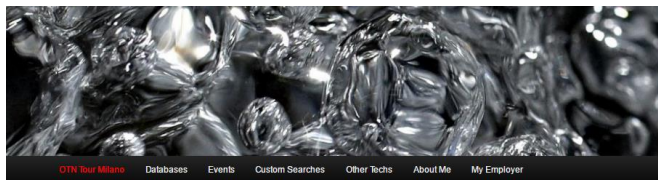
December 17, 2015 | Written by Christian Antognini

1 Comment



How to disable a SQL Plan Directive permanently

By Franck Pachot | June 12, 2015 | Database management | 3 Comments



Posted on May 21, 2015

← Previous Next →

SQL Plan Directives: they're always good... except when they're bad!



SQL Plan Directives strike again

By Franck Pachot | February 4, 2016 | Database Administration & Monitoring | No Comments

berxblog

Dienstag, 23. Juni 2015

SQL Plan Directives and result cache affects performance

Bugs Related to SQL Plan Directives Pack and Unpack



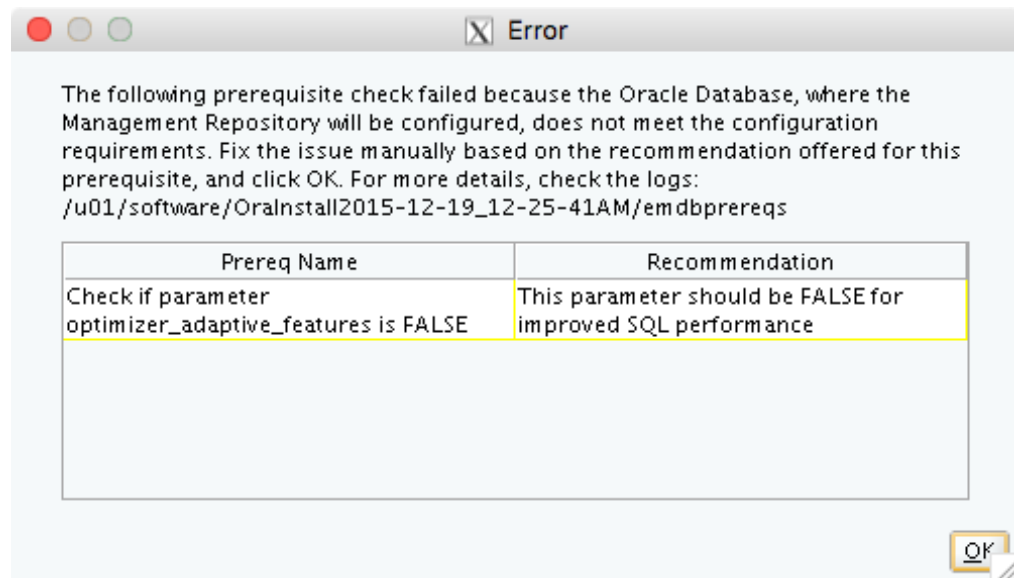
July 13, 2015 | Written by Christian Antognini

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■ SQL Plan Directives

- It does not impact only one statement but ALL the statements that involve specific tables/columns/joins
- A few cardinality misestimates can lead to several side effects
 - Adaptive Dynamic Sampling triggered "without reason"
 - Extended Statistics created "without control"
- Different symptoms. Among others:
 - Library Cache contention
 - Result Cache problems
 - Bad Execution Plans
 - High CPU usage

■ Solution to SQL Plan Directives?



■ Solution to SQL Plan Directives?

Order by intrusiveness ASC:

- Disable the directives selectively
- Disable the SPD Usage
- Disable the cardinality feedback
- Disable all the adaptive features
- Disable all the new optimizer features of 12.1

■ Best strategy for SQL Plan Directives?

- SQL Plan directives are a hot topic!
- Most customers prefer to disable the adaptive features completely
- I personally disagree, maybe they are right! 😞

■ DBMS_FEATURE_AWR and SPDs

- DBMS_FEATURE_AWR sistematically has misestimations
- This leads to SPDs on
 - WRH\$_SYS_TIME_MODEL
 - WRH\$_STAT_NAME
 - WRM\$_SNAPSHOT
- Check if it is the case and use this post to fix:
 - http://www.ludovicocaldara.net/dba/cpu-usage-12c-dbms_feature_awr/

■ Other performance considerations (incomplete list)

- Patches to Consider for 12.1.0.2 to Avoid Problems with SQL Plan Management (SPM) (Doc ID 2035898.1)
- Things to Consider to Avoid Poor Performance or Wrong Results on 12.1.0.2 (Doc ID 2034610.1)
- Parameter Recommendations for Oracle Database 12c - Part I
 - https://blogs.oracle.com/UPGRADE/entry/parameter_recommendations_for_oracle_database

Bugs?

■ August 2015

Ouch, this hurts: bug 17325413 - patch BEFORE upgrade!

By Mike Dietrich-Oracle on Aug 18, 2015

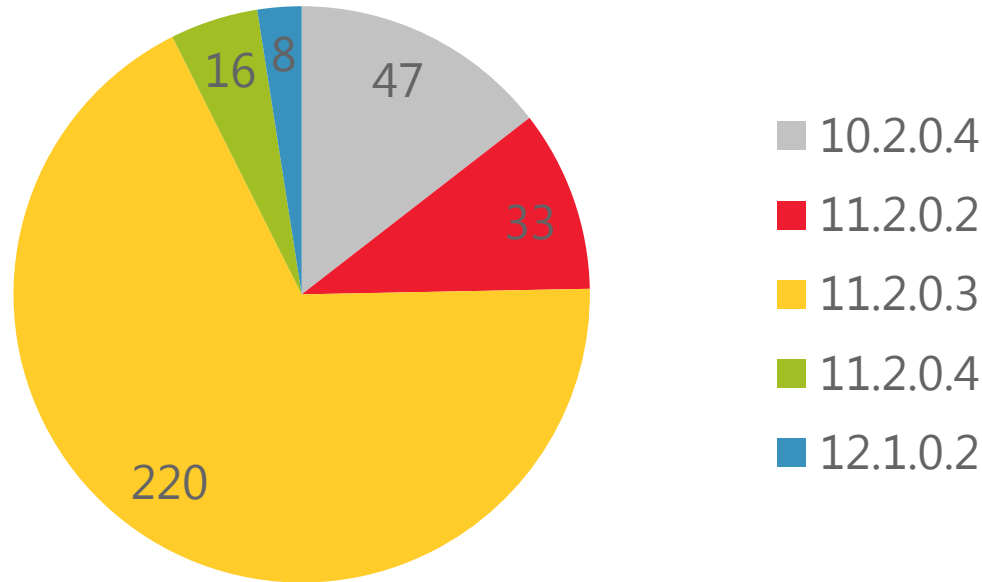
“Bug 17325413 - Drop column with DEFAULT value and NOT NULL definition ends up with dropped column data hitting disk leading to corruption”

https://blogs.oracle.com/UPGRADE/entry/ouch_this_really_hurts_bug

Change of upgrade strategy because of bug 17325413

`$ upgrade_db_to_11204.sh && upgrade_db_to_12102.sh`

08.01.2015



■ bug 17325413: impact?

- No problems or corruptions encountered so far
- A strategy has been set to sanitize the data in case of future corruptions
- Let 30 minutes of additional downtime for double-patching

■ November 2015

Ouch, this hurts: bug 21923026 - patch Oracle 12c Home before upgrading if you have OLTP Compression in 11g

By Mike Dietrich-Oracle on Nov 02, 2015

Bug 21923026 Corruption during Recovery after upgrading to 12c for Compressed Tables

https://blogs.oracle.com/UPGRADE/entry/ouch_this_hurts_bug_21923026

■ bug 21923026: impact?

- Luckily, my customer was not using OLTP compression
- Now all migrations are done on a patched Oracle Home

■ Things to Consider to Avoid... Wrong Results on 12.1.0.2

MOS Doc ID 2034610.1

- Wrong results from GROUP BY query when "_optimizer_aggr_groupby_elim"=true (Doc ID 20508819.8)
- Wrong results from OUTER JOIN with a bind variable and a GROUP BY clause in 12.1.0.2 (Doc ID 20634449.8)
- Bug 18430870 - Adaptive Plan and Left Join Give Wrong Result (Doc ID 18430870.8)

■ Things to Consider to Avoid... Wrong Results on 12.1.0.2

MOS Doc ID 2034610.1

- Wrong results from GROUP BY query when "optimizer_aggregatby_elim"=true (Doc ID 20553519.8) **FIXED IN PROACTIVE BP 160119**

- Wrong results from OUTER JOIN with a bind variable and a GROUP BY clause in 12.1.0.2 (Doc ID 20634419.8) **FIXED IN PROACTIVE BP 160119**

- Bug 18430870 - Adaptive Plan and Left Join Give Wrong Result (Doc ID 18430870.8) **FIXED IN PROACTIVE BP 160419**

■ Trivadis customers encountered other bugs

- Bug 22913528: **WRONG RESULTS** WITH PARTITION PRUNING AND MIN/MAX SCANS
- Bug 18650065 - **WRONG RESULTS** ON QUERY WITH SUBQUERY USING OR EXISTS
- Bug 18499088: PARALLEL QUERY RUNS WITH **WRONG RESULT** WITH PUSHDOWN DISTINCT (UNIQUE)
- Bug 19526873: **Wrong result** on temp table under UNION ALL when accessed by Concurrent Parallel
- Bug 21079201: **WRONG RESULTS** WITH CONCURRENT PX ON GTT UNDER UNION ALL
- Bug 22173980: **WRONG RESULTS** (NUMBER OF ROWS) WHEN "_ROWSETS_ENABLED" = TRUE
- Bug 21459392: QUERY WITH ANSI OUTER JOIN RETURNS **WRONG RESULT** IN 12C
- Bug 19894622: ORA-600 [kkqcsfixfro:1 -- frooutj] error occur in 12c

■ Trivadis customers encountered other bugs

- Bug 22913528: **WFO - C RESULTS WITH PARTITION PRU... AND M... MEANS**
Still no patch. Fix not viable
- Bug 18650065 - **WFO - C RESULTS DELETED FROM SUBQ... US... C... ES...**
One-off required, not included in BP
- Bug 18499088: **PARALLEL QUERY RUNS WITH LONG RESULT WITH PLUS... D... LLS INCT (UNIQUE)**
FIXED IN PROACTIVE BP 160419
- Bug 19526873: **Wrong result on temp table during ON ALL when accessed by other parallel**
FIXED IN PROACTIVE BP 160419
- Bug 21079201: **WFO - C RESULTS WITH NO MORE ENTRIES EXCEEDS UNDER 1000000**
FIXED IN PROACTIVE BP 160419
- Bug 22173980: **WFO - C RESULTS NUMBER OF (ROWS) IN "..."_... SE... IS... TRUE**
FIXED IN PROACTIVE BP 160419
- Bug 21459392: **QUERY WITH AN DUPLICATE DUPLICATE RETURNS MORE RESULTS (12)**
FIXED IN PROACTIVE BP 160419
- Bug 19894622: **ORA-00113: ORACLE internal error: fatal error: 113 (no data found)**
FIXED IN PROACTIVE BP 160419

■ Trivadis customers encountered other bugs

<https://antognini.ch/2016/04/wrong-results-involving-index-full-scan-minmax-in-12-1-0-2/>

- Bug 22913528: **Still no patch. Fix not viable**
WRONG RESULTS WITH PARTITION FULL SCANS
- Bug 18650065: **One-off required, not included in BP**
WRONG RESULTS WITH SUBQUERY USE OF INDEXES
- Bug 18499088: **FIXED IN PROACTIVE BP 160419**
PARALLEL QUERY RUNS WITH WRONG RESULT WITH PLUS AND DISTINCT (UNIQUE)
- Bug 19526873: **FIXED IN PROACTIVE BP 160419**
Wrong result on temp table join ON ALL when accessed by different parallel
- Bug 21079201: **FIXED IN PROACTIVE BP 160419**
WRONG RESULTS WITH NON-IDENTICAL GET UNDER ALL
- Bug 22173980: **FIXED IN PROACTIVE BP 160419**
WRONG RESULTS NUMBER OF ROWS WHEN "_BASES" IS SET TO TRUE
- Bug 21459392: **FIXED IN PROACTIVE BP 160419**
QUERY WITH AN DUPLICATE RETURNS MORE RESULTS THAN
- Bug 19894622: **FIXED IN PROACTIVE BP 160419**
ORA-00100: block size 1 is incompatible with occurrence 2

■ Impact?

- My customer did not encounter any bug related to wrong results
- Other Trivadis customers had some impacts
- As precaution, we used to set some hidden parameters before fixes were available
- Now we fix everything with the latest Proactive BP

Other problems?

■ ORA-39346: data loss in character set conversion

- Issue with impdp when using NCHAR/NVARCHAR2 columns with histograms
 - Histogram Data is Corrupted After Importing Data Using Impdp or ORA-39346 is Raised While Executing Impdp (Doc ID 2105130.1)
- Solution: Ignore the error and re-compute the statistics

■ Error: prereq checks failed!

- Issue when running datapatch on a freshly installed ORACLE_HOME
- Only if the database already has patches installed
- Solution 1: copy the rollback scripts from the old ORACLE_HOME
- Solution 2: patch at the same level as the old ORACLE_HOME
- Solution 3: use ORACLE_HOME cloning installations (Rapid Home Provisioning?)

■ Data Guard delayed switchover

- When Data Guard is set with a specific delay
- Switchover time = normal switchover time + delay
- Solution: it's a feature, not a bug ;-)

Best of the best (from operations PoV)

■ Online datafile move

```
SQL> select file#, name from v$datafile where file#=1;
```

```
FILE# NAME
```

```
-----  
1 +DATA/CLASSIC/DATAFILE/system.267.814717093
```

```
SQL> alter database move datafile 1 to '/data/CLASSIC/system01.dbf';
```

```
Database altered.
```

```
SQL> select file#, name from v$datafile where file#=1;
```

```
FILE# NAME
```

```
-----  
1/data/CLASSIC/system01.dbf
```

■ Data Guard Transport and Apply Lag Thresholds

```
DGMGRL> show database verbose 'STDBY';
```

```
Database - STDBY
```

```
Role:                PHYSICAL STANDBY
Intended State:      APPLY-ON
Transport Lag:       0 seconds (computed 1 second ago)
Apply Lag:           0 seconds (computed 1 second ago)
Average Apply Rate: 5.00 KByte/s
Active Apply Rate:   0 Byte/s
Maximum Apply Rate: 0 Byte/s
Real Time Query:     OFF
Instance(s):
  STDBY
```

```
DGMGRL> show configuration verbose;
```

```
Configuration Status:
```

```
SUCCESS
```

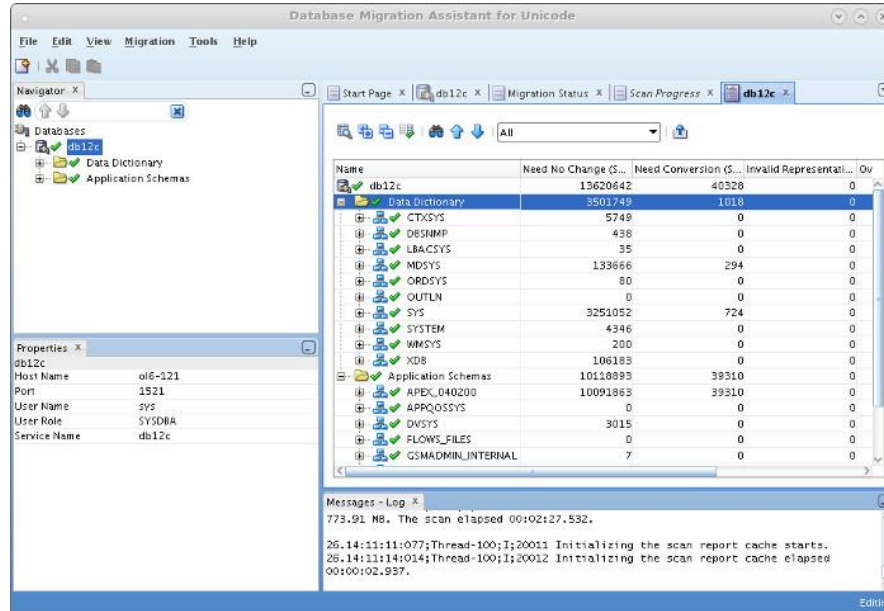

■ Datapatch & DBMS_QOPATCH

- Datapatch rules! Patching a DB is really easy now
- DBMS_QOPATCH allows querying the patches applied to the DB
 - Great for taking the patch roadmap under control

Database Migration Assistant for Unicode (DMU)

■ DMU replaces csscan and csalter

■ If you still use a single-byte character set, DMU will be your friend



The screenshot displays the Database Migration Assistant for Unicode (DMU) application window. The main window shows a scan progress report for the database 'db12c'. The report includes a table with the following columns: Name, Need No Change (S...), Need Conversion (S...), Invalid Representati..., and Ov. The table lists various schemas and their respective statistics.

Name	Need No Change (S...)	Need Conversion (S...)	Invalid Representati...	Ov
db12c	13620642	40326	0	
Data Dictionary	3501749	1018	0	
CTXSYS	5749	0	0	
DESHMP	436	0	0	
LBACSYS	35	0	0	
MDSYS	133666	294	0	
OPDSYS	80	0	0	
OUTLN	0	0	0	
SYS	3251052	724	0	
SYSTEM	4346	0	0	
WMSYS	200	0	0	
XDB	106183	0	0	
Application Schemas	10110893	39310	0	
APEX_040200	10091863	39310	0	
APRQOSSYS	0	0	0	
DVSYS	3015	0	0	
FLOW_FILES	0	0	0	
GSMADMIN_INTERNAL	7	0	0	

The Properties window shows the following details for db12c:

- Host Name: ol6-121
- Port: 1521
- User Name: sys
- User Role: SYSDBA
- Service Name: db12c

The Messages - Log window shows the following messages:

```
773.91 MB. The scan elapsed 00:02:27.532.  
26.14:11:11:077;Thread-100;I;20011 Initializing the scan report cache starts.  
26.14:11:14:014;Thread-100;I;20012 Initializing the scan report cache elapsed  
00:00:02.937.
```

My conclusion

■ 12c strengths and weaknesses

- Very Stable! Never seen a crash or whatever
- Since April 2016 really production ready (because most wrong results are fixed)
- Easier to manage than ever before
- The SQL Plan Directives and Adaptive Dynamic Sampling require all your attention

Questions?

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