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November 11–15, 2007

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Using Active Session History for Performance Tuning: Advanced Topics in Performance Diagnostics

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Agenda

- Performance Diagnosis
- What is ASH?
- Using ASH data
- What is SQL Trace?
- Comparison of ASH and SQL trace/tkprof
- Conclusions

Performance Diagnosis

- Many different scopes
 - Database/Instance
 - Service/module/action
 - Session
- Application Performance Diagnosis
 - Detailed diagnosis of what an application is doing in the database
 - Or not
 - SQL*Trace widely used
 - ASH

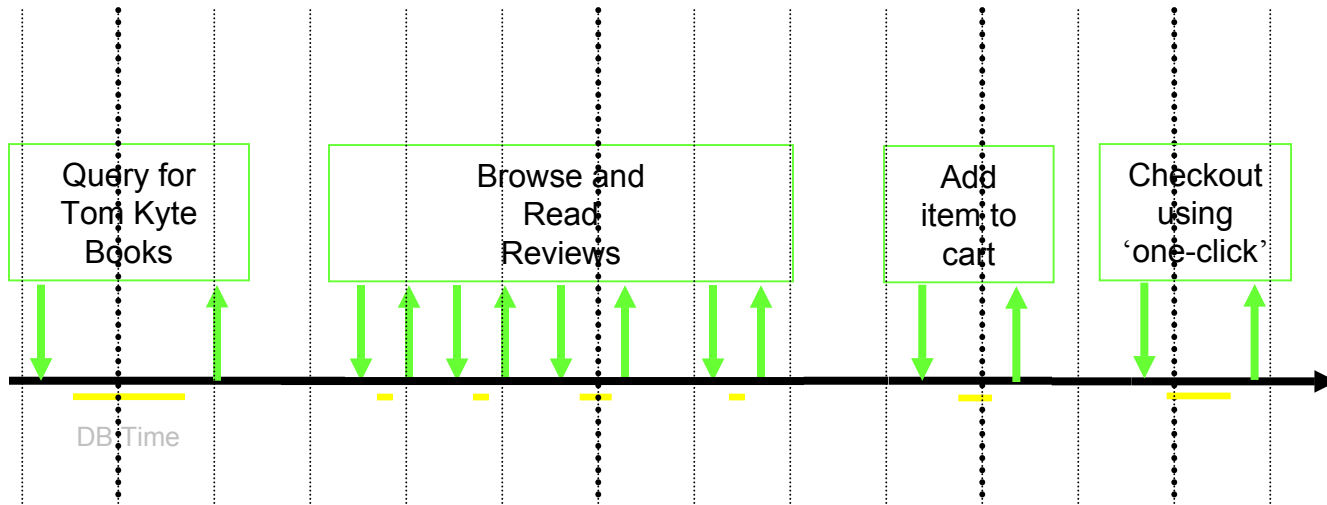
What is ASH?

- Active Session History
- Sampled, detailed, non-intrusive activity data
- Part of Oracle 10g
- On by default
- Licensed as part of the Diagnostic pack

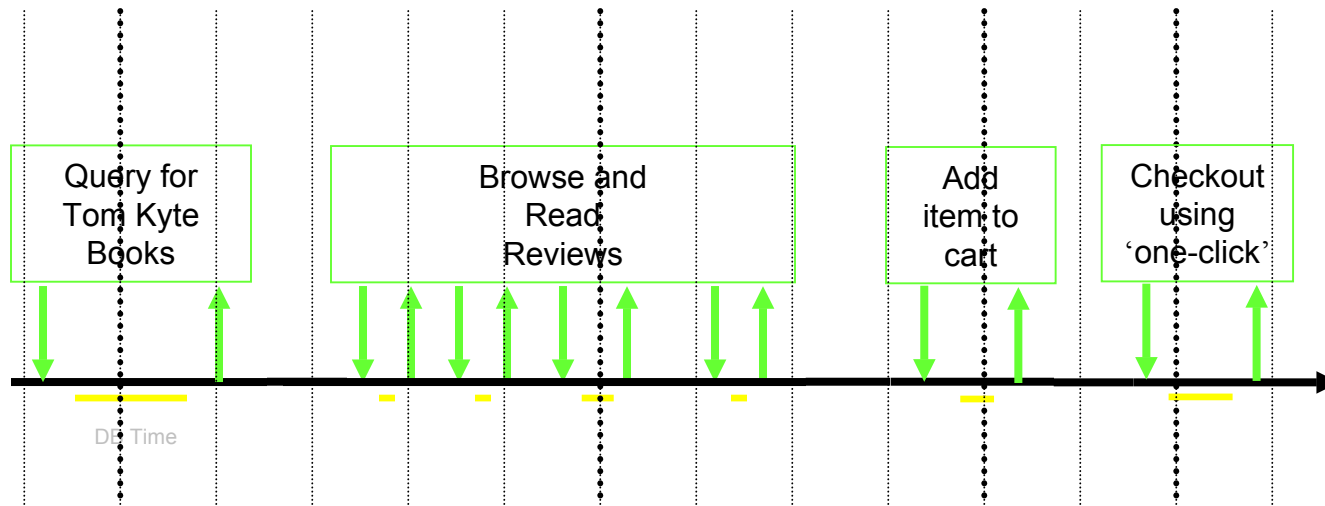
Active Session History (ASH)

- Samples 'Active' sessions into memory buffer every second
 - V\$ACTIVE_SESSION_HISTORY
- 'Active' == Non-idle sessions
 - Waiting on non-idle event or on CPU
- Written to disk by AWR snapshots
 - DBA_HIST_ACTIVE_SESS_HISTORY
- 10 second samples in AWR

Active Session History (ASH)



Active Session History (ASH)



Time	SID	Module	SQL ID	State	Event
7:38:26	213	Book by author	qa324jffritcf	WAITING	db file sequential read
7:42:35	213	Get review id	aferv5desfzs5	CPU	
7:50:59	213	Add to cart	hk32pekfcdf	WAITING	buffer busy wait
7:52:33	213	One click	abngldf95f4de	WAITING	log file sync

ASH: Dimensions

- Session
- Waits
 - Event, P1, P2, P3, blocking_sid
- SQL
 - Sql_id, Opcode, Plan_hash
- PLSQL
 - Top level, Current call
- Objects
 - Object#, File#, Block#
- Application
 - Program, Module, Action, Client_id, Service

Using ASH data

- STATISTICAL analysis of where time was being spent by many different dimension.
 - What events were taking most time?
 - What was a session doing?
 - What does a SQL statement wait for?
 - ASH SQL often uses counts and group bys
- How much data is enough data?
 - 30 ASH entries gives us 95% confidence that we are not missing anything that is 10% or more
 - 300 ASH entries total gives 99% confidence that any activity that is 10% of the time will be between 17 and 43 ASH entries

Using ASH data

- V\$ACTIVE_SESSION_HISTORY
- DBA_HIST_ACTIVE_SESS_HISTORY
- ADDM
- ASH report
- EM Diagnostic Pack

ASH: Top SQL

- ```
select sql_id, count(*),
 count(*)*100/sum(count(*)) over() pctlload
from v$active_session_history
where sample_time > sysdate - 1/24
 and session_id = :B1
group by sql_id
order by count(*) desc;
```
- Returns most active SQL in a session in the past hour

# ASH: Top SQL

| SQL_ID        | COUNT (*) | PCTLOAD |
|---------------|-----------|---------|
| 25wtt4ycbtkyz | 456       | 32.95   |
| 7umwqvcy7tusf | 123       | 8.89    |
| 01vunx6d35khz | 119       | 8.6     |
| bdyq2uph07cmp | 102       | 7.37    |
| 9y4f9n5hr23yr | 73        | 5.27    |
| 0bnc9a5kkf4wn | 57        | 4.12    |
| bv1gns48hgxpj | 57        | 4.12    |
| gq82c5361nxbq | 57        | 4.12    |
| djzkbxr7cm122 | 57        | 4.12    |
| b2bakhq4w7rbv | 57        | 4.12    |
| 8jydryyvdcqp  | 57        | 4.12    |
| 69x6zf5myht7s | 57        | 4.12    |
| 2ccawhzy8b7ua | 57        | 4.12    |
| 4z5z7xb2g04m6 | 55        | 3.97    |

# What is SQL trace?

- First appeared with Oracle V6
- sql trace (Event 10046) used to generate trace of session activity
  - wait events and bind values added in Oracle7
- tkprof produces summary reporting
  - aggregation by cursor
  - Sorted
  - reports wait event since Oracle9i

# What is SQL trace?

- Turned on by event, parameter or PLSQL packages
  - Event 10046
  - SQL\_TRACE
  - Dbms\_session
  - Dbms\_support
  - Dbms\_monitor (default includes waits)
- One file per process
- Entry for every parse,exec,fetch,wait



# What is SQL trace?

- Best practices for tracing
  - Check or set file dump parameter
    - `timed_statistics = TRUE`
    - `user_dump_dest = '<directory name>'`
    - `max_dump_file_size = <size>`
    - `_trace_files_public = TRUE`
    - `trace_file_identifier = '<string>'`
- Best Practices for tkprof
  - `Sort=exeela,fchela,prsela`
    - Equivalent of DB time tuning
  - `Print=10,20,30`
    - Rather than 150 page output

# But ...

- Must be able to identify session(s)
- Must have correct parameters for trace file size, access
- Requires host access to read file
- Overhead is intrusive
- Not easy to drilldown because of trace file structure
- Shared server and PQ tracing is problematic
- Cursors must be closed to get plan data

# ASH: desc v\$active\_session\_history

|             | Name                | Null? | Type         |
|-------------|---------------------|-------|--------------|
|             | SAMPLE_ID           |       | NUMBER       |
|             | SAMPLE_TIME         |       | TIMESTAMP(3) |
| Session     | SESSION_ID          |       | NUMBER       |
|             | SESSION_SERIAL#     |       | NUMBER       |
|             | USER_ID             |       | NUMBER       |
|             | SESSION_TYPE        |       | VARCHAR2(10) |
|             | SESSION_STATE       |       | VARCHAR2(7)  |
|             | QC_SESSION_ID       |       | NUMBER       |
|             | QC_INSTANCE_ID      |       | NUMBER       |
|             | Wait                | EVENT |              |
| EVENT_ID    |                     |       | NUMBER       |
| EVENT#      |                     |       | NUMBER       |
| SEQ#        |                     |       | NUMBER       |
| P1          |                     |       | NUMBER       |
| P2          |                     |       | NUMBER       |
| P3          |                     |       | NUMBER       |
| SQL         | SQL_ID              |       | VARCHAR2(13) |
|             | SQL_CHILD_NUMBER    |       | NUMBER       |
|             | SQL_PLAN_HASH_VALUE |       | NUMBER       |
|             | SQL_OPCODE          |       | NUMBER       |
| Object      | CURRENT_OBJ#        |       | NUMBER       |
|             | CURRENT_FILE#       |       | NUMBER       |
|             | CURRENT_BLOCK#      |       | NUMBER       |
| Application | PROGRAM             |       | VARCHAR2(48) |
|             | MODULE              |       | VARCHAR2(48) |
|             | ACTION              |       | VARCHAR2(32) |
|             | CLIENT_ID           |       | VARCHAR2(64) |
|             | SERVICE_HASH        |       | NUMBER       |
|             | WAIT_TIME           |       | NUMBER       |
|             | TIME_WAITED         |       | NUMBER       |

# ASH: desc v\$active\_session\_history

|                          | Name                    | Null?  | Type         |      |
|--------------------------|-------------------------|--------|--------------|------|
|                          | SAMPLE_ID               |        | NUMBER       |      |
|                          | SAMPLE_TIME             |        | TIMESTAMP(3) |      |
| Session                  | SESSION_ID              |        | NUMBER       |      |
|                          | SESSION_SERIAL#         |        | NUMBER       |      |
|                          | USER_ID                 |        | NUMBER       |      |
|                          | SESSION_TYPE            |        | VARCHAR2(10) |      |
|                          | SESSION_STATE           |        | VARCHAR2(7)  |      |
|                          | QC_SESSION_ID           |        | NUMBER       |      |
|                          | QC_INSTANCE_ID          |        | NUMBER       |      |
| Wait                     | EVENT                   |        | VARCHAR2(64) |      |
|                          | EVENT_ID                |        | NUMBER       |      |
|                          | EVENT#                  |        | NUMBER       |      |
|                          | SEQ#                    |        | NUMBER       |      |
|                          | P1TEXT                  |        | VARCHAR2(64) | New! |
|                          | P1                      |        | NUMBER       |      |
|                          | P2TEXT                  |        | VARCHAR2(64) | New! |
|                          | P2                      |        | NUMBER       |      |
|                          | P3TEXT                  |        | VARCHAR2(64) | New! |
|                          | P3                      |        | NUMBER       |      |
|                          | WAIT_CLASS              |        | VARCHAR2(64) | New! |
|                          | WAIT_CLASS_ID           |        | NUMBER       |      |
|                          | WAIT_TIME               |        | NUMBER       |      |
|                          | TIME_WAITED             |        | NUMBER       |      |
|                          | BLOCKING_SESSION        |        | NUMBER       | New! |
|                          | BLOCKING_SESSION_STATUS |        | VARCHAR2(11) | New! |
| BLOCKING_SESSION_SERIAL# |                         | NUMBER | New!         |      |

# ASH: desc v\$active\_session\_history

|             | Name                     | Null? | Type          |      |
|-------------|--------------------------|-------|---------------|------|
| SQL         | SQL_ID                   |       | VARCHAR2 (13) |      |
|             | SQL_CHILD_NUMBER         |       | NUMBER        |      |
|             | SQL_PLAN_HASH_VALUE      |       | NUMBER        |      |
|             | FORCE_MATCHING_SIGNATURE |       | NUMBER        | New! |
|             | SQL_OPCODE               |       | NUMBER        |      |
| Object      | XID                      |       | RAW (8)       | New! |
|             | CURRENT_OBJ#             |       | NUMBER        |      |
|             | CURRENT_FILE#            |       | NUMBER        |      |
|             | CURRENT_BLOCK#           |       | NUMBER        |      |
| Application | PROGRAM                  |       | VARCHAR2 (48) |      |
|             | MODULE                   |       | VARCHAR2 (48) |      |
|             | ACTION                   |       | VARCHAR2 (32) |      |
|             | CLIENT_ID                |       | VARCHAR2 (64) |      |
|             | SERVICE_HASH             |       | NUMBER        |      |

# ASH vs SQLtrace/tkprof

|                              | ASH | SQLtrace |
|------------------------------|-----|----------|
| Parse/Exec/Fetch breakdown   | No  | Yes      |
| Time based data              | Yes | Yes      |
| Counts/occurrence data       | No  | Yes      |
| Detailed session level data  | Yes | Yes      |
| Individual Wait event data   | Yes | Yes      |
| Complete trace of operations | No  | Yes      |
| Always on                    | Yes | No       |
| Full row source data         | No  | Yes      |
| Bind variables available     | No  | Yes      |

# 11g ASH enhancements

- Run-time SQL row source information
  - Identifies current row source within plan
- SQL execution ID
  - Is this same execution as last sample?
- Operation flags (IN columns)
  - Capture non-timed operations
  - Examples: IN\_BIND, IN\_CURSOR\_CLOSE
- Remote instance id for Cache transfers
  - Which instance sourced requested block?

# 11g ASH vs SQLtrace/tkprof

|                              | ASH | 11g ASH | SQLtrace |
|------------------------------|-----|---------|----------|
| Parse/Exec/Fetch breakdown   | No  | Yes     | Yes      |
| Time based data              | Yes | Yes     | Yes      |
| Counts/occurrence data       | No  | Partial | Yes      |
| Detailed session level data  | Yes | Yes     | Yes      |
| Individual Wait event data   | Yes | Yes     | Yes      |
| Complete trace of operations | No  | No      | Yes      |
| Always on                    | Yes | Yes     | No       |
| Full row source data         | No  | Partial | Yes      |
| Bind variables available     | No  | No      | Yes      |



# Worked Example

- From Oracle internal email system
- Picked a session with periodic highload
- Compare tkprof and ASH report data

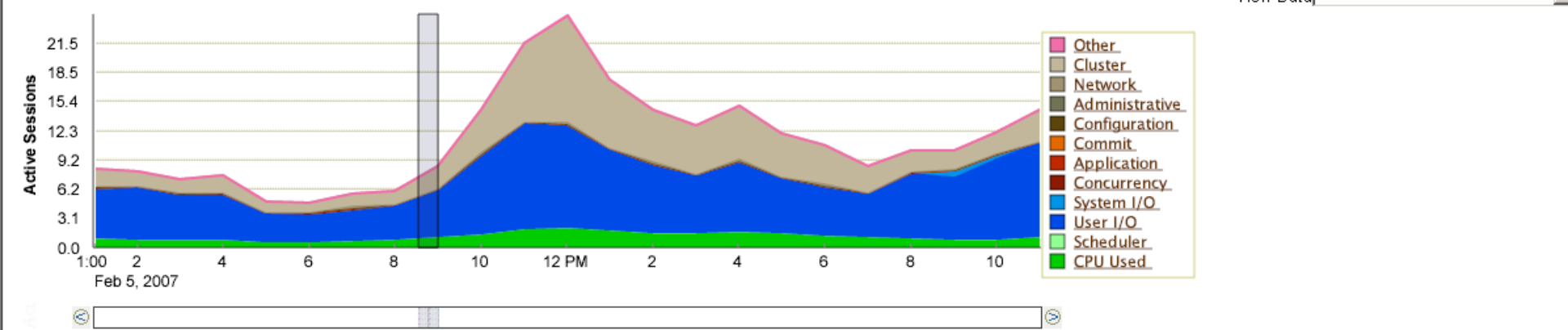


D E M O N S T R A T I O N

# EM Diagnostic Pack

Top Activity Switch Database Instance STMAIL.ORACLE.COM\_stmail\_crs\_STMAIL2

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



Detail for Selected 30 Minute Interval

Start Time Feb 5, 2007 8:32:11 AM MST Run ASH Report

Top SQL

| Select                   | Activity (%) | SQL Hash Value | SQL Type |
|--------------------------|--------------|----------------|----------|
| <input type="checkbox"/> | 37.79        | a347sknd1s1pk  | SELECT   |
| <input type="checkbox"/> | 15.13        | gwh6tnrt8p9qm  | SELECT   |
| <input type="checkbox"/> | 9.48         | 9tvpkx15dp     | SELECT   |
| <input type="checkbox"/> | 6.4          | 7cbtfju71h5tu  | SELECT   |
| <input type="checkbox"/> | 4.96         | 4hgy0pc64z76a  | SELECT   |
| <input type="checkbox"/> | 4.9          | gnp96p70727h5  | UNKNOWN  |
| <input type="checkbox"/> | 2.64         | dt60t96hzj407  | SELECT   |
| <input type="checkbox"/> | 1.38         | 0h21n98jpkpfk  | SELECT   |
| <input type="checkbox"/> | 1.38         | 90xs9adafps3y  | SELECT   |
| <input type="checkbox"/> | 1.26         | f19131c1b0nc3  | SELECT   |

Top Sessions

| Activity (%) | Session ID | User Name | Program                       |
|--------------|------------|-----------|-------------------------------|
| 6.28         | 1898       | ES_MAIL   | JDBC Thin Client              |
| 6.22         | 2034       | ES_MAIL   | esimapds@rcsmt252 (TNS V1-V3) |
| 5.16         | 2084       | ES_MAIL   | esimapds@rcsmt250 (TNS V1-V3) |
| 5.05         | 2062       | ES_MAIL   | esimapds@rcsmt250 (TNS V1-V3) |
| 4.93         | 2116       | ES_MAIL   | esimapds@rcsmt250 (TNS V1-V3) |
| 4.75         | 1930       | ES_MAIL   | esimapds@rcsmt250 (TNS V1-V3) |
| 4.69         | 2200       | SYS       | oracle@rgmdbs306 (LMS0)       |
| 4.64         | 1962       | ES_MAIL   | esimapds@rcsmt252 (TNS V1-V3) |
| 3.76         | 2105       | ES_MAIL   | esimapds@rcsmt251 (TNS V1-V3) |
| 3.46         | 1901       | ES_MAIL   | esimapds@rcsmt250 (TNS V1-V3) |

Total Sample Count: 1,700

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Grid Control

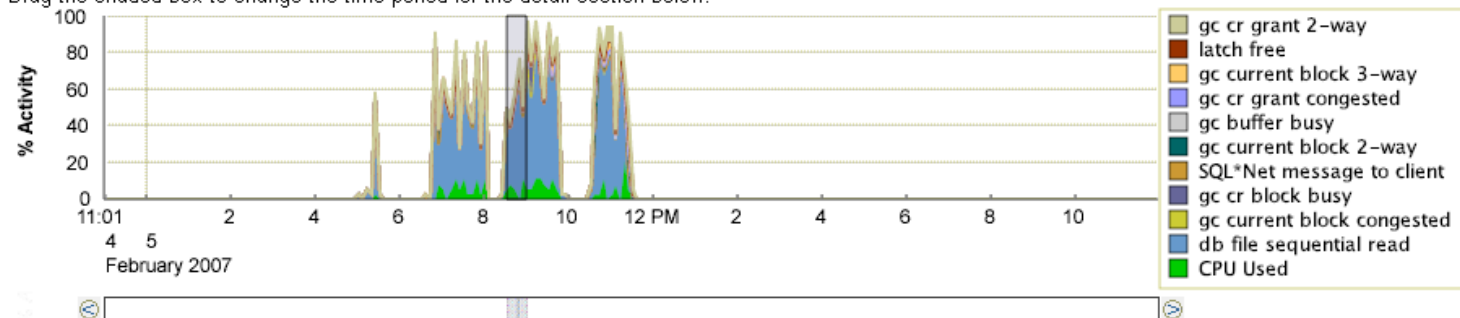
**Warning**  
Session has expired.

**Session Details: 1898 (Unknown)**

Collected From Target Feb 8, 2007 12:01:21 PM MST

View Data

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



**Detail for Selected 30 Minute Interval**

Start Time Feb 5, 2007 8:32:11 AM

| Activity (%) | SQL ID        | SQL Command    | Plan Hash Value | Module           | Action | Client ID |
|--------------|---------------|----------------|-----------------|------------------|--------|-----------|
| 87.59        | 7cbtju71h5tu  | SELECT         | 892285662       | JDBC Thin Client |        |           |
| 6.57         | a347sknd1s1pk | SELECT         | 3092225490      | JDBC Thin Client |        |           |
| 1.46         | 0kwbv7xjax37q | SELECT         | 3936179336      | JDBC Thin Client |        |           |
| 1.46         | f19131c1b0nc3 | SELECT         | 3445699260      | JDBC Thin Client |        |           |
| 1.46         |               | UNKNOWN        | 0               | JDBC Thin Client |        |           |
| .73          | 650wqpk10w8d  | PL/SQL EXECUTE | 0               | JDBC Thin Client |        |           |
| .73          | 5wstbtv3xkf8y | PL/SQL EXECUTE | 0               | JDBC Thin Client |        |           |

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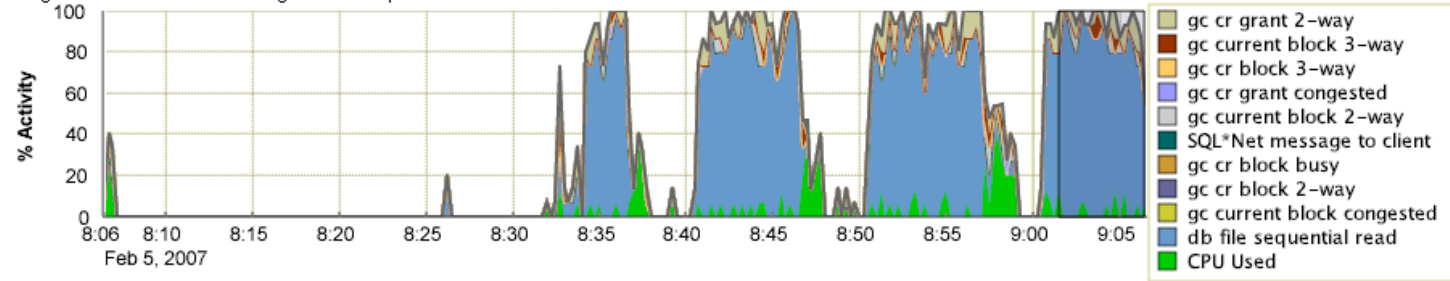
Session Details: 1898 (ES\_MAIL)

Collected From Target Feb 5, 2007 9:06:29 AM MST

View Data Real Time: 15 Second Refresh Refresh

Kill Session Disable SQL Trace

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



Detail for Selected 5 Minute Interval

Start Time Feb 5, 2007 9:01:29 AM View Show Aggregated Data Run ASH Report

| Activity (%) | SQL ID        | SQL Command    | Plan Hash Value | Module           | Action | Client ID |
|--------------|---------------|----------------|-----------------|------------------|--------|-----------|
| 92.33        | 7cbtnju71h5tu | SELECT         | 892285662       | JDBC Thin Client |        |           |
| 6.27         | a347sknd1s1pk | SELECT         | 3092225490      | JDBC Thin Client |        |           |
| .70          | 5k72xkapv03g4 | SELECT         | 821585987       | JDBC Thin Client |        |           |
| .35          | 5wstbtv3xk8y  | PL/SQL EXECUTE | 0               | JDBC Thin Client |        |           |
| .35          |               | UNKNOWN        | 0               | JDBC Thin Client |        |           |

Kill Session Disable SQL Trace

Text

```

SELECT
"BUG" ."RPTHEAD" ."BASE_RPTNO",
"BUG" ."RPTHEAD" ."CATEGORY",
"BUG" ."RPTHEAD" ."CLOSED_DATE",
"BUG" ."RPTHEAD" ."CS_PRIORITY",
"BUG" ."RPTHEAD" ."DO_BY_RELEASE",
"BUG" ."RPTHEAD" ."FIXED_DATE",
"BUG" ."RPTHEAD" ."OS_VERSION",
"BUG" ."RPTHEAD" ."PRODUCT_ID",
"BUG" ."RPTHEAD" ."PROGRAMMER",
"BUG" ."RPTHEAD" ."RELEASE_STATUS",
"BUG" ."RPTHEAD" ."RPTD_BY",
"BUG" ."RPTHEAD" ."RPTDATE",
"BUG" ."RPTHEAD" ."RPTNO",
"BUG" ."RPTHEAD" ."STATUS",
"BUG" ."RPTHEAD" ."SUB_COMPONENT",
"BUG" ."RPTHEAD" ."SUBJECT",
"BUG" ."RPTHEAD" ."VERSION_FIXED"
FROM
"BUG" ."RPTHEAD"
where
"BUG" ."RPTHEAD" ."PRODUCT_ID" in (1876, 1162, 1032, 807, 768)
and
"BUG" ."RPTHEAD" ."UTILITY_VERSION" like '10.1.3%'

```

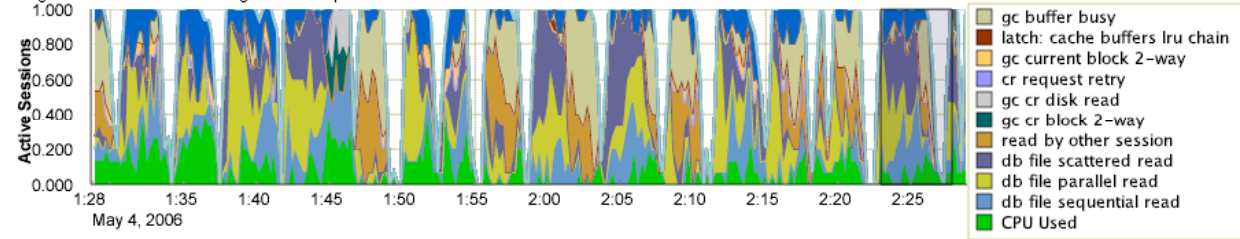
Details

Select the plan hash value to see the details below. Plan Hash Value

[Statistics](#) **Activity** [Plan](#) [Tuning Information](#)

Summary

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



Detail for Selected 5 Minute Interval

Start Time **May 4, 2006 2:22:55 PM**

| Activity (%)                                                                              | SID                  | User                   | Program      | Service                             | Plan Hash Value |
|-------------------------------------------------------------------------------------------|----------------------|------------------------|--------------|-------------------------------------|-----------------|
|  100.00 | <a href="#">2293</a> | <a href="#">QABASE</a> | SADCAGNT.EXE | <a href="#">bugap.us.oracle.com</a> | 155860993       |

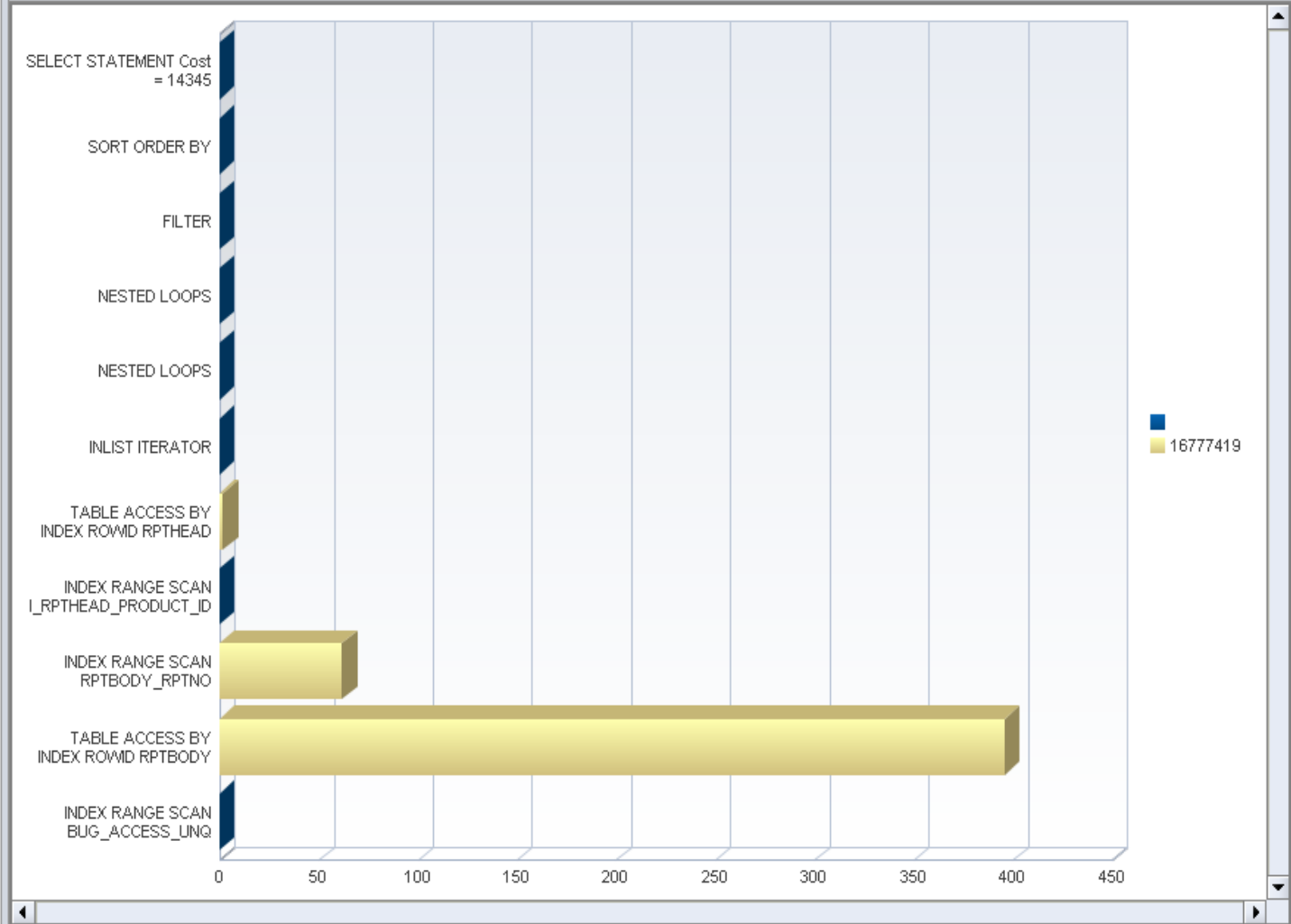


Connections Reports

bug1 local11 ash rowsources

- All Reports
  - Data Dictionary Reports
  - Migration Reports
  - User Defined Reports
    - graham
      - New folder
        - Hourly ASH
        - Top sessions
        - Top sql
      - ash rowsources
      - Daily ASH
      - graham's report
      - Top sessions
      - Top sql
    - graham's report
    - Hourly ASH
    - SQL history
    - time

Refresh: 0



Migration Log - Log

| Message | Date | Source |
|---------|------|--------|
|         |      |        |

Migration Log Extensions Messages **Logging Page**

## SQL Details: 21zvrn2udt6gz

Search to SQL ID

View Data

### Text

```
SELECT h.rptno||' -xx-'||
h.es_priority||' -xx-'||
h.status||' -xx-'||
 h.CATEGORY||' -xx-'||
replace(h.subject,chr(10))||' -xx-...
```

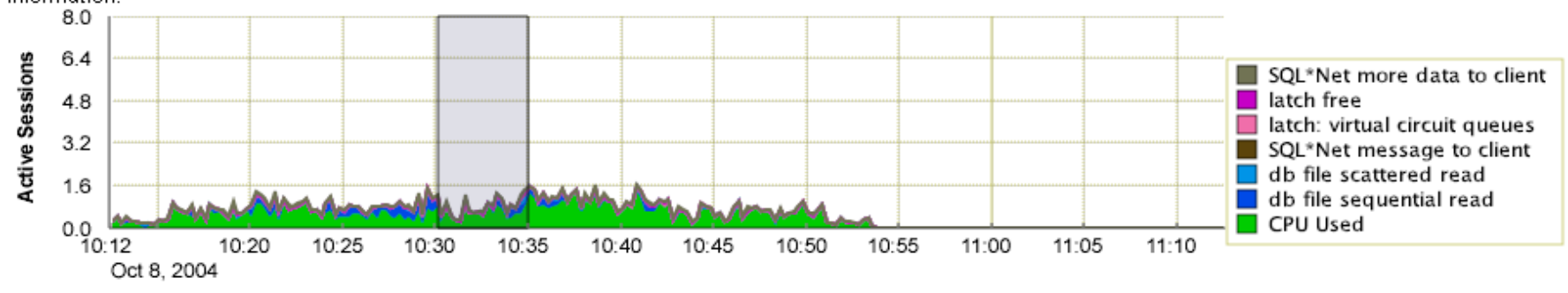
### Details

Select the plan hash value to see the details below. Plan Hash Value

[Execution Statistics](#) [Session Activity](#) [Execution Plan](#) [Tuning Information](#)

### Execution Activity

The following chart displays the users executing of the wait events and CPU of the SQL statement in the last hour. Move the slider to view the session activity detail information.



### Detail for Selected 5 Minute Interval

Start Time **Oct 8, 2004 10:30:08 AM**

| Activity (%) | SID                  | User                 | Program                      | Service                    | Plan Hash Value |
|--------------|----------------------|----------------------|------------------------------|----------------------------|-----------------|
| 34.21        | <a href="#">1266</a> | <a href="#">JPAL</a> | sqlplus@ap672wgs (TNS V1-V3) | <a href="#">SYS\$USERS</a> | 4047790200      |
| 32.71        | <a href="#">1469</a> | <a href="#">JPAL</a> | sqlplus@ap672wgs (TNS V1-V3) | <a href="#">SYS\$USERS</a> | 4047790200      |
| 28.57        | <a href="#">1795</a> | <a href="#">JPAL</a> | sqlplus@ap672wgs (TNS V1-V3) | <a href="#">SYS\$USERS</a> | 4047790200      |



# SQL Trace/tkprof advantages

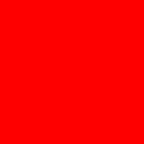
- Full trace of activity
- Contains full plan details (sometime!)
- SQL trace text file is portable
- Bind values can be collected
  - Allows skew identification

# ASH advantages

- Always available (HUGE!)
- Any time range
- Many dimensions
- Concurrency issues

# Conclusion

- ASH provides most of the data that we use from SQL Trace/tkprof
- ASH data always available
- Using ASH means never having to say 'I'm Sorry. Can you just run it again please?'
- Use any dimension, not just session
- Using ASH greatly reduces the number of times that you need to resort to SQL Trace



The preceding is intended to outline our general product direction. It is intended for information purposes only, and may not be incorporated into any contract. It is not a commitment to deliver any material, code, or functionality, and should not be relied upon in making purchasing decisions. The development, release, and timing of any features or functionality described for Oracle's products remains at the sole discretion of Oracle.

# Recommended Campground Demos

| Demo                                                            | Location                  |
|-----------------------------------------------------------------|---------------------------|
| Oracle Real Application Testing: Database Replay                | Moscone West Exhibit Hall |
| Oracle Real Application Testing: SQL Performance Analyzer       | Moscone West Exhibit Hall |
| Self-Managing Database: Automatic Performance Diagnostics       | Moscone West Exhibit Hall |
| Self-Managing Database: Automatic Application & SQL Tuning      | Moscone West Exhibit Hall |
| Self-Managing Database: Automatic Fault Diagnostics             | Moscone West Exhibit Hall |
| Self-Managing Database: Oracle Database 11g SQL Plan Management | Moscone West Exhibit Hall |
| Change Management & Data Masking for DBAs                       | Moscone West Exhibit Hall |

# Recommended Sessions (Wed sessions)

| Session Title                                                                                    | Date               | Time       | Location                |
|--------------------------------------------------------------------------------------------------|--------------------|------------|-------------------------|
| Real-World Case Studies: A Look at Real Application Testing from the Customer's Perspective      | Wednesday, Nov. 14 | 9:45 a.m.  | Moscone South: 309      |
| Does Your Business Need Oracle 11g Real Application Testing: Findings of Ovum Summit             | Wednesday, Nov. 14 | 11:15 a.m. | Moscone South: 309      |
| DBA's New Best Friend: Advanced SQL Tuning Features of Oracle Database 11g                       | Thursday, Nov. 15  | 10:00 a.m. | Moscone West: 2001 - L2 |
| SQL Plan Management: New Approach for Providing SQL Performance Stability in Oracle Database 11g | Thursday, Nov. 15  | 10:00 a.m. | Moscone South: 309      |
| Fault-Diagnostic Best Practices: What Every DBA Must Know About Oracle Database 11g              | Thursday, Nov. 15  | 11:30 a.m. | Moscone South: 309      |