2012 DOAG Konferenz + Ausstellung

Klug integrierte Systeme

Resolving Child Cursor Issues Resulting In Mutex Waits

Martin Klier
Senior DBA
Klug GmbH integrierte Systeme

Nürnberg, November 22nd 2012

English or German?
Deutsch oder Englisch?

Agenda

- Introduction 
- Oracle Parsing, Child Cursors
- Mutexes, Waits and Reasons
- Issues, Quick Fixes and Solutions
- Summary, Acknowledgements, Q&A session

Speaker

- Martin Klier (martin.klier@klug-is.de)
- Senior DBA for ORACLE at Klug integrierte Systeme
- Focus on Performance, Tuning and High Availability
- Linux since 1997, Oracle since 2003
- Weblog: http://www.usn-it.de

- Klug GmbH integrierte Systeme (http://www.klug-is.de)
  92552 Teunz, GERMANY

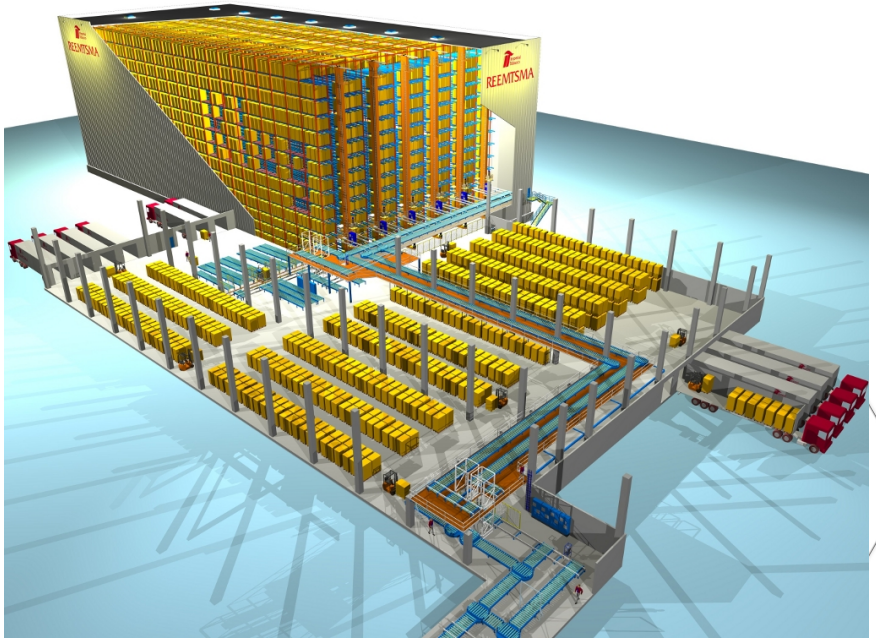
ORACLE Gold Partner

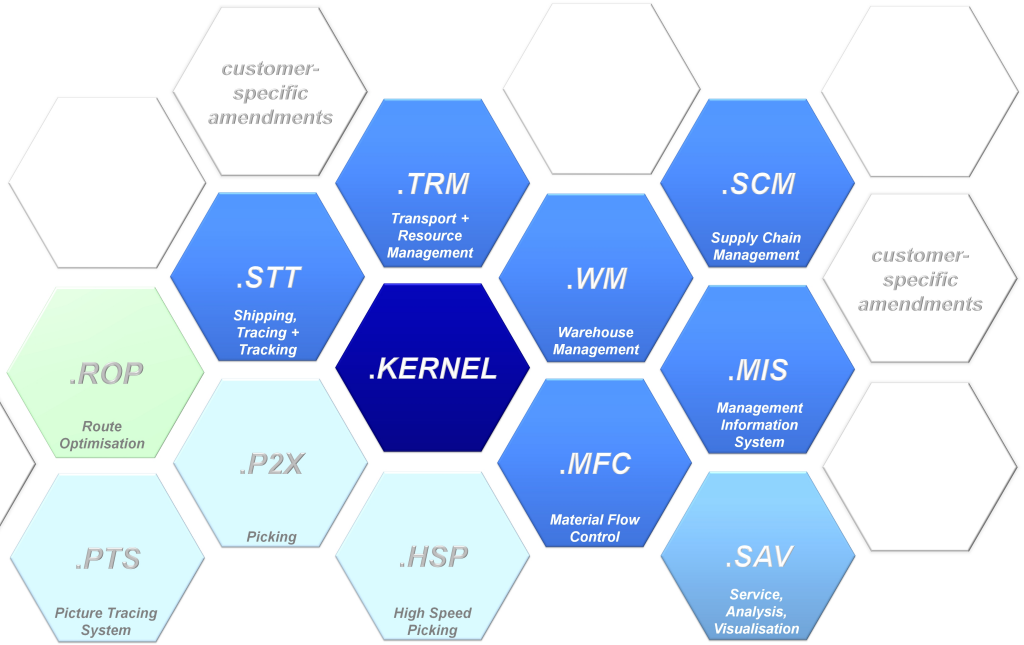
- Specialist leading in complex intralogistical solutions
- Planning and design of automated intralogistics systems, focus on software and system control / PLC
- >300 successful major projects in Europe, America, Asia

2012 DOAG Konferenz + Ausstellung

iWACS®

Klug integrierte Systeme



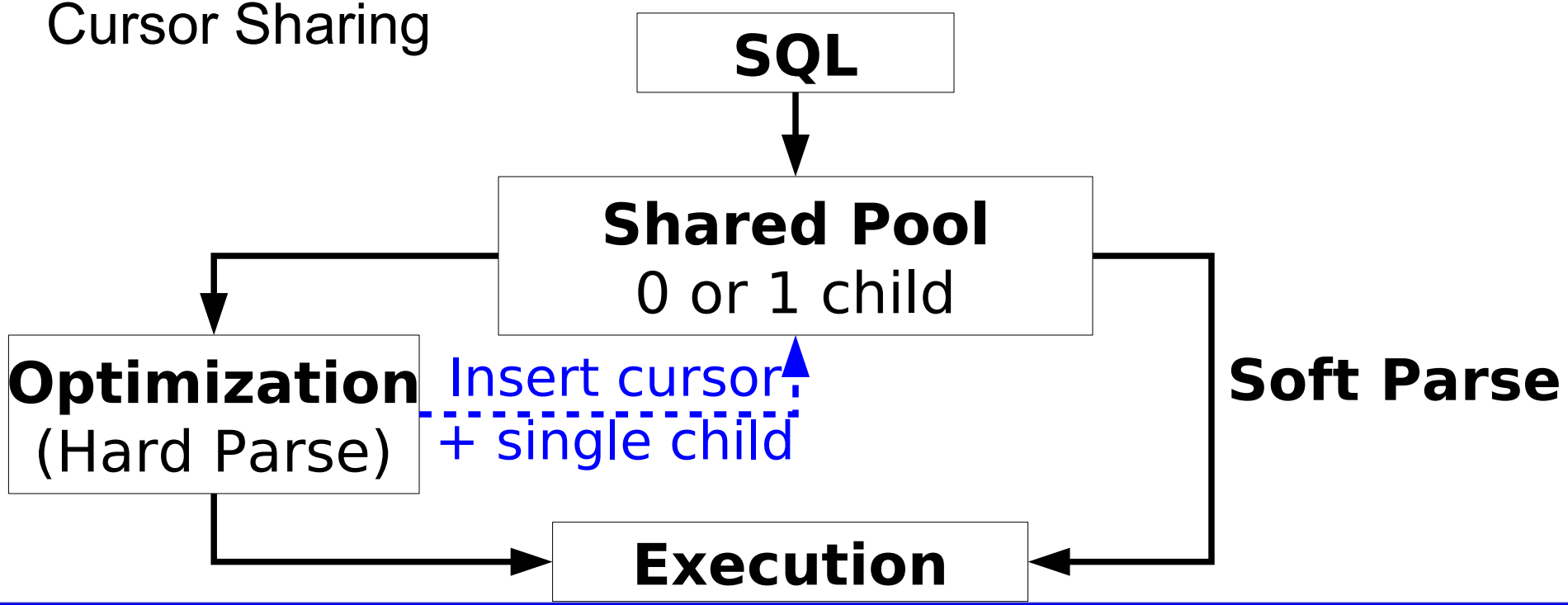


Agenda

- Introduction
- Oracle Parsing, Child Cursors 
- Mutexes, Waits and Reasons
- Issues, Quick Fixes and Solutions
- Summary, Acknowledgements, Q&A session

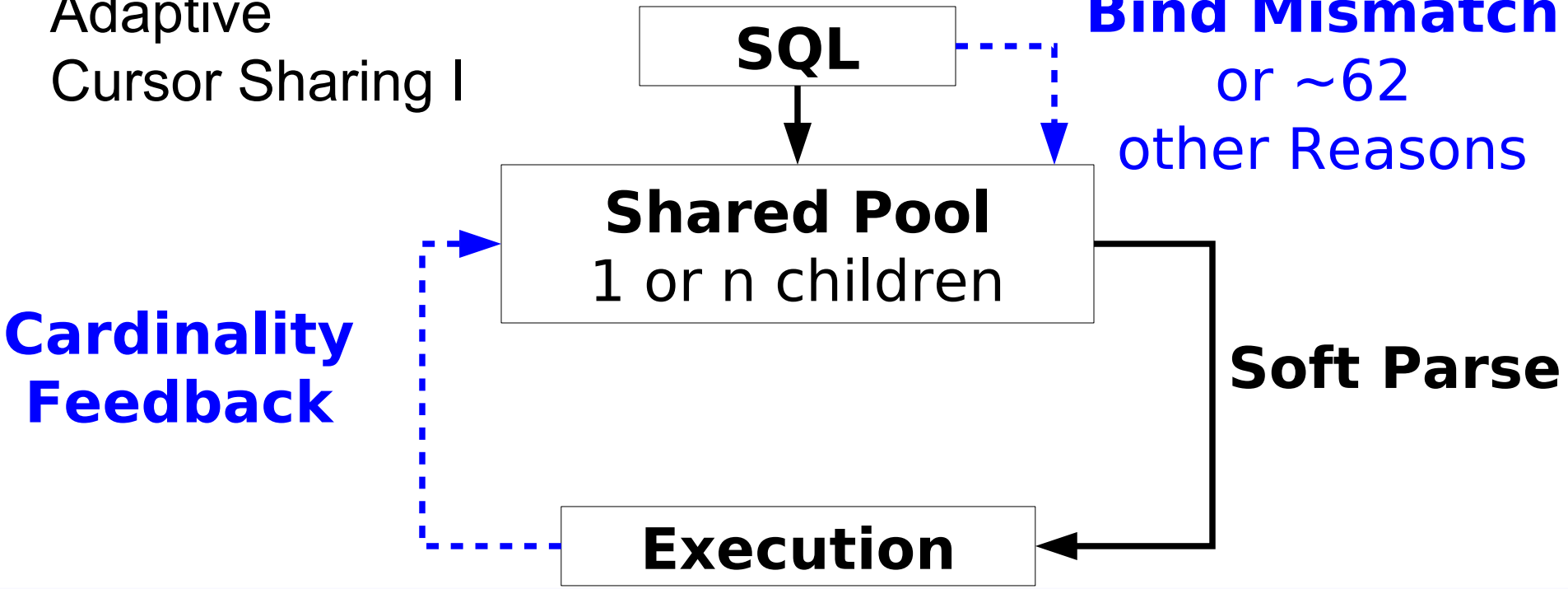
Parsing

Cursor Sharing



Parsing

Adaptive
Cursor Sharing I



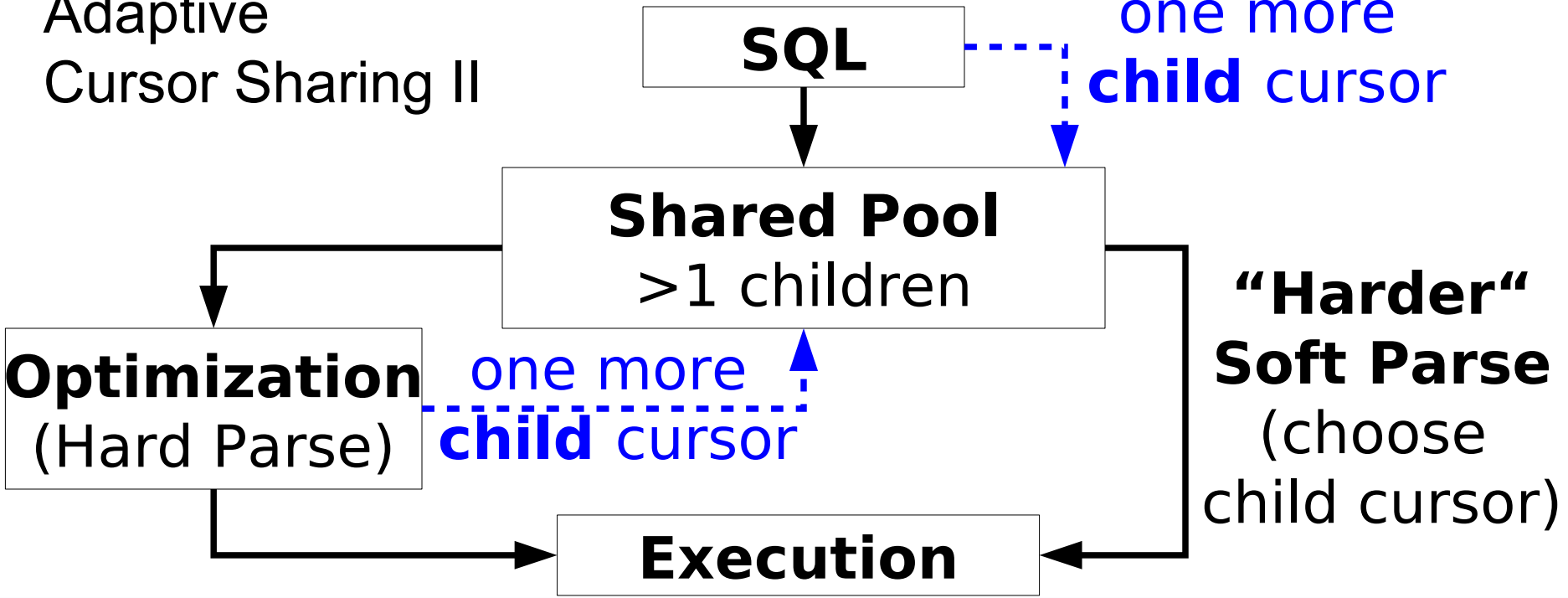
Parsing

64 Reasons for not re-using an existing child cursor

- Optimizer mode change (ALL_ROWS, FIRST_ROWS)
- NLS- and user identity trouble,
- Outline mismatch, Cardinality feedback (**wanted**)
- Bind mismatch (many sub-reasons, **most unwanted**)
- ...

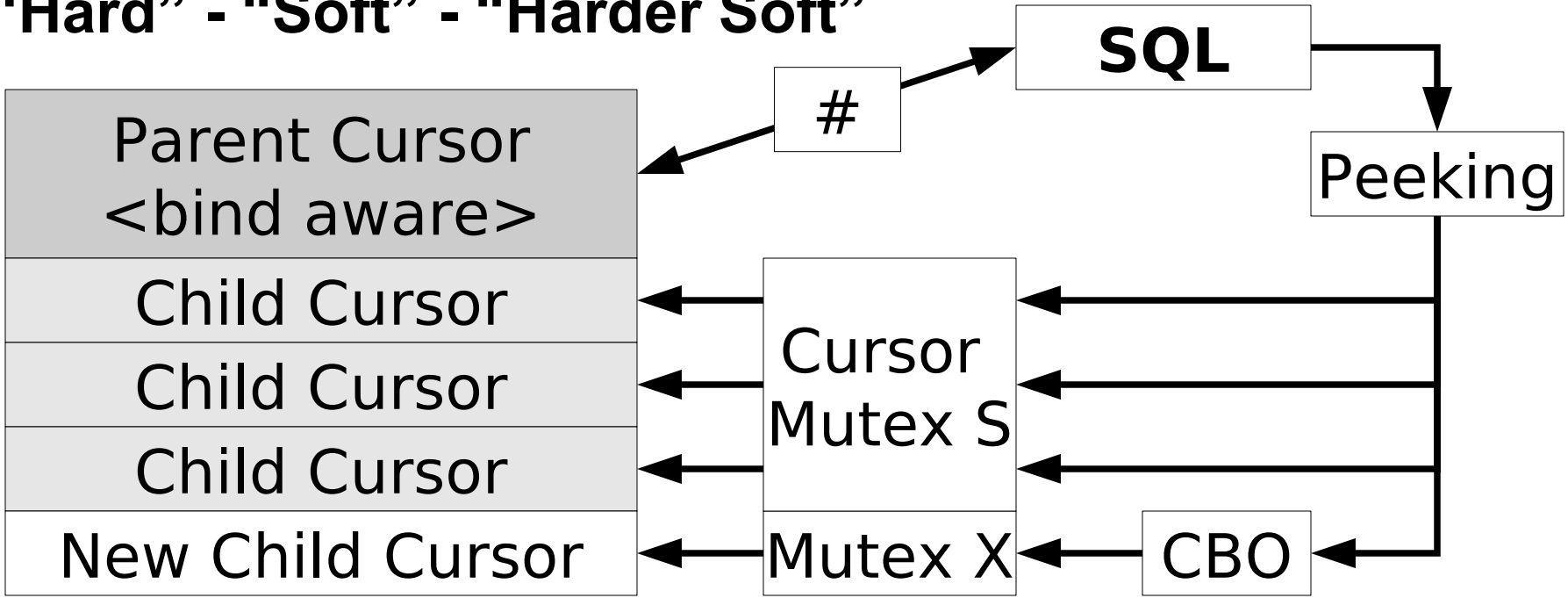
Parsing

Adaptive
Cursor Sharing II



Parsing

“Hard” - “Soft” - “Harder Soft”



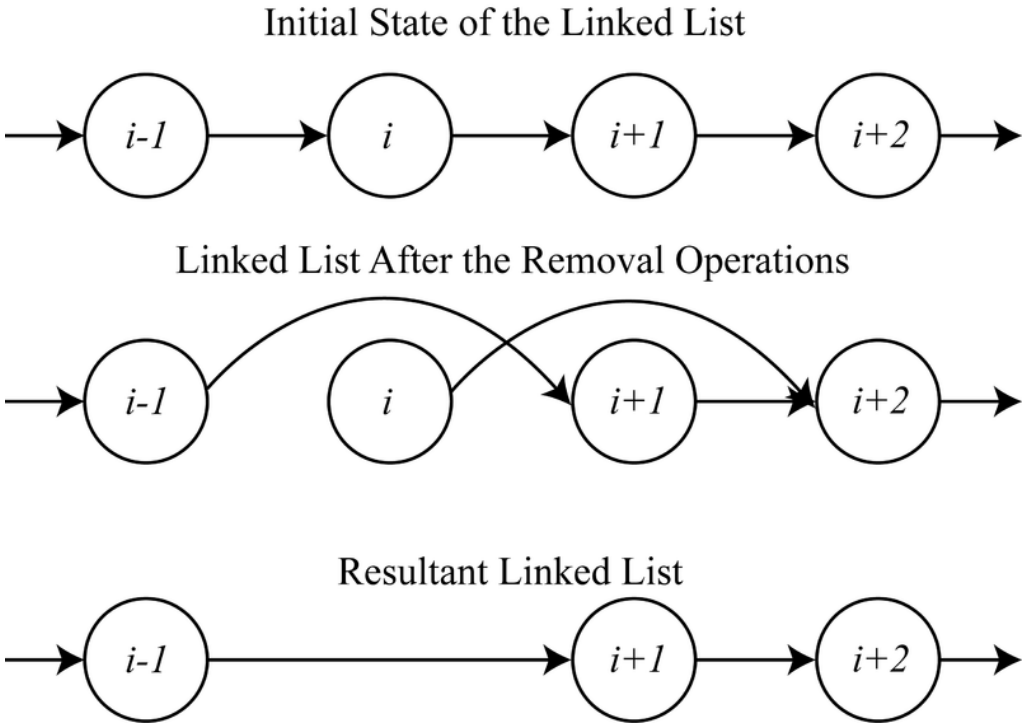
Agenda

- Introduction
- Oracle Parsing, Child Cursors
- Mutexes, Waits and Reasons 
- Issues, Quick Fixes and Solutions
- Summary, Acknowledgements, Q&A session

Mutex

Example:

Simultaneously removing two nodes from a singly linked list



(picture from Wikipedia)

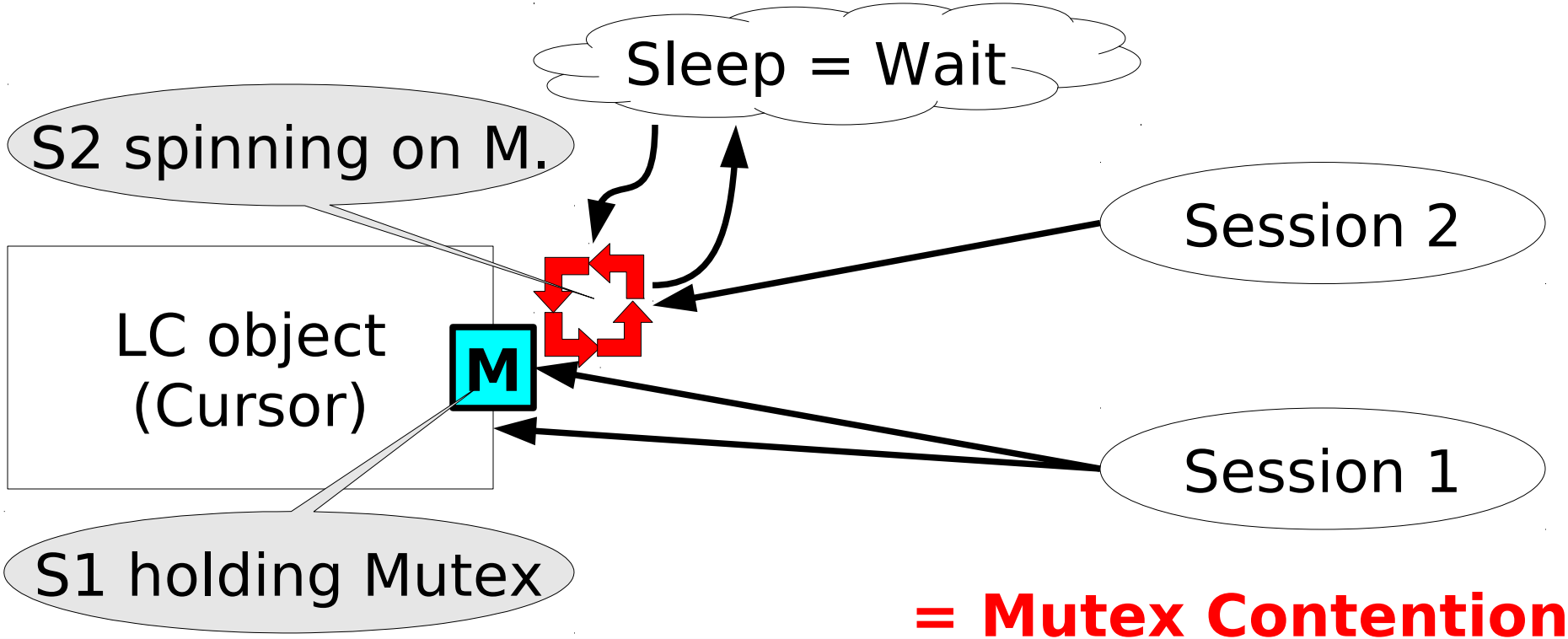
Mutex

- “Mutual Exclusion”
  = Fine-grained serialization structure

- It's just like a **latch**, but smaller, lighter, **faster**

- Introduced in 10g R2
- managed by KGX (Kernel Generic Mutex Module)

Waits



= Mutex Contention

Waits

What are Wait Events (on Mutexes)?

- Somebody **requests** a Mutex
- Can **not get it** by spinning
- And thus, **sleeps**

- Sleeping is recorded as wait time
- Spinning is **not** recorded as wait-, but as CPU time

Waits

cursor: mutex X

Wants: **Exclusive** mode on Mutex of Parent / Child

To:

- Build a new Child Cursor
- Capture SQL bind data (peek)
- Modify cursor-related statistics

Waits

cursor: mutex S

Wants: **Shared** mode on Mutex of Parent / Child

To:

- Change the reference count (“in flux”)
  = “new guy is interested / spinning”

Waits

cursor: pin X

Wants: **Exclusively** pin a P/C cursor in cache

To:

- Create the cursor
- Alter the cursor

Waits

cursor: pin S

Wants: Pin a P/C cursor in **shared** mode

To:

- Use (execute) the cursor

Waits

cursor: pin S wait on X

Wants: Pin a P/C cursor in **shared** mode
but **sb. already has it** in **exclusive** mode

To:

- Use (execute) the cursor
- When sb. is altering the cursor (e.g. due to DDL)

Agenda

- Introduction
- Oracle Parsing, Child Cursors
- Mutexes, Waits and Reasons
- Issues, Quick Fixes and Solutions 
- Summary, Acknowledgements, Q&A session

Issues

Simple - cursor: pin S

- Caused by massively parsing one SQL_ID
  => Hot Spot Object in Library Cache

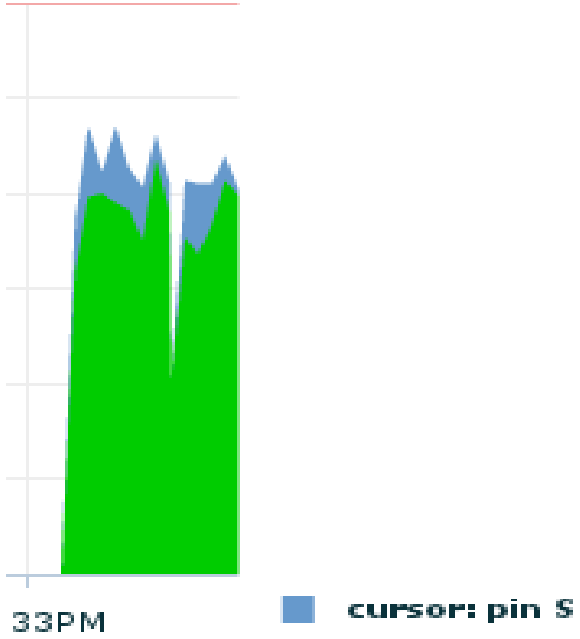
- Diagnosis: Oracle Wait Interface

- (Half) solution: Diversify SQL_ID (not **randomize!**)
  select /* WebServer4 */ something from table;

Issues

Provocation of a
cursor: pin S wait situation

- Tightly looping one SQL 1,000,000 times
- in 20 threads



➔ Overcrowding the cursor's pin mutex

Issues

Complex - cursor: mutex S/X

- Root-caused by invalidated child cursor(s)
  => Too many cursor objects in Library Cache

- Diagnosis:
  - Oracle Wait Interface
  - 10046 Level 12 session trace (=sql_trace event)
  - v$sql_shared_cursor **plus** cursortrace [296377.1]

Issues

One example reason for <u>cursor: mutex S/X</u>

Application uses jdbc setter methods improperly on INTEGER column (=2)

- setNUMBER(2) => Bind Var. is **NUMBER**
- setNULL(2) => Bind Var. is **VARCHAR2**

= BIND MISMATCH

Issues

10046 Level 12 trace for cursor: mutex S/X

```
Trace 1:
Bind#2
>> oacdty=01 mxl=32(04) mxlc=00 mal=00 scl=00 pre=00
oacflg=03 fl2=1000010 frm=01 csi=873 siz=0 off=168
kxsbbbfp=1118e1cd8 bln=32 avl=00 flg=01

Trace 2:
Bind#2
>> oacdty=02 mxl=22(22) mxlc=00 mal=00 scl=00 pre=00
oacflg=03 fl2=1000000 frm=01 csi=873 siz=0 off=168
kxsbbbfp=110977db8 bln=22 avl=02 flg=01
value=99
```

in 30 columns
= 2^30 times
BIND MISMATCH

Issues

One Quick Fix for cursor: mutex S/X

System is loaded with heavy mutex waits
due to high number of cursors (=version count)

=> **frequently** flush this cursor with
dbms_shared_pool.purge
(look out for new parsing issues = CPU)

Issues

One solution for <u>cursor: mutex S/X</u>

Application uses jdbc setter methods
now properly on INTEGER column (=2)

- setNUMBER(2) => Bind Var. is **NUMBER**
- setNULL(2, java.sql.Types.INTEGER)
  => Bind Var. is **NUMBER**

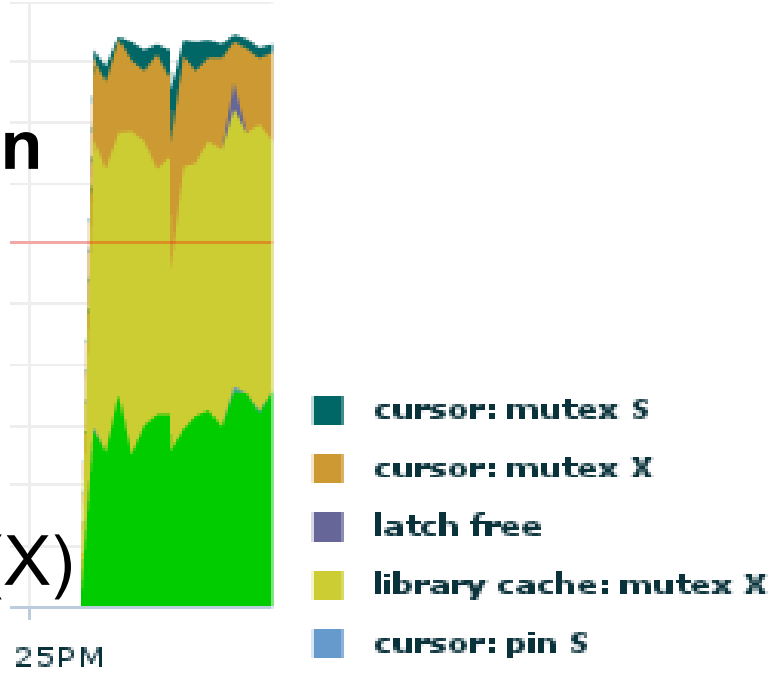
Issues

Provocation of a
cursor: mutex S/X wait situation

- Generating 64 child cursors for one SQL_ID
- Accessing them 20x parallel

→ Delay to create new children (X)

→ Delay to select good child (S)



Issues

Similar Problem with CHAR binds

- Bind buffers are size 32, 128, 2000 or 4000 bytes
- Changing CHAR bind length invalidates
- Reason BIND_LENGTH_UPGRADEABLE
  = 4^n cursor versions
- Trace event 10503 (bugs!)

Issues

Heavy - Oracle internal pitfalls I

- 11g “features” like
  MOS: “Its important to note that cursor obsoletion code was removed in version 11.
  *That means **we no longer obsolete a parent cursor when it reaches 1024 child cursors** [as we did in 10g.]”*
- Workaround
  Enhancement Patch 10187168 introduces parameter “_cursor_obsolete_threshold”

Issues

Heavy - Oracle internal pitfalls II

- DB Bugs like 10157392 + 12939876
  (fixed in 12.1, backported to 11.2.0.3)
  Memory leak: increasing number of child cursors over time, especially if the shared pool is under load.
- DB Bug 9591812 (fixed in 12.1)
  Wrong wait events in 11.2 ("cursor: mutex S" instead of "cursor: mutex X")
  Official MOS workaround:

  Be cautious when interpreting S mode mutex / pin waits.…

Agenda

- Introduction
- Oracle Parsing, Child Cursors
- Mutexes, Waits and Reasons
- Issues, Quick Fixes and Solutions
- Summary, Acknowledgements, Q&A session

I suggest...

My suggestions for “cursor: mutex S/X” casualties

- Check how the application does handle **bind** variables
  Avoid BIND MISMATCH at (nearly) any cost
- Reduce the number of **cursor versions** below 100
  More will lead to overhead
- Look for matching Oracle **bugs** in your RDBMS release
- **Upgrade** to 11.2.0.3 or higher
  11.2.0.2 is worst version for cursor issues IMHO

Read on...

More resources on this topic

- MOS Documents
  1356828.1; 1377998.1; 296377.1
- Põder, Tanel
  Presentation: “Oracle Latch and Mutex Contention Troubleshooting”
- Shallahamer, Craig
  Book: “Oracle Performance Firefighting”
  (ISBN 978-0-9841023-0-3)
- Nikolaev, Andrey
  Blog entries: “Mutex waits. Part 1 + 2”

Thank you very much for your attention!

Martin Klier
Senior DBA
Klug GmbH integrierte Systeme

Nürnberg, November 22nd 2012

2012 DOAG Konferenz + Ausstellung

Thank you

Klug integrierte Systeme

Many people have helped with suggestions, supplying test cases or taking daily work off me during
preparation and travel phase. Guys, you are top!

My special thanks to:
My boss and company, for endorsement
Two special customers, for interested patience
An ex-colleague, for The Code
One guy from OR, who made it possible.