Practical Use of Active Session History

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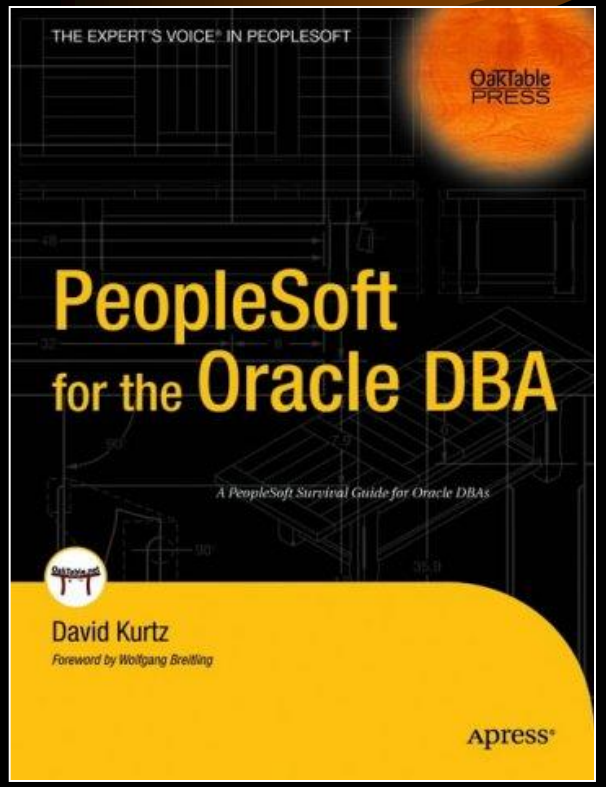
Who Am I?

- Oracle Database Specialist
- PeopleSoft
  - Independent consultant
- Performance tuning
  - PeopleSoft ERP
  - Oracle RDBMS
- Book
  - www.psftdba.com
- Oak Table
- ORACLE ACE Director



Agenda: Active Session History

- What is it? What does it do?
- Enterprise Manager & ASH Report
- Compare and contrast SQL*Trace
- Instrumentation
- Using SQL to Analyse ASH
  - Top SQL, Locking, Changing Plans, I/O, Temporary Usage, Limitations
  - Pitfalls

Further Reading

- This presentation started out as a document, you might find it easier to work with that than this presentation.
  - Not everything in the document appears in the presentation.
  - http://www.go-faster.co.uk/Practical_ASH.pdf

Background Reading

- Graham Wood
  - Sifting through the ASHes of (DB) Time
    - http://www.oracle.com/technetwork/database/manageability/ppt-active-session-history-129612.pdf
  - Video of presentation at MOW2010
    - http://www.oaktable.net/media/mow2010-graham-wood-ashes-time-part1
    - http://www.oaktable.net/media/mow2010-graham-wood-ashes-time-part-2
  - ASH Architecture and Advanced Usage
    - www.youtube.com/watch?v=rxQkvXIY7X0
- Doug Burns' Oracle Blog
    - http://oracledoug.com/serendipity/index.php?/plugin/tag/ASH
- Introduction to DBMS_XPLAN
    - http://www.go-faster.co.uk/Intro_DBMS_XPLAN.ppt

Your Mileage May Vary

- Throughout this presentation I will be showing you examples from PeopleSoft systems.
  - If you have a different package or you own application, you are likely to face similar challenges.
  - Don’t worry about the PeopleSoft specifics.
  - Focus on the kind of information I am using to filter my ASH data.

A Brief Overview

- Samples active sessions every second
- Circular buffer in memory
  - *v$active_Session_history*
  - It should hold about 1 hour of data
- 1 in 10 samples stored in database
  - *DBA_HIST_ACTIVE_SESS_HISTORY*
  - Flushed out during AWR snapshot

Licensing

- ASH is a part of the Diagnostics Pack
  - That's means it costs money.
    - I don't like it either, but that is how it is!
  - Only available on Enterprise Edition
  - S-ASH: http://www.ashmasters.com/
  - OraSASH: http://pioro.github.io/orasash/

What does ASH retain?

- Many of the columns are on *v$session*
  - Session
    - *Session ID and serial, query coordinator*
  - Wait
    - *event id, name and parameters*
  - SQL
    - *SQL_ID, plan hash, opcode*
  - Object
    - *object, file and block numbers*
    - *row numbers from 11g*
  - Application
    - *module, action, client_id …*

What does ASH retain?

Column on v$active_session_history	Correspondence to v$session
SAMPLE_ID	ID of ASH Sample
SAMPLE_TIME	Time of ASH Sample
SESSION_ID	V$SESSION.SID
SQL_ID	√
SQL_CHILD_NUMBER	√
SQL_PLAN_HASH_VALUE	V$SQL.PLAN_HASH_VALUE
EVENT	√
PROGRAM	√
MODULE	√
ACTION	√
…	…

New in 11gR1

- **SQL_PLAN_LINE_ID, SQL_PLAN_OPERATION, SQL_PLAN_OPTIONS**
- **SQL_EXEC_ID, SQL_EXEC_START**
- TOP_LEVEL_SQL_ID, TO_LEVEL_SQL_OPCODE
- QC_SESSION_SERIAL#
- REMOTE_INSTANCE#
- CURRENT_ROW#
- CONSUMER_GROUP_ID
- IN_PARSE, IN_HARD_PARSE, IN_SQL_EXECUTION

  …

New in 11gR2

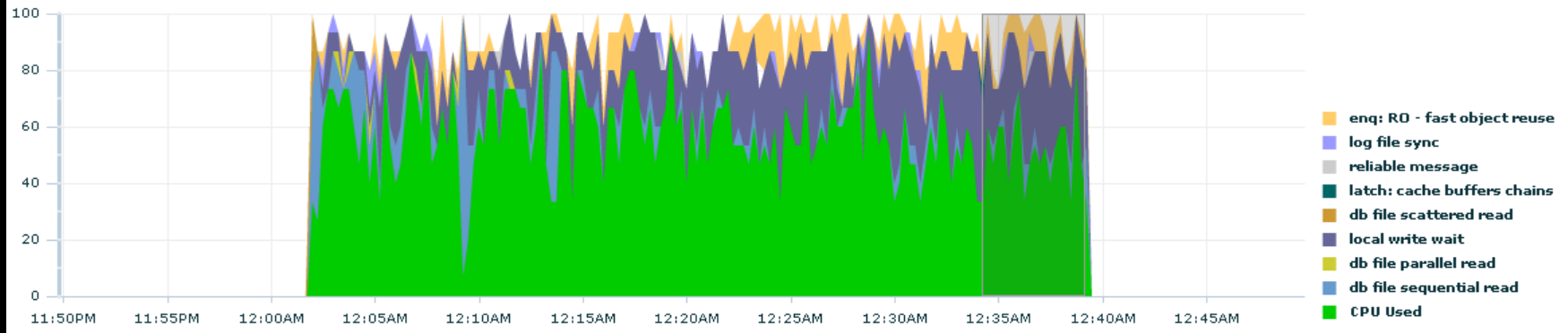
- **IS_AWR_SAMPLE**
- IS_SQL_ID_CURRENT
- CAPTURED_OVERHEAD, REPLAY_OVERHEAD, IS_CAPTURED, IS_REPLAYED
- **MACHINE, PORT**, ECID
- TM_DELTA_TIME, TM_DELTA_CPU_TIME, TM_DELTA_DB_TIME, DELTA_TIME
- DELTA_READ_IO_REQUESTS, DELTA_WRITE_IO_REQUESTS, DELTA_READ_IO_BYTES, DELTA_WRITE_IO_REQUESTS
- **PGA_ALLOCATED**
- **TEMP_SPACE_ALLOCATED**

New in 12c

- **CON_ID**
- **DBOP_NAME**
- **DBOP_EXEC_ID**
- **IN_MEMORY%**

ASH in OEM

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



Detail for Selected 5 Minute Interval

Start Time **17-May-2010 00:34:13** View Show Aggregated Data Run ASH Report

Previous 1-10 of 67 Next 10

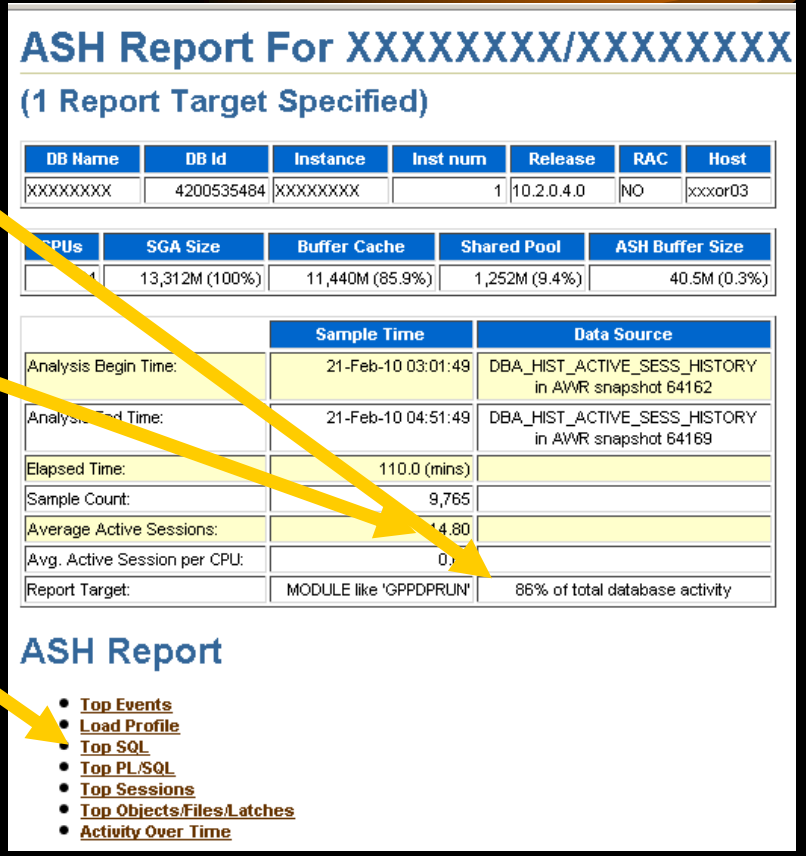
Activity (%)	SQL ID	SQL Command	Plan Hash Value	Module	Action	Client ID
72.99	7a62909337ud7	TRUNCATE TABLE	3070778916	SCRTY_SJTDLY	PI=2973767:Processing	
1.46		UNKNOWN	0	SCRTY_SJTDLY	PI=2973767:Processing	
1.09	6tjfm0rv28q7p	TRUNCATE TABLE	3397350833	SCRTY_SJTDLY	PI=2973767:Processing	
.73	9cjj74dv4zjdp	UPDATE	1016177545	SCRTY_SJTDLY	PI=2973767:Processing	
.73	6cjud5qt9c180	DELETE	2123667390	SCRTY_SJTDLY	PI=2973767:Processing	
.73	8m816jhy50cq6	UPDATE	1104483064	SCRTY_SJTDLY	PI=2973767:Processing	
.36	2jy24ruszgbv0	INSERT	2973194850	SCRTY_SJTDLY	PI=2973767:Processing	
.36	8tvuwj0bh8uuu	INSERT	2973194850	SCRTY_SJTDLY	PI=2973767:Processing	
.36	310fa9mng2ut9	INSERT	3422340667	SCRTY_SJTDLY	PI=2973767:Processing	

ASH in OEM

- You can run ASH reports via EM

Example ASH Report

- These processes were responsible for 86% of total DB activity
- Average 14.8 active sessions (out 32 processes)
- If I go on I get SQL statements
- But I don't get execution plans.



ASH Report For XXXXXXXX/XXXXXXXX

(1 Report Target Specified)

DB Name	DB Id	Instance	Inst num	Release	RAC	Host
XXXXXXXX	4200535484	XXXXXXXX	1	10.2.0.4.0	NO	xxxxor03

CPUs	SGA Size	Buffer Cache	Shared Pool	ASH Buffer Size
	13,312M (100%)	11,440M (85.9%)	1,252M (9.4%)	40.5M (0.3%)

	Sample Time	Data Source
Analysis Begin Time:	21-Feb-10 03:01:49	DBA_HIST_ACTIVE_SESS_HISTORY in AWR snapshot 64162
Analysis End Time:	21-Feb-10 04:51:49	DBA_HIST_ACTIVE_SESS_HISTORY in AWR snapshot 64169
Elapsed Time:	110.0 (mins)	
Sample Count:	9,765	
Average Active Sessions:	14.80	
Avg. Active Session per CPU:	0.	
Report Target:	MODULE like 'GPPDPRUN'	86% of total database activity

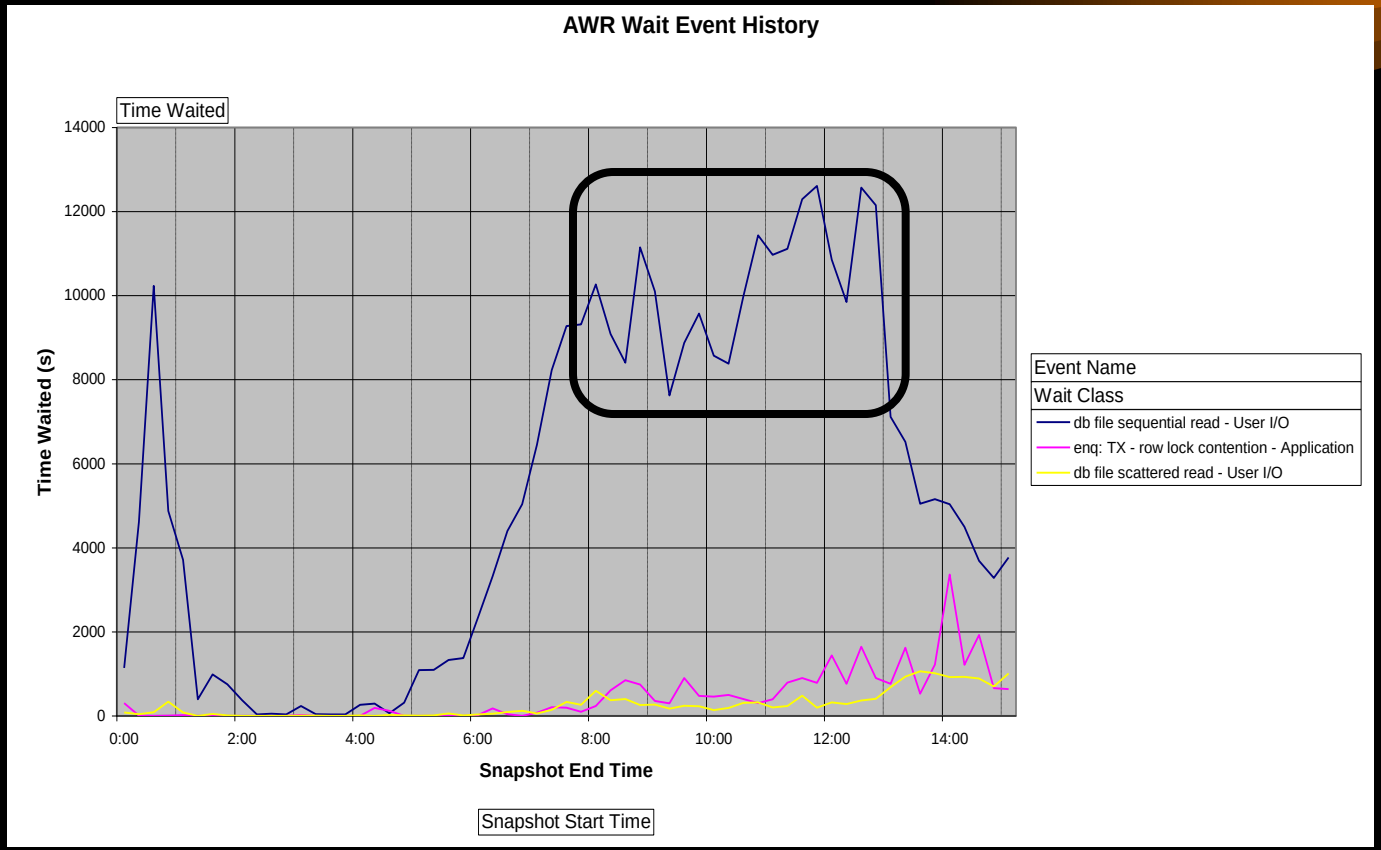
ASH Report

- Top Events
- Load Profile
- Top SQL
- Top PL/SQL
- Top Sessions
- Top Objects/Files/Latches
- Activity Over Time

Graphing AWR

- Use Excel to Query AWR and Graph the results
  - http://blog.go-faster.co.uk/2008/12/graphing-awr-data-in-excel.html

I/O Spike in AWR Metrics



I/O Spike in AWR Metrics

Time Waited	Event Name	Wait Class	
	db file sequential read	enq: TX - row lock contention	db file scattered read
Snapshot Start Time	User I/O	Application	User I/O
Mon 1.2.10 06:00	2,329.153	16.822	33.918
Mon 1.2.10 06:15	3,323.358	174.772	53.615
Mon 1.2.10 06:30	4,397.850	41.172	89.261
Mon 1.2.10 06:45	5,037.319	1.595	120.131
Mon 1.2.10 07:00	6,451.124	72.692	58.929
Mon 1.2.10 07:15	8,226.684	205.765	142.622
Mon 1.2.10 07:30	9,274.853	196.430	334.784
Mon 1.2.10 07:45	9,315.794	99.286	264.559
Mon 1.2.10 08:00	10,267.237	233.664	595.512
Mon 1.2.10 08:15	9,084.140	607.859	375.025
Mon 1.2.10 08:30	8,404.167	845.342	400.352
Mon 1.2.10 08:45	11,145.149	746.139	257.539
Mon 1.2.10 09:00	10,097.621	352.595	268.699
Mon 1.2.10 09:15	7,625.934	298.300	171.158
Mon 1.2.10 09:30	8,876.006	896.529	238.797
Grand Total	113,856.388	4,788.961	3,404.901

*ASH –v- SQL*Trace*

- ASH
  - Licensed
  - Always there
  - No marginal cost
  - Real Time
  - Who is blocking me?
  - Statistical data
  - Plan if captured by AWR
  - Estimate of duration
    - Per wait event
    - Operation in 11gR2
- SQL*Trace
  - Free
  - Enable, File, Profile
  - Run-time overhead
  - Reactive
  - Being Blocked
  - Every SQL & event
  - Actual execution plan
  - Exact duration
    - Operations in Plan

*ASH –v- SQL*Trace*

- ASH can be used to resolve many of your performance issues.
- Sometimes, you will still need SQL*Trace

Application Instrumentation

- It is essential to be able to match
  - database sessions
  - application processes
- *DBMS_APPLICATION_INFO*
  - *set_module, set_action*
  - Calls in application
    - Not all packaged application vendors do this

PL/SQL Instrumentation

```
k_module      CONSTANT VARCHAR2(48) := $$PLSQL_UNIT;
…
PROCEDURE my_procedure IS
  l_module VARCHAR2(48);
  l_action VARCHAR2(32);
BEGIN
  dbms_application_info.read_module(module_name=>l_module
                                   ,action_name=>l_action);
  dbms_application_info.set_module(module_name=>k_module
                                  ,action_name=>'MY_PROCEDURE');
…
 dbms_application_info.set_module(module_name=>l_module
                                 ,action_name=>l_action);
EXCEPTION
  WHEN … THEN
    dbms_application_info.set_module(module_name=>l_module
                                    ,action_name=>l_action);
    RAISE / EXIT
…
END my_procedure;
```

DIY Instrumentation

- You may need to be creative!
  - PeopleSoft: When a process starts (and sets its own status), I have a trigger that sets module and action

```
CREATE OR REPLACE TRIGGER sysadm.psftapi_store_prcsinstance
BEFORE UPDATE OF runstatus ON sysadm.psprcsrqst FOR EACH ROW
WHEN ((new.runstatus IN('3','7','8','9','10') OR old.runstatus
   IN('7','8')) AND new.prcstype != 'PSJob')
BEGIN
…
  psftapi.set_action(p_prcsinstance=>:new.prcsinstance
   ,p_runstatus=>:new.runstatus, p_prcsname=>:new.prcsname);
…
EXCEPTION WHEN OTHERS THEN NULL; --do not crash the scheduler
END;
/
```

Statistical Analysis of ASH data

- Recent

```
SELECT …
,      SUM(1) ash_secs
FROM   v$active_session_history
WHERE  …
GROUP BY …
```

- Historical

```
SELECT …
,      SUM(10) ash_secs
FROM   dba_hist_active_sess_history
WHERE  …
GROUP BY …
```

Querying ASH Repository

- DBA_HIST_ACTIVE_SESS_HISTORY
  - WRH$_ACTIVE_SESSION_HISTORY partitioned on DBID and SNAP_ID
- DBA_HIST_SNAPSHOT
  - WRM$_SNAPSHOT

Querying ASH Repository

```
SELECT /*+LEADING(x) USE_NL(h)*/
…
,      SUM(10) ash_secs
FROM   dba_hist_active_sess_history h
,      dba_hist_snapshot x
WHERE  x.snap_id = h.snap_id
AND    x.dbid = h.dbid
AND    x.instance_number = h.instance_number
AND    x.end_interval_time >= …
AND    x.begin_interval_time <= …
AND    h.sample_time BETWEEN … AND …
AND    …
GROUP BY …
```

What are you looking for?

- You need a clear idea of the question you are asking of the ASH data.

- What are you interested in?
  - Time Window
    - Recent –v- Historical
  - Single Session / Group of Sessions / Whole Database
  - All ASH Data / One Event / One SQL ID / One Plan
  - Related ASH data (sessions blocked by lock)

Example: On-Line

```
SELECT /*+LEADING(x h) USE_NL(h)*/
         h.sql_id
,        h.sql_plan_hash_value
,        SUM(10) ash_secs
FROM     dba_hist_snapshot x
,        dba_hist_active_sess_history h
WHERE    x.end_interval_time
                            >= TO_DATE('201402010730','yyyymmddhh24mi')
AND      x.begin_interval_time
                            <= TO_DATE('201402010830','yyyymmddhh24mi')
AND      h.sample_time BETWEEN TO_DATE('201402010730','yyyymmddhh24mi')
                           AND TO_DATE('201402010830','yyyymmddhh24mi')
AND      h.SNAP_id = X.SNAP_id
AND      h.dbid = x.dbid
AND      h.instance_number = x.instance_number
AND      h.module like 'PSAPPSRV%'
GROUP BY h.sql_id, h.sql_plan_hash_value
ORDER BY ash_secs DESC
/
```

Snapshots for Period for which process was running

ASH Data for period for which process was running

Application not instrumented Can Only Filter by Module

Top SQL

SQL_ID	SQL Plan Hash Value	ASH_SECS
7hvaxp65s70qw	1051046890	1360
fdukyw87n6prc	313261966	760
8d56bz2qxwy6j	2399544943	720
876mfmryd8yv7	156976114	710
bphpwrud1q83t	3575267335	690

…

Get the Execution Plan from AWR

```
SELECT * from table(
  dbms_xplan.display_awr(
  '7hvaxp65s70qw', 1051046890, NULL,
  'ADVANCED'));
```

Example: A Batch Process

- In PeopleSoft: a process request table
  - one row per scheduled process.
- Process Attributes
  - Process Instance
  - Operator ID
  - Process Type & Name
  - Begin Date/Time
  - End Date/Time

Example: A Batch Process

```
SELECT   /*+LEADING(r x h) USE_NL(h)*/
         r.prcsinstance
,        h.sql_id, h.sql_plan_hash_value
,        (r.enddttm-r.begindttm)*86400 exec_secs
,        SUM(10) ash_secs
FROM     dba_hist_snapshot x
,        dba_hist_active_sess_history h
,        sysadm.psprcsrqst r
WHERE    x.end_interval_time >= r.begindttm
AND      x.begin_interval_time <= r.enddttm
AND      h.sample_time BETWEEN r.begindttm AND r.e
AND      h.snap_id = x.snap_id
AND      h.dbid = x.dbid
AND      h.instance_number = x.instance_numbe
AND      h.module = r.prcsname
AND      h.action LIKE 'PI='||r.prcs              ||'%'
AND      r.prcsinstance = 1956338
GROUP BY r.prcsinstance, r.prcsname, r.begindttm,
,        h.sql_id,h.sql_plan_hash_value
ORDER BY ash_secs DESC
```

Hint to guarantee sensible join order, and partition elimination

Process Request Table One Row per Process

Snapshots for Period for which process was running

Specifc Process by ID

ASH Data for period for which process was running

Filter ASH data by MODULE and ACTION

Example: A Running Batch Process

- The process has been running for a long time.
  - It appears to have ground to a halt.

Example: A Running Batch Process

```
SELECT   /*+LEADING(r)*/
         r.prcsinstance
,        h.sql_id
,        h.sql_child_number
,        h.sql_plan_hash_value
,        (NVL(r.enddttm,SYSDATE)-r.begi    ttm)*86400 e
,        SUM(1) ash_secs
,        max(sample_time) max_sample_ti
FROM     v$active_session_history h
,        sysadm.psprcsrqst r
WHERE    h.sample_time BETWEEN r.begindttm A    NVL
AND      h.module = r.prcsname
AND      h.action LIKE 'PI='||r.prcsinstance||'%'
AND      r.prcsinstance = 1561519
GROUP BY r.prcsinstance, r.prcsname, r.begindttm,
,        h.sql_id, h.sql_plan_hash_value, h.sql_ch
ORDER BY max_sample_time DESC
```

Current Data rather than Historical ASH repository

Process Request Table One Row per Process

Specific Process by ID

Latest ASH sample for statement

ASH Data for period for which process was running

Filter ASH data by MODULE and ACTION

Example: A Running Batch Process

Process Instance	SQL_ID	Child No.	SQL Plan Hash Value	Exec Secs	ASH Secs	Last Running
1561509	**9yj020x2762a9**	**0**	**3972644945**	**18366**	**17688**	**19-FEB-14 04.24.41.392 PM**
1561509	9yj020x2762a9	0	799518913	18366	1	19-FEB-14 11.26.29.096 AM
1561509	b5r9c04ck29zb	1	149088295	18366	1	19-FEB-14 11.26.28.085 AM
1561509	5vdhh2m8skh86	1	0	18366	1	19-FEB-14 11.26.27.075 AM
1561509	gyuq5arbj7ykx	0	3708596767	18366	1	19-FEB-14 11.26.26.065 AM
1561509		0	0	18366	1	19-FEB-14 11.26.25.055 AM
1561509	5jkh8knvxw7k2	0	1549543010	18366	1	19-FEB-14 11.26.24.043 AM
1561509	9pz262n5gbhmk	0	1935542	18366	1	19-FEB-14 11.26.23.033 AM
1561509	6qg99cfg26kwb	1	3610	18366	1	19-FEB-14 11.26.22.035 AM
1561509	gpdwr389mg61h	0	088	18366	422	19-FEB-14 11.26.21.014 AM
1561509	gpdwr389mg61h	0	1518	18366	1	19-FEB-14 11.19.13.931 AM
1561509	fmbbqm351p05q		875690	18366	1	19-FEB-14 11.19.12.916 AM
1561509			791	18366	14	19-FEB-14 11.19.11.912 AM
1561509			903	18366	9	19-FEB-14 11.18.57.771 AM
1561509			731	18366	10	19-FEB-14 11.18.48.679 AM
1561509			0	18366	1	19-FEB-14 11.18.38.571 AM
1561509	cbppam9ph5bu8	0	3488560417	18366	1	19-FEB-14 11.18.37.551 AM
1561509	3cswz2x9ubjm3	0	504495601	18366	1	19-FEB-14 11.18.36.541 AM

This Statement has been running for a while

Same Process, a little later

Process Instance	SQL_ID	Child No.	SQL Plan Hash Value	Exec Secs	ASH Secs	Last Running
1561509	5zq8mtxp0nfn8	0	1505304026	38153	1	19-FEB-14 09.28.52.628 PM
1561509	b023ph16myv5d	0	1416307094	38153	30	19-FEB-14 09.28.51.618 PM
1561509	b023ph16myv5d	0	51594791	38153	1	19-FEB-14 09.28.21.300 PM
1561509	14k7bqan2vfh8	0	1620828024	38153	1	19-FEB-14 09.28.20.280 PM
1561509	d2498j5x025rq	0	3746253366	38153	82	19-FEB-14 09.28.19.270 PM
1561509	fsvwg5xgn66nf	0	3233283327	38153	43	19-FEB-14 09.26.54.280 PM
1561509	[illegible]	[illegible]	[illegible]65386	38153	14	19-FEB-14 09.24.54.853 PM
1561509	[illegible]	[illegible]	[illegible]20797	38153	1	19-FEB-14 09.24.27.533 PM
1561509	[illegible]	[illegible]	[illegible]35589	38153	78	19-FEB-14 09.24.26.523 PM
1561509	[illegible]	[illegible]	[illegible]29132	38153	42	19-FEB-14 09.23.07.685 PM
1561509	[illegible]	[illegible]	[illegible]62754	38153	3	19-FEB-14 09.22.25.207 PM
1561509	[illegible]	[illegible]	[illegible]66321	38153	13296	19-FEB-14 09.22.21.167 PM
1561509	8za7232u5pnrf	[illegible]	[illegible]37741215	38153	1	19-FEB-14 05.38.13.085 PM
1561509	8msvfudz3bc1w	0	[illegible]55751	38153	24	19-FEB-14 05.38.11.939 PM
1561509	5fvtbncfpkbuu	0	144435[illegible]1	38153	32	19-FEB-14 05.37.47.615 PM
1561509	59sdxn718fs8w	0	1746491243	[illegible]8153	11	19-FEB-14 05.37.13.236 PM
1561509	g0by0mj1d6dy2	0	2128929267	3815[illegible]	1	19-FEB-14 05.37.02.049 PM
1561509	7sx5p1ug5ag12	1	2873308018	38153	1	19-FEB-14 05.37.01.033 PM
1561509	**9yj020x2762a9**	**0**	**3972644945**	**38153**	**13295**	**19-FEB-14 05.36.59.620 PM**

Same Statement as before, but shows less run time. ASH Buffer has flushed some data

Obtain Execution Plan from Library Cache

```
SELECT * from table(
  dbms_xplan.display_cursor(
  '9yj020x2762a9', 0, 'ADVANCED'));
```

Use SQL Query to Generate Code to Obtain Execution Plan

```
SELECT DISTINCT 'SELECT * from table(
  dbms_xplan.display_cursor( ''' ||sql_id
  ||''','' ||sql_child_number
  ||','''ADVANCED'''));'
FROM (
…
)
```

Which Part of Execution Plan Consumed the Most Time?

```
SELECT …
, h.sql_plan_line_id
, sum(10) ash_secs
FROM dba_hist_snapshot x
, dba_hist_active_sess_history h
…
WHERE …
AND h.sql_id = 'a47fb0x1b23jn'
GROUP BY …
, h.sql_plan_line_id
ORDER BY prcsinstance, ASH_SECS DESC
```

Which Part of Execution Plan Consumed the Most Time?

PRCSINSTANCE	SQL_PLAN_HASH_VALUE	SQL_PLAN_LINE_ID	ASH_SECS
4945802	483167840	25	2410
	483167840	24	1190
	483167840	26	210
	483167840	20	190
	483167840	21	30
	483167840	16	20
	483167840	23	10
	483167840	22	10
	483167840	18	10
	483167840		10
	483167840	7	10

Which Part of Execution Plan Consumed the Most Time?

```
Plan hash value: 483167840
-------------------------------------------------------------------------------------------------------------------------------------
| Id  | Operation                          | Name                | Rows  | Bytes | Cost (%CPU)| Time     |    TQ  |IN-OUT| PQ Distrib |
-------------------------------------------------------------------------------------------------------------------------------------
…
|  14 |         NESTED LOOPS               |                     |       |       |            |          |  Q1,04 | PCWP |            |
|  15 |          NESTED LOOPS              |                     |  3988 |   669K|   113K  (1)| 00:06:08 |  Q1,04 | PCWP |            |
|  16 |           HASH JOIN SEMI           |                     |  3851 |   481K|   112K  (1)| 00:06:05 |  Q1,04 | PCWP |            |
|  17 |            PX RECEIVE              |                     |  3771K|   233M| 61175   (1)| 00:03:19 |  Q1,04 | PCWP |            |
|  18 |             PX SEND HASH           | :TQ10003            |  3771K|   233M| 61175   (1)| 00:03:19 |  Q1,03 | P->P | HASH       |
|  19 |              PX BLOCK ITERATOR     |                     |  3771K|   233M| 61175   (1)| 00:03:19 |  Q1,03 | PCWC |            |
|  20 |               TABLE ACCESS FULL    | PS_CM_DEPLETE       |  3771K|   233M| 61175   (1)| 00:03:19 |  Q1,03 | PCWP |            |
|  21 |            BUFFER SORT             |                     |       |       |            |          |  Q1,04 | PCWC |            |
|  22 |             PX RECEIVE             |                     |  6058K|   364M| 50906   (1)| 00:02:46 |  Q1,04 | PCWP |            |
|  23 |              PX SEND HASH          | :TQ10001            |  6058K|   364M| 50906   (1)| 00:02:46 |        | S->P | HASH       |
|  24 |               INDEX FULL SCAN      | PS_CM_DEPLETE_COST  |  6058K|   364M| 50906   (1)| 00:02:46 |        |      |            |
|  25 |           INDEX UNIQUE SCAN        | PS_TRANSACTION_INV  |     1 |       |     1   (0)| 00:00:01 |  Q1,04 | PCWP |            |
|  26 |          TABLE ACCESS BY INDEX ROWID| PS_TRANSACTION_INV |     1 |    44 |     1   (0)| 00:00:01 |  Q1,04 | PCWP |            |
…
-------------------------------------------------------------------------------------------------------------------------------------
```

Bind Variables

- Developers Should Use Them!

- Unfortunately…

Different SQL, Same Plan

P.I.	SQL_ID	SQL_PLAN_HASH_VALUE	EXEC_SECS	ASH_SECS
1949129	0uj7k70z1s76y	2239378934	619	210
1949819	0sd03jvun7us6	2239378934	336	20
1953197	22kn2sb7vttnp	2239378934	753	150
1956338	0xkjtywub2861	2602481067	19283	18550
1956338	998wf4g84dk8z	1041940423	19283	10
1956805	7c7dzavm70yku	2602481067	16350	15690
1956925	1knvx57dnrz29	2602481067	15654	15010
1956925	a9mw8hjxfwczm	338220129	15654	10
1957008	9s2jct0jfmwgy	2602481067	15077	14430
1957008	9s2jct0jfmwgy	3265949623	15077	10
1957087	cwarnq7kv4d84	2602481067	14638	14000
1957691	9nv93p134xjb0	2602481067	13477	12980
1958659	9s2jct0jfmwgy	2602481067	9354	9140
1958697	1bd0fg0fvsfyp	2602481067	9176	8950

Non-Shareable SQL

```
SQL_ID djqf1zcypm5fm
--------------------
SELECT ...
FROM PS_TL_EXCEPTION A,
     PS_PERSONAL_DATA B,
     PS_PERALL_SEC_QRY B1,
…
WHERE B.EMPLID = B1.EMPLID
AND B1.OPRID = '12345678'
…
```

Same Problem in One Process

PRCSINSTANCE	SQL_ID	SQL_PLAN_HASH_VALUE	EXEC_SECS	ASH_SECS
50002824		0	10306	50
50002824	2ybtak62vmx58	2262951047	10306	20
50002824	ck3av6cnquwfc	2262951047	10306	20
50002824	gvys6kd9fqn7u	2262951047	10306	20
50002824	7ymcbn6q8utj8	2262951047	10306	10
50002824	9qud2n3qq7nzr	2262951047	10306	10
50002824	6pxvns97m1fua	2262951047	10306	10
50002824	5ngqj5zg8vbz8	2262951047	10306	10
50002824	9zp6nndfvn66b	2262951047	10306	10
50002824	15kfs3c3005xm	2262951047	10306	10
50002824	4qvhpygc7cq2t	2262951047	10306	10
50002824	23yc8dcz9z4yj	2262951047	10306	10
50002824	bn8xczrvs2hpr	2262951047	10306	10
50002824	9g6k9dnrjap08	2262951047	10306	10
50002824	1art8dhzbvpwt	2262951047	10306	10
50002824	6gqj337xnr5y4	2262951047	10306	10

...

Aggregate by SQL_PLAN_HASH_VALUE

PRCSINSTANCE	SQL_PLAN_HASH_VALUE	EXEC_SECS	ASH_SECS
50002824	2262951047	10306	2300
50002824	0	10306	60
50002824	3085938243	10306	20
50002824	563410926	10306	10
50002824	1068931976	10306	10

Can you find the SQL in AWR?

- Now Find the SQL with that plan.
- If it was captured by AWR
  - Lots of parsing causes statements to be aged out of library cache before they get stored in AWR by a snapshot
  - Only Top-n statements are captured.

Can you find the SQL in AWR?

- Outer Join SQLTEXT

```
SELECT h.sql_id, h.sql_plan_hash_value
,      SUM(10) ash_secs
,      10*COUNT(t.sql_id) awr_secs
FROM   dba_hist_snapshot X
,      dba_hist_active_sess_history h
       LEFT OUTER JOIN dba_hist_sqltext t
            ON t.sql_id = h.sql_id
WHERE …
GROUP BY h.sql_id, h.sql_plan_hash_value
```

Can you find the SQL in AWR?

```
SELECT  ROW_NUMBER() OVER (PARTITION BY x.sql_plan_hash_value
                           ORDER BY x.awr_secs desc) ranking
,x.sql_id, x.sql_plan_hash_value
,SUM(x.ash_secs) OVER (PARTITION BY x.sql_plan_hash_value) ash
,SUM(x.awr_secs) OVER (PARTITION BY x.sql_plan_hash_value) awr
,COUNT(DISTINCT sql_id) OVER
                      (PARTITION BY x.sql_plan_hash_value) sql_ids
FROM (  SELECT  h.sql_id, h.sql_plan_hash_value
   ,    SUM(10) ash_secs
   ,    10*COUNT(t.sql_id) awr_secs
   FROM dba_hist_snapshot X
   ,    dba_hist_active_sess_history h
        LEFT OUTER JOIN dba_hist_sqltext t ON t.sql_id = h.sql_id
   WHERE        …
   GROUP BY h.sql_id, h.sql_plan_hash_value ) x ) y
WHERE   y.ranking = 1
ORDER BY tot_ash_secs desc, ranking
```

Can you find the SQL in AWR?

RNK	SQL_ID	SQL_PLAN HASH_VALUE	TOTAL ASH_SECS	TOTAL AWR_SECS	SQL_IDS
1	**8mkvravdrxvcn**	**0**	**38270**	**480**	**74[1]**
1	**027qsfj7n71cy**	**1499159071**	**4230**	**4230**	**1[2]**
1	**cxwz9m3auk4y7**	**1898065720**	**4190**	**4190**	**198[3]**
1	9513hhu1vucxz	2044891559	3590	3590	1
1	95dx0mkjq38v5	1043916244	3450	3450	23

1. Special case. There is no plan because it's the *dbms_stats* function. There were 74 statements, but in reality they were all totally different
2. One SQL, one plan, this is a shareable SQL_ID, or it did just execute once.
3. This is many statements with the same plan, at least 198.

ASH for Single Wait Event

```
SELECT /*+LEADING(x h) USE_NL(h)*/
       h.sql_id
,      h.sql_plan_hash_value
,      SUM(10) ash_secs
FROM   dba_hist_snapshot x
,      dba_hist_active_sess_history h
WHERE  x.end_interval_time   <=TO_DATE('201402010830','yyyymmddhh24mi')
AND    x.begin_interval_time >=TO_DATE('201402010730','yyyymmddhh24mi')
AND    h.sample_time BETWEEN   TO_DATE('201401261100','yyyymmddhh24mi')
                       AND   TO_DATE('201401261300','yyyymmddhh24mi')
AND    h.SNAP_id = X.SNAP_id
AND    h.dbid = x.dbid
AND    h.instance_number = x.instance_number
AND    h.event = 'db file sequential read'
GROUP BY h.sql_id, h.sql_plan_hash_value
ORDER BY ash_secs desc
/
```

Statements with Highest I/O

SQL_ID	SQL Plan Hash Value	ASH_SECS
90pp7bcnmz68r	2961772154	2490
81gz2rtabaa8n	1919624473	2450
7hvaxp65s70qw	1051046890	1320
7fk8raq16ch0u	3950826368	890
9dzpwkff7zycg	2020614776	840

…

What Kind of Single Block Read?

- For I/O wait events ASH reports
  - File number
  - Block number
  - Object number
  - Row number (from 11g)
- Only valid on DB File events.
  - Invalid on other events because simply not cleared from previous operation.

Categorise Tablespaces/Data Files

```
CREATE TABLE dmk_data_files as
SELECT tablespace_name
, file_id
, CASE
   WHEN f.tablespace_name LIKE 'SYS%' THEN 'SYSTEM'
   WHEN f.tablespace_name LIKE 'UNDO%' THEN 'UNDO'
   WHEN f.tablespace_name LIKE '%IDX%' THEN 'INDEX'
   WHEN f.tablespace_name LIKE '%INDEX%' THEN 'INDEX'
   ELSE 'TABLE'
  END AS tablespace_type
FROM dba_data_files f
ORDER BY tablespace_name
/
```

- Working storage table performs better than DBA_DATA_FILES

ASH Data by Tablespace Type

```
SELECT   /*+LEADING(x h) USE_NL(h f)*/
         f.tablespace_type
,        SUM(10) ash_secs
FROM     dba_hist_snapshot x
,        dba_hist_active_sess_history h
,        dmk_data_files f
WHERE    x.end_interval_time <=TO_DATE('201402161300','yyyymmddhh24mi')
AND       x.begin_interval_time
                          >=TO_DATE('201402161100','yyyymmddhh24mi')
AND      h.sample_time BETWEEN TO_DATE('201401261100','yyyymmddhh24mi')
                       AND      TO_DATE('201401261300','yyyymmddhh24mi')
AND      h.SNAP_id = X.SNAP_id
AND      h.dbid = x.dbid
AND      h.instance_number = x.instance_number
AND      h.event LIKE 'db file%'
AND      h.p1text = 'file#'
AND      h.p2text = 'block#'
AND      f.file_id = h.p1
GROUP BY f.tablespace_type
ORDER BY ash_secs desc
/
```

ASH Data by Tablespace Type

TABLES	ASH_SECS
INDEX	30860
TABLE	26970
UNDO	1370
SYSTEM	490

- Most time spent on index read
  - Includes index maintenance during DML
- Not much undo, so not much consistent read.

Which Tables Account for the I/O?

- Need own copy of DBA_OBJECTS

```
CREATE TABLE dmk_objects
(object_id NUMBER NOT NULL
,owner VARCHAR2(30) NOT NULL
,object_name VARCHAR2(128) NOT
   NULL
,subobject_name VARCHAR2(30)
,PRIMARY KEY (OBJECT_ID))
/
INSERT INTO dmk_objects
SELECT object_id, owner,
   object_name, subobject_name
FROM dba_objects
WHERE object_type LIKE 'TABLE%'
UNION ALL
SELECT o.object_id, i.table_owner,
   i.table_name, o.subobject_name
FROM dba_objects o, dba_indexes i
WHERE o.object_type like 'INDEX%'
AND i.owner = o.owner
AND i.index_name = o.object_name
/
```

Which Objects are Used?

```
SELECT   /*+LEADING(x h) USE_NL(h)*/
         o.owner, o.object_name
,        SUM(10) ash_secs
FROM     dba_hist_snapshot x
,        dba_hist_active_sess_history h
,        dmk_objects o
WHERE    x.end_interval_time   >= SYSDATE-7
AND      x.begin_interval_time <= SYSDATE
AND      h.sample_time         >= SYSDATE-7
AND      h.sample_time         <= SYSDATE
AND      h.Snap_id = X.snap_id
AND      h.dbid = x.dbid
AND      h.instance_number = x.instance_number
AND      h.event LIKE 'db file%'
AND      h.current_obj# = o.object_id
GROUP BY o.owner, o.object_name
HAVING   SUM(10) >= 3600
ORDER BY ash_secs DESC
```

Which Objects are Used?

OWNER	OBJECT_NAME	ASH Secs
SYSADM	PS_TL_RPTD_TIME	800510
SYSADM	PS_TL_PAYABLE_TIME	327280
SYSADM	PS_GP_RSLT_ACUM	287870
SYSADM	PS_SCH_DEFN_DTL	161690
SYSADM	PS_SCH_DEFN_TBL	128070
SYSADM	PS_GP_RSLT_PIN	124560
SYSADM	PS_GP_PYE_PRC_STAT	92410
SYSADM	PS_SCH_ADHOC_DTL	88810

…

Which Processes Read This Table?

```
SELECT /*+LEADING(x) USE_NL(h)*/
      o.owner, o.object_name
,     h.module
,     SUM(10) ash_secs
FROM  dba_hist_snapshot x
,     dba_hist_active_sess_history h
,     dmk_objects o
WHERE x.end_interval_time   >= SYSDATE-7
AND   x.begin_interval_time <= SYSDATE
AND   h.sample_time         >= SYSDATE-7
AND   h.sample_time         <= SYSDATE
AND   h.Snap_id = X.snap_id
AND   h.dbid = x.dbid
AND   h.instance_number = x.instance_number
AND   h.event LIKE 'db file%'
AND   h.current_obj# = o.object_id
AND   o.object_name = 'PS_GP_RSLT_ACUM'
GROUP BY o.owner, o.object_name
, h.module
HAVING SUM(10) >= 900
ORDER BY ash_secs desc
```

Which Processes Read This Table?

OWNER	OBJECT_NAME	MODULE	ASH Secs
SYSADM	PS_GP_RSLT_ACUM	XXX_HOL_MGMT	79680
SYSADM	PS_GP_RSLT_ACUM	DBMS_SCHEDULER	37810
SYSADM	PS_GP_RSLT_ACUM	SQL*Plus	37060
SYSADM	PS_GP_RSLT_ACUM	GPGBHLE	30710
SYSADM	PS_GP_RSLT_ACUM	GPPDPRUN	27440
SYSADM	PS_GP_RSLT_ACUM	XXX_AE_AB007	21440
SYSADM	PS_GP_RSLT_ACUM	SQL Developer	11210
SYSADM	PS_GP_RSLT_ACUM	GPGBEPTD	7240
SYSADM	PS_GP_RSLT_ACUM	XXX_CAPITA	5850
SYSADM	PS_GP_RSLT_ACUM	GPGB_PSLIP_X	5030
SYSADM	PS_GP_RSLT_ACUM	GPGB_EDI	4880

Who is using this index?

- CURRENT_OBJ# has been suggested as a way to identify index usage.
  - It only identifies index physical read
  - So it also includes index maintenance during DML
  - Doesn't work if the object has been rebuilt and has a new object number

SQL Plans captured by AWR

- SQL statements and plans captured during AWR snapshot
  - Top N by Elapsed Time, CPU Time, Parse Calls, Shareable Memory, Version Count
- DBA_HIST_SQL_PLAN
  - OBJECT_OWNER
  - OBJECT_TYPE
  - OBJECT_NAME

Who is using this index?

- Join plans that reference index to ASH data by SQL_PLAN_HASH_VALUE
  - Do not join by SQL_ID
- Filter out
  - SQL*Plus, Toad, Ad-Hoc query tools
  - Statistics collection

Extract ASH for statements that use specified indexes

```
CREATE TABLE my_ash COMPRESS AS
WITH p AS (
    SELECT DISTINCT p.plan_hash_value, p.object#
    ,      p.object_owner, p.object_type, p.object_name
    FROM   dba_hist_sql_plan p
    WHERE  p.object_name like 'PS_PROJ_RESOURCE'
    AND    p.object_type LIKE 'INDEX%'
    AND    p.object_owner = 'SYSADM')
SELECT p.object# object_id
,      p.object_owner, p.object_type, p.object_name
,      h.*
FROM   dba_hist_active_sess_history h
,      p
WHERE  h.sql_plan_hash_value = p.plan_hash_value
```

Profile the ASH extracted

```
WITH h AS (
  SELECT   object_name
  ,        CASE WHEN h.module IS NULL THEN REGEXP_SUBSTR(h.program,'[^.@]+',1,1)
                WHEN h.module LIKE 'PSAE.%' THEN REGEXP_SUBSTR(h.module,'[^.]+',1,2)
                ELSE REGEXP_SUBSTR(h.program,'[^.@]+',1,1)
           END as module
 ,         CASE WHEN h.action LIKE 'PI=%' THEN NULL
                ELSE h.action
           END as action
 ,         CAST(sample_time AS DATE) sample_time
 ,         sql_id, sql_plan_hash_value, sql_exec_id
 FROM    my_ash h
)
SELECT object_name, module, action
,      sum(10) ash_secs
,      COUNT(DISTINCT sql_plan_hash_value) sql_plans
,      COUNT(DISTINCT sql_id||sql_plan_hash_value||sql_exec_id) sql_execs
,      MAX(sample_time) max_sample_time
FROM   h
WHERE NOT lower(module) IN('oracle','toad','sqlplus','sqlplusw')
AND       NOT lower(module) LIKE 'sql%'
GROUP BY object_name, module, action
ORDER BY SUBSTR(object_name,4), object_name, ash_secs desc
```

Profile the ASH extracted

```
 ASH    SQL     SQL Last
OBJECT_NAME        MODULE               ACTION                          Secs Plans  Execs Sample
------------------ -------------------- ------------------------------- ------- ----- ------ ------------------
…
PSMPROJ_RESOURCE   PC_TL_TO_PC          GF_PBINT_AE.XxBiEDM.Step07.S         60     2      6 18:35:18 20/08/2014
******************                                                      -------
sum                                                                         60

PSNPROJ_RESOURCE   PC_TL_TO_PC          GF_PBINT_AE.CallmeA.Step20.S        300     1     49 18:53:58 26/08/2014
                   PC_TL_TO_PC          GF_PBINT_AE.CallmeA.Step
                   GF_OA_CMSN           GF_OA_CMSN.01INIT.Step01
                   PC_TL_TO_PC          GF_PBINT_AE.CallmeA.Step
                   PC_TL_TO_PC          GF_PBINT_AE.
                   PC_TL_TO_PC          GF_PBINT_AE.CallmeA.                1680     1     24 18:53:18 26/08/2014
                   PC_TL_TO_PC          GF_PBINT_AE.CallmeA.Step10.S          60     1     33 17:26:26 22/08/2014
                   PC_TL_TO_PC          GF_PBINT_AE.CallmeA.Step
                   PC_TL_TO_PC          GF_PBINT_AE.CallmeA.Step
                   PC_TL_TO_PC          GF_PBINT_AE.CallmeA.Step
                   PC_PRICING           GF_PBINT_AE.CallmeG.Step
                   PC_AP_TO_PC          GF_PBINT_AE.CallmeH.Step00A.S       120     1     17 21:33:26 21/08/2014
                   PC_PRICING           GF_PBINT_AE.CallmeA.Step20.S        300     1     49 18:53:58 26/08/2014
                   PC_PRICING           GF_PBINT_AE.CallmeA.Step
                   PC_PRICING           GF_PBINT_AE.CallmeA.Step
                   PC_TL_TO_PC          GF_PBINT_AE.CallmeA.Pseu
******************                                                      -------
sum                                                                      21770
…
```

This index used lightly. Perhaps we don't really need it.

This index used widely. Probably can't drop it.

Indexes that do not appear are probably not used.

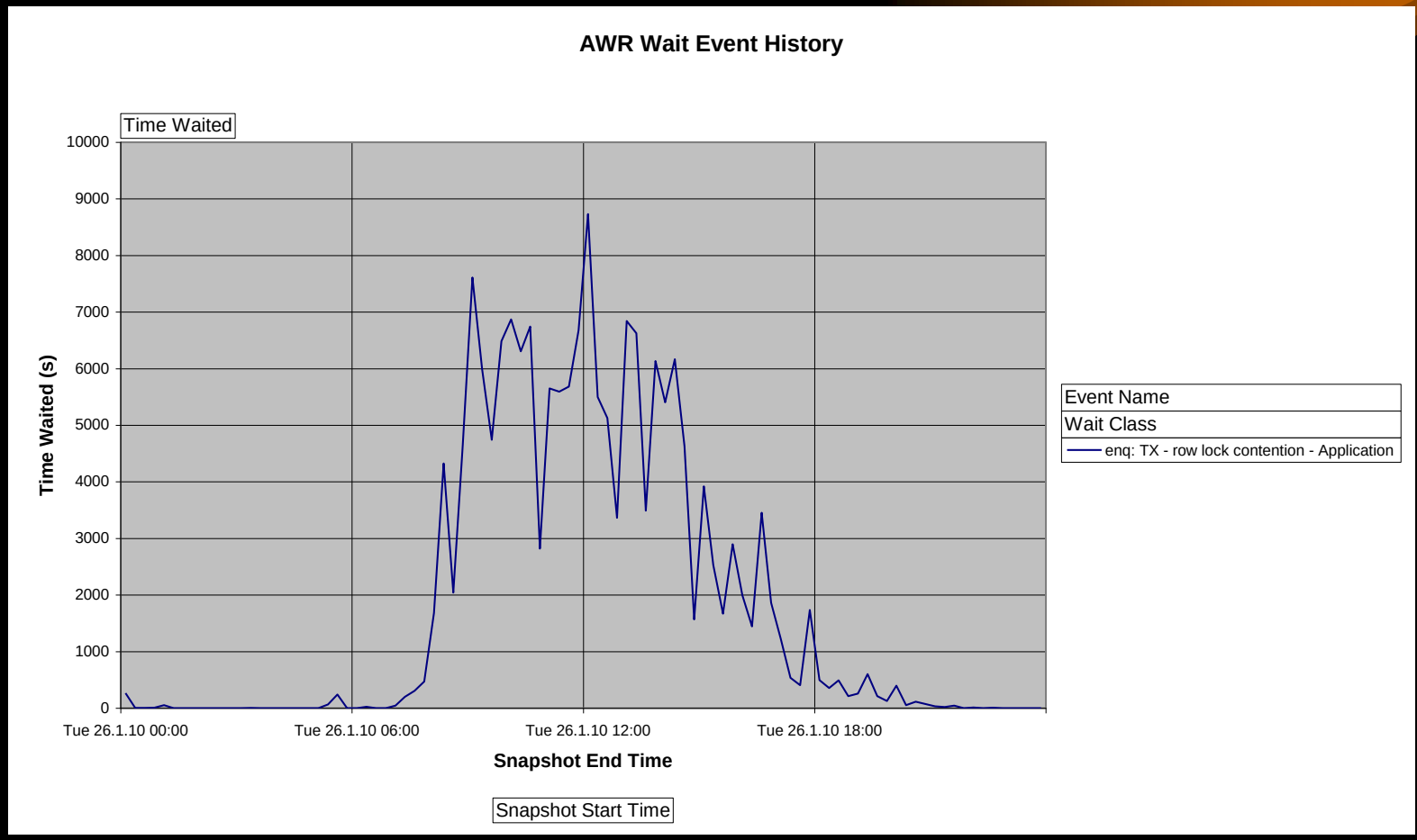
Limitations of Method

- AWR doesn't capture all SQLs
  - A very effective index that is only used occasionally might not be captured.
  - Results are only indicative, not absolute.
- ASH data purged after 31 days (by default)
  - An index only be used for annual process might not be detected, but it might be essential for that process
  - Consider establishing longer term repository, retaining perhaps 400 days.

Before I can drop an index…

- Need to look at SQL found to reference it.
- Might prefer to make index invisible and drop later if no issue.

AWR Data indicates locking



Where did we wait on a lock?

```
SELECT   /*+LEADING(x h) USE_NL(h)*/
         h.sql_id
,        h.sql_plan_hash_value
,        SUM(10) ash_secs
FROM     dba_hist_snapshot x
,        dba_hist_active_sess_history h
WHERE    x.end_interval_time >=TO_DATE('201401261100','yyyymmddhh24mi')
AND      x.begin_interval_time <=
                            TO_DATE('201401261300','yyyymmddhh24mi')
AND      h.sample_time BETWEEN TO_DATE('201401261100','yyyymmddhh24mi')
                       AND     TO_DATE('201401261300','yyyymmddhh24mi')
AND      h.snap_id = x.snap_id
AND      h.dbid = x.dbid
AND      h.instance_number = x.instance_number
AND      h.event = 'enq: TX - row lock contention'
GROUP BY h.sql_id, h.sql_plan_hash_value
ORDER BY ash_secs desc
/
```

Where did we wait on a lock?

SQL_ID	SQL Plan Hash Value	ASH_SECS
7qxdrwcn4yzhh	3723363341	26030
652mx4tffq415	1888029394	11230
c9jjtvk0qf649	3605988889	6090
artqgxug4z0f1	8450529	240
gtj7zuzy2b4g6	2565837323	100

Statements Blocked by TX Locks

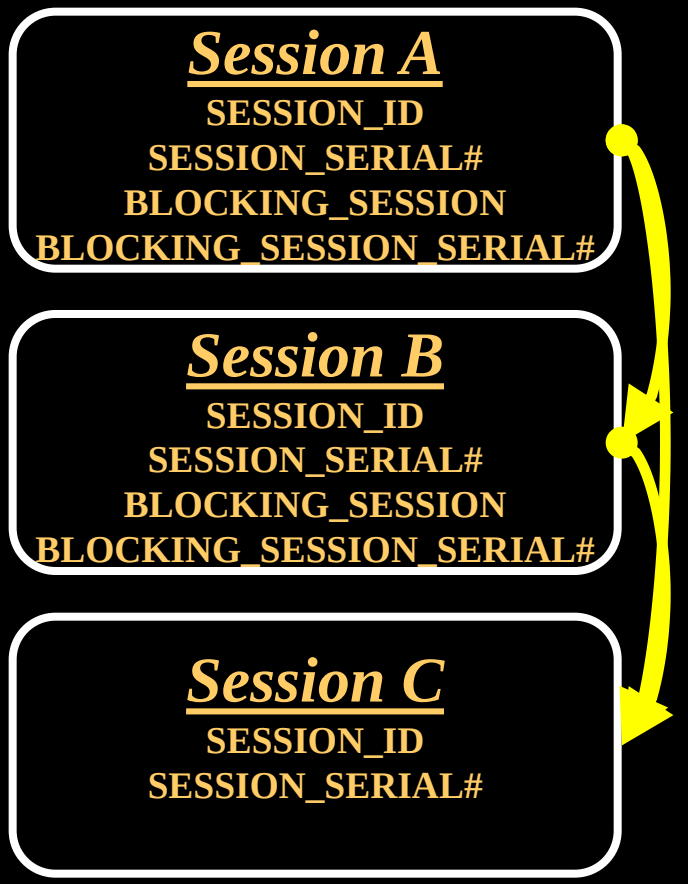
```
SQL_ID 7qxdrwcn4yzhh
--------------------
UPDATE PSIBQUEUEINST SET QUEUESEQID=QUEUESEQID+:1
WHERE QUEUENAME=:2

SQL_ID 652mx4tffq415
--------------------
UPDATE PSAPMSGPUBSYNC SET LASTUPDDTTM=SYSDATE
WHERE QUEUENAME=:1

SQL_ID c9jjtvk0qf649
--------------------
UPDATE PSAPMSGSUBCSYNC SET LASTUPDDTTM=SYSDATE
WHERE QUEUENAME=:1
```

The real question about locking:

- What is the session that is holding the lock doing while it is holding the lock?
  - and can I do something about that?

- *Home-made sequences are not scalable. Should really be using an Oracle Sequence.*
  - *Not possible in a PeopleSoft Application*

Resolve the Lock Chain



- Navigating the lock chain works across RAC instances from 11g.
- There may not be any ASH data for session C because it is not active on the database.

Extract ASH data for period in question

```
CREATE TABLE my_ash AS
SELECT   /*+LEADING(x) USE_NL(h)*/ h.*
FROM     dba_hist_snapshot x
,        dba_hist_active_sess_history h
WHERE    x.end_interval_time >=
                              TO_DATE('201401261100','yyyymmddhh24mi')
AND      x.begin_interval_time <=
                              TO_DATE('201401261300','yyyymmddhh24mi')
AND      h.sample_time BETWEEN TO_DATE('201401261100','yyyymmddhh24mi')
                       AND     TO_DATE('201401261300','yyyymmddhh24mi')
AND      h.Snap_id = X.snap_id
AND      h.dbid = x.dbid
AND      h.instance_number = x.instance_number;

CREATE UNIQUE INDEX my_ash ON my_ash (dbid, instance_number, snap_id,
   sample_id, session_id, sample_time, session_serial#) COMPRESS 4;
CREATE INDEX my_ash2 ON my_ash (event, dbid, instance_number, snap_id)
   COMPRESS 3;
```

What are the blocking sessions doing?

```
SELECT   /*+LEADING(x w) USE_NL(h w)*/
         h.sql_id
,        h.sql_plan_hash_value
,        SUM(10) ash_secs
FROM     my_ash w
   LEFT OUTER JOIN my_ash h
   ON    h.snap_id = w.snap_id
   AND   h.dbid = w.dbid
   AND   h.instance_number = w.instance_number
   AND   h.sample_id = w.sample_id
   AND   h.sample_time = w.sample_time
   AND   h.session_id = w.blocking_session
   AND   h.session_serial# = w.blocking_session_serial#
WHERE    w.event = 'enq: TX - row lock contention'
GROUP BY h.sql_id, h.sql_plan_hash_value
ORDER BY ash_secs desc
/
```

What are the blocking sessions doing?

SQL_ID	SQL_PLAN_HASH_VALUE	ASH_SECS
		29210[1]
5st32un4a2y92	2494504609	10670[2]
652mx4tffq415	1888029394	7030
artqgxug4z0f1	8450529	580
7qxdrwcn4yzhh	3723363341	270

1. This SQL_ID is blank. May not be able to find ASH sample for blocking session because it is idle – busy on the client not the database.
2. This statement is running while the session holds a lock that is blocking another session.

Execution Plan captured by AWR: Correct Plan, Old Costs, Old Binds

- DISPLAY_AWR()

```
SQL_ID 5st32un4a2y92
--------------------
SELECT 'X' FROM PS_CDM_LIST  WHERE CONTENTID = :1

Plan hash value: 2494504609

-------------------------------------------------------------------------------
| Id  | Operation            | Name        | Rows  | Bytes | Cost (%CPU)| Time     |
-------------------------------------------------------------------------------
|   0 | SELECT STATEMENT     |             |       |       |    22 (100)|          |
|   1 |  INDEX FAST FULL SCAN| PS_CDM_LIST |     1 |     5 |    22  (10)| 00:00:01 |
-------------------------------------------------------------------------------

Query Block Name / Object Alias (identified by operation id):
-------------------------------------------------------------

   1 - SEL$1 / PS_CDM_LIST@SEL$1

Peeked Binds (identified by position):
--------------------------------------

  1 - :1 (NUMBER): 17776
```

Fresh Execution Plan generated by execute explain plan

- Note increase of cost of full scan.

```
Plan hash value: 2494504609
-------------------------------------------------------------------------------------
| Id  | Operation            | Name        | Rows  | Bytes |  Cost (%CPU)| Time     |
-------------------------------------------------------------------------------------
|   0 | SELECT STATEMENT     |             |     1 |     6 |   3178   (9)| 00:00:05 |
|*  1 |  INDEX FAST FULL SCAN| PS_CDM_LIST |     1 |     6 |   3178   (9)| 00:00:05 |
-------------------------------------------------------------------------------------
Predicate Information (identified by operation id):
---------------------------------------------------
   1 - filter("CONTENTID"=TO_NUMBER(:1))
```

Did My Execution Plan Change?

- Can see change in execution plan and performance

PRCSINSTANCE	BEGINDTTM	SQL_ID	SQL_PLAN HASH_VALUE	EXEC_SECS	ASH_SECS
1964975	08:30:52 22/01/2010	46smbgcfcrb8d	2602481067	20379	20080
1965250	**09:08:51 22/01/2010**	**fpftdx2405zyq**	**2602481067**	**20983**	**20690**
1968443	**16:42:51 22/01/2010**	**3rxad5z3ccusv**	**3398716340**	**105**	**80**
1968469	16:47:21 22/01/2010	3rxad5z3ccusv	3398716340	90	70
1968485	16:50:19 22/01/2010	3rxad5z3ccusv	3398716340	62	40
1968698	17:40:01 22/01/2010	0ku8f514k3nt0	3398716340	76	50
1968866	18:19:19 22/01/2010	cbmyvpsxzyf5n	3398716340	139	120
1968966	18:34:24 22/01/2010	5jb1sgmjc7436	3398716340	187	170

Temporary Tablespace Usage

```
SELECT /*+leading(r x h) use_nl(h)*/
  h.sql_id
, h.sql_plan_hash_value
, COUNT(DISTINCT sql_exec_id) num_execs
, SUM(10) ash_secs
, 10*COUNT(DISTINCT sample_id) elap_secs
, ROUND(MAX(temp_space_allocated)/1024/1024,0) tempMb
, COUNT(distinct r.prcsinstance) PIs
FROM dba_hist_snapshot x
,    dba_hist_active_sess_history h
,    sysadm.psprcsrqst r
WHERE …
ORDER BY ash_secs DESC
```

Temporary Tablespace Usage

- Can see temporary usage of individual SQL statements

SQL_ID	SQL_PLAN_HASH_VALUE	NUM_EXECS	ASH_SECS	ELAP_SECS	TEMPMB	PIS
a47fb0x1b23jn	483167840	3	6280	910	132	3
cbw2bztjyztnq	544286790	4	5920	390		4
fcrxxp8f0c8cg	2119221636	2	4480	280		2
8h7ga9g761naj	4127129594	1	3980	3980		1
8cypfzadbub4k	4127129594	1	3450	3450		1
3gz46jhw7b5w8	3643021188	8	3190	200		4
a47fb0x1b23jn	3805993318	1	2610	1120	132	1
dxqkbuynbqk09	2119221636	1	2240	140		1
c75jcr5s71s2h	2119221636	1	2240	140		1

Effect of Plan Stability

- Three scenarios

1. Large payroll – collecting stored outlines
2. Small payroll – no outlines
3. Small payroll – with outlines applied

Effect of Plan Stability

```
SELECT /*+ LEADING(@q1 r1@q1 x1@q1 h1@q1) USE_NL(h1@q1)
           LEADING(@q2 r2@q2 x2@q2 h2@q2) USE_NL(h2@q2)
           LEADING(@q3 r3@q3 x3@q3 h3@q3) USE_NL(h3@q3) */
   q1.sql_id
,  q1.sql_plan_hash_value, q1.ash_secs
,  DECODE(q1.sql_plan_hash_value,q2.sql_plan_hash_value,'**SAME**',
             q2.sql_plan_hash_value)   sql_plan_hash_value2,
   q2.ash_secs
,  DECODE(q1.sql_plan_hash_value,q3.sql_plan_hash_value,'**SAME**',
             q3.sql_plan_hash_value)   sql_plan_hash_value3,
   q3.ash_secs
FROM (
   ...
   ) Q1
LEFT OUTER JOIN  (
   ...
   ) Q2 ON q1.sql_id = q2.sql_id
INNER JOIN  (
   ...
   ) Q3 ON q1.sql_id = q3.sql_id
ORDER BY q3.ash_secs desc, q1.sql_id
```

Usual Query in each of three in-line views

Effect of Plan Stability

SQL_ID	SCENARIO 1	ASH_SECS	SCENARIO 2	ASH_SECS	SCENARIO 3	ASH_SECS
4uzmzh74rdrnz	**2514155560**	**280**	**3829487612**	**>28750**	****SAME****	**5023**[1]
4n482cm7r9qyn	**1595742310**	**680**	**869376931**	**140**	****SAME****	**889**[2]
2r66y2u54ru1v	1145975676	630			**SAME**	531
1n2dfvb3jrn2m	1293172177	150			**SAME**	150
652y9682bqqvp	3325291917	30			**SAME**	110
d8gxmqp2zydta	1716202706	10	678016679	10	**SAME**	32
2np47twhd5nga	3496258537	10			**SAME**	27
4ru0618dswz3y	**2621940820**	**10**			**539127764**	**22**[3]
4ru0618dswz3y	539127764	100			**SAME**	22
4ru0618dswz3y	3325291917	10			539127764	22
4ru0618dswz3y	1403673054	110			539127764	22
gnnu2hfkjm2yd	1559321680	80			**SAME**	19

1. Better with outline, but not great, but it did run
2. A little worse
3. 4 execution plans, now just 1, probably better.

How Many Transactions

```
SELECT /*+leading(r h) use_nl(h)*/ h.xid
,      h.sql_plan_hash_value
,      (NVL(r.enddttm,SYSDATE)-r.begindttm)*86400 exec_secs
,      sum(1) ash_secs
,      MIN(sample_Time) first_sample_time
,      MAX(sample_Time) last_sample_time
FROM   gv$active_session_history h
,      sysadm.psprcsrqst r
WHERE h.sample_time BETWEEN r.begindttm AND
   NVL(r.enddttm,SYSDATE)
AND    h.module  like r.prcsname
AND    h.action LIKE 'PI='||r.prcsinstance||'%'
AND    r.prcsinstance = 10026580
AND    h.sql_id = 'dungu07axr0z5'
GROUP BY r.prcsinstance, r.prcsname, r.begindttm, r.enddttm
, h.sql_id, h.sql_plan_hash_value, h.xid
ORDER BY last_sample_time, ash_secs desc
/
```

How Many Transactions?

- 3 transactions + 1, so at least 4 executions

XID	SQL_PLAN HASH_VALUE	EXEC SECS	ASH SECS	FIRST_SAMPLE_TIME	LAST_SAMPLE_TIME
00080026000185A7	461068291	4774	943	23-APR-14 11.13.50.548	23-APR-14 11.29.33.546
000100250001861A	461068291	4774	906	23-APR-14 11.30.16.590	23-APR-14 11.45.22.487
000700280001CC47	461068291	4774	783	23-APR-14 11.46.06.543	23-APR-14 11.59.09.286
	461068291	4774	775	23-APR-14 11.59.51.325	23-APR-14 12.12.46.056

- From 11g can count distinct executions.

When did the Transaction Begin?

SQL_ID	SQL Plan Hash Value	XID	ASH Secs	Exec Secs	First Running
7uj72ad03k13k	3087414546		82	1124	28-APR-14 04.42.48.662 PM
7uj72ad03k13k	3087414546	000A001400044C6D	1	1124	28-APR-14 04.44.11.672 PM
1ng9qkc0zspkh	3423396304		104	1124	28-APR-14 04.44.12.682 PM
1ng9qkc0zspkh	3423396304	0007002D0004116E	5	1124	28-APR-14 04.45.57.971 PM

- Transaction ID only created when first row deleted

When did the Transaction Begin?

```
DELETE /*GPPCANCL_D_ERNDGRP*/ FROM PS_GP_RSLT_ERN_DED
WHERE EMPLID BETWEEN :1 AND :2
AND CAL_RUN_ID= EMPLID IN (
   SELECT EMPLID FROM PS_GP_GRP_LIST_RUN
   WHERE RUN_CNTL_ID=:4 AND OPRID=:5)
AND EXISTS (
   SELECT 'X' FROM PS_GP_PYE_RCLC_WRK RW
   WHERE RW.CAL_ID = PS_GP_RSLT_ERN_DED.CAL_ID
   AND RW.CAL_RUN_ID = PS_GP_RSLT_ERN_DED.CAL_RUN_ID
   AND RW.GP_PAYGROUP = PS_GP_RSLT_ERN_DED.GP_PAYGROUP
   AND RW.EMPLID BETWEEN :6 AND :7
   AND RW.CAL_RUN_ID = :8
   AND RW.EMPLID = PS_GP_RSLT_ERN_DED.EMPLID
   AND RW.EMPL_RCD = PS_GP_RSLT_ERN_DED.EMPL_RCD)
```

- Depending on data, it could be a while before this statement found something to delete.

How Many Executions (from 11g)

```
SELECT /*+LEADING(x h) USE_NL(h)*/ h.program
,       h.sql_id, h.sql_plan_hash_value
,       SUM(10) ash_secs
,       COUNT(DISTINCT h.sql_exec_id) execs
,       COUNT(DISTINCT xid) XIDs
FROM    DBA_HIST_SNAPSHOT x
,       DBA_HIST_ACTIVE_SESS_HISTORY h
WHERE   X.END_INTERVAL_TIME   >= …
AND     x.begin_interval_time <= …
AND     h.sample_TIME >= …
AND     h.sample_time <= …
AND     h.SNAP_id = X.SNAP_id
AND     h.dbid = x.dbid
AND     h.instance_number = x.instance_number
GROUP BY h.program, h.sql_id, h.sql_plan_hash_value
ORDER BY ash_secs desc
/
```

How Many Executions?

PROGRAM	SQL_ID	SQL Plan Hash Value	ASH Secs	EXECS	XIDS	USERS
t_async.exe	7q90ra0vmd9xx	2723153562	3020	297	0	20
t_async.exe	6mw25bgbh1stj	1229059401	320	32	0	17

…

- Samples ≈ Executions
  - Based on DBA_HIST_ACTIVE_SESS_HISTORY
  - 1 sample / 10 seconds.
  - Each sample is worth 10 seconds.
  - Probably underestimates number of executions.

How Many Executions?

- Samples ≈ Executions
  - ASH says there were at least 297 executions of first statement.
  - Likely were more executions that ASH data suggests.
  - Would need session trace to get accurate number.

SQL ID	Seconds	Samples	Executions
7q90ra0vmd9xx	**3020**	**302**	**297**
6mw25bgbh1stj	**320**	**32**	**32**

SQL_ID –v- TOP_LEVEL_SQL_ID

```
SELECT /*+leading(r q x h) use_nl(h)*/  ...
, h.sql_id
, NULLIF(h.top_level_sql_id, h.sql_id) top_level_sql_id
...
FROM dba_hist_snapshot x
, dba_hist_active_sess_history h
...
```

SQL_ID –v- TOP_LEVEL_SQL_ID

TOP_LEVEL_SQL	SQL_ID	Hash Value	SQL_IDS	PLAN_EXECS	PLAN_ASH_SECS
		0	0	0	210
	6np8qdbrmj8s4	2609910643	8	12	160
105xa4pfkv2jz	1dtnz2z7ujv23	3901024798	2	14	140
	3m3ubmf7529mh	2188542943	2	13	140
	g21xv51r09w4j	2905535923	1	10	100

Things That Can Go Wrong

- DISPLAY_AWR
  - Correct plan, old costs & binds
  - ORA-6502 – very large SQL
  - ORA-44002 – short-lived objects(?)
  - ORA-1422 – duplicate SQL from cloning
- Statement not in Library Cache
  - Only Some Statements in Library Cache
- Lots of short-lived non-shareable SQL

Statement not in Library Cache

```
SELECT * FROM
  table(dbms_xplan.display_cursor('gpdwr389mg61h'
  ,0,'ADVANCED'));

PLAN_TABLE_OUTPUT
  ------------------------------------------------
  SQL_ID: gpdwr389mg61h, child number: 0 cannot
  be found
```

Some Statements in AWR Repository

SQL Plan RANKING	SQL_ID	Hash Value	TOT_ASH_SECS	TOT_AWR_SECS	SQL_IDS
1	1wfhpn9k2x3hq	0	7960	4600	13
1	2wsan9j1pk3j2	1061502179	4230	4230	1
1	bnxddum0rryyh	918066299	2640	1200	179
1	**02cymzmyt4mdh**	**508527075**	**2070**	**0**	**45**
1	5m0xbf7vn8490	2783301143	1700	0	49
1	0jfp0g054cb3n	4135405048	1500	0	47
1	11bygm2nyqh0s	3700906241	1370	0	27
1	6qg99cfg26kwb	3058602782	1300	1300	1

- 207 samples, representing 2070 seconds of SQL
- 45 distinct SQL_IDs, we don't know how many executions
  - probably one per SQL_ID, but I don't know that until 11g.
- Often associated with non-shareable SQL

Lots of Short-lived SQL Statements

PRCSINSTANCE	NUM_SQL_ID	SQL_PLAN HASH_VALUE	EXEC_SECS	ASH_SECS
50007687	**169**	**953836181**	**3170**	**1690**
50007687	**50**	**807301148**	**3170**	**500**
50007687	**22**	**4034059499**	**3170**	**220**
50007687	**14**	**2504475139**	**3170**	**140**
50007687	2	0	3170	70
50007687	1	1309703960	3170	20
50007687	**1**	**3230852326**	**3170**	**10**

…

169 SQLs

1690 Secs

- Probably more than 169 statements that took about 1690 seconds, but we only sampled 169.

Lots of Compiles

Batch Timings - Summary

Process

Instance:	50007687	**Type:**	Application Engine
Name:	AR_CNDMON	**Description:**	Receivables Condition Monitor

Time (in milliseconds)

Elapsed:	3164410
In PeopleCode:	90500
In SQL:	2940090

Trace Level

Application Engine:	1159
SQL & PeopleCode:	128

Customize | Find | View 100 | First 1-50 of 477 Last

Program	Detail line identifer	Compile Count	Compile Time	Execute Count	Execute Time	Fetch Count	Fetch Time	PC Count	PC Time
AR_CNDMON	CHK_USER.INSPRCS2.S	64224	30960	64224	2566340	0	0	0	0
AR_CNDMON	CHK_USER.LDSQL.S	64224	6230	64224	230220	64224	0	0	0
AR_CNDMON	CANCLACT.CANSLST3.S	1	0	1	18010	0	0	0	0

ORA-06502

- This seems to be associated with very large SQL statements

```
SQL_ID 9vnan5kqsh1aq
--------------------
An uncaught error happened in prepare_sql_statement :
   ORA-06502: PL/SQL: numeric or value error
Plan hash value: 2262951047
-------------------------------------------------------------------------------------------------------
| Id  | Operation                                | Name              | Rows  | Bytes | Cost (%CPU)| Time     |
-------------------------------------------------------------------------------------------------------
|   0 | SELECT STATEMENT                         |                   |       |       |     1 (100)|          |
|   1 |  HASH GROUP BY                           |                   |     1 |   164 |     1 (100)| 00:00:01 |
…
```

ORA-44002

- I have seen this with Global Temporary Tables and with direct path mode (the APPEND hint).

```
PLAN_TABLE_OUTPUT
--------------------------------------------------
ERROR: cannot get definition for table 'BZTNCMUX31XP5'
ORA-44002: invalid object name
```

ORA-01422

- This happens on a database that has been cloned, often from production to test.

```
An uncaught error happened in
  prepare_sql_statement : ORA-01422:
  exact fetch returns more than requested
  number of rows
```

ORA-01422

- Workaround

```
DELETE FROM sys.wrh$_sqltext t1
WHERE t1.dbid != (
   SELECT d.dbid FROM v$database d)
AND EXISTS(
 SELECT 'x'
 FROM sys.wrh$_sqltext t2
 WHERE t2.dbid = (
   SELECT d.dbid FROM v$database d)
 AND t2.sql_id = t1.sql_id)
```

Conclusion

- ASH data
  - Recent: *V$ACTIVE_SESSION_HISTORY*
  - History: *DBA_HIST_ACTIVE_SESS_HISTORY*
- Application Instrumentation is essential
- Lots of ways to query the data
  - Be imaginative!
- Understand the pitfalls.

Questions?

Conclusion

- ASH data
  - Consider longer term retention in central repository
- Application Instrumentation is essential
- Lots of ways to query the data
  - Be imaginative!
- Understand the pitfalls.