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AWR Warehouse

Helping DBAs Make Sure History Never Repeats Itself

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Safe Harbor Statement

The following 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.

Agenda

1. AWR Overview
2. Introducing AWR Warehouse
3. Deployment
4. AWR Warehouse Use Cases
5. Customer Case Study: eBay

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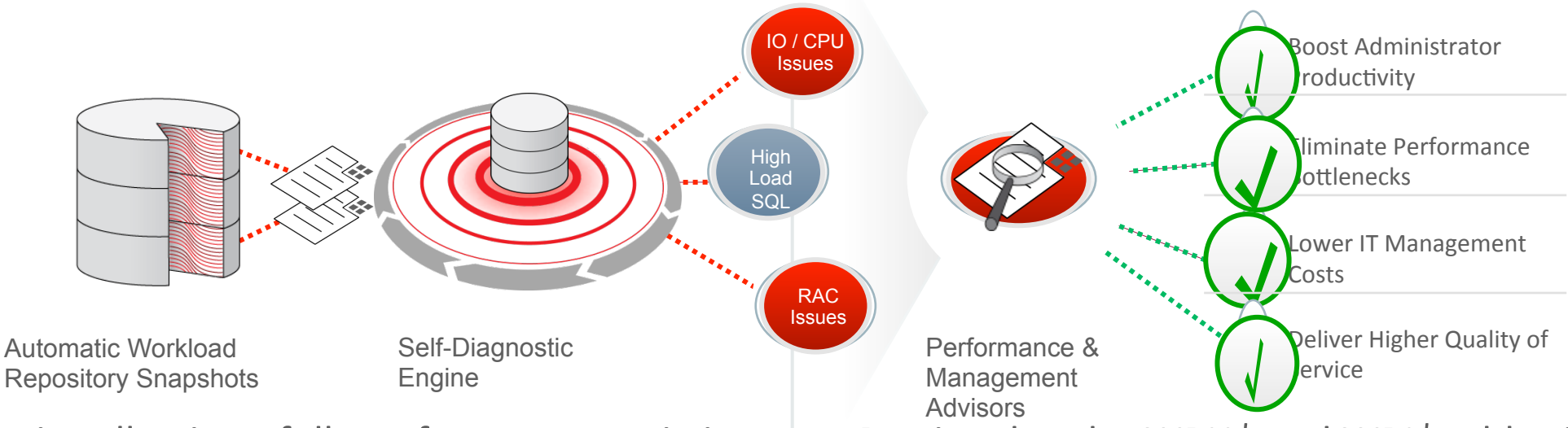
Evolution of Performance Tuning Methodology

- Pre-10g Releases
  - V6: BSTAT & ESTAT & SQL Trace
  - V7.3: Wait events instrumentation
  - V8.1 – 9.1: STATSPACK
- Oracle 10g+:
  - Enhanced Time-Wait Model
  - Database Time (DB Time) Based Methodology
  - New always-on performance warehouse: Automatic Workload Repository

Automatic Workload Repository (AWR)



- Automatic collection of db performance statistics by MMON background process
- AWR snapshots: Data collected by MMON slaves every hour on the hour from memory
  - Configurable collection frequency
  - Manual snapshot creation
  - AWR baselines: named snapshots to capture representative workload (not affected by retention period)
- Persisted under WRH$ and WRI$ tables in the SYSAUX tablespace
- By default, enabled, collected hourly and retained for 8 days*
- Contents accessible via DBA_HIST_* views
- Volume of data controlled by STATISTICS_LEVEL

* 7 days for 10g databases

AWR Data

- AWR Statistics
  - Counter statistics e.g. session logical reads
  - Value statistics, e.g. logons current
  - Time Statistics, e.g. DB time
  - Metrics, e.g. DB Block Gets Per Txn
  - Sampled, e.g. Active Session History
- Operating System (OS) statistics
  - CPU usage (including CPU count)
  - Memory usage (including paging)
  - Viewable via V$OSSTAT and DBA_HIST_OSSTAT
- Wait Classes & Events
  - Events: Sessions waiting for external events: resources (latches), services (IO), user (idle)
  - Classes: Logical grouping of events (CPU, concurrency, application, commit)
- Active Session History (ASH)
  - samples of current state of every active (in database call) session every second
  - AWR snapshots capture sample of ASH data from last hour
- Top SQL
  - By various criteria: Elapsed Time, CPU Time, Parse Calls, Shared Memory, and Version Count
  - Additional related meta data: SQL Text, SQL Statistics, SQL Plans, Bind Types, Bind Values, Optimizer Environment

Performance Diagnostics

- AWR-based performance advisors
  - Automatic Database Diagnostics Monitor (ADDM): DB Time based advisor to pinpoint root cause of performance bottlenecks
  - Auto SQL Tuning & SQL Tuning Advisor: high load SQL identification and automatic tuning
- AWR-based out-of-the-box reports
  - AWR report: all statistics over a snapshot range
  - Compare Period AWR: Comparison of two snapshot periods to compare difference in performance using DB time as basis
  - ASH report: Detailed analysis of ASH data along session, SQL, time dimensions.
- Manual analysis of various dimensions of performance
  - System → V$SYSTAT
  - Session → V$SESSTAT
  - Service → Designated in TNS connection
  - SQL Statement → V$SQLSTATS
  - Segment → V$SEGSTAT
  - Module-Action → Instrumented in application
  - Client ID → True end user provided by mid-tier

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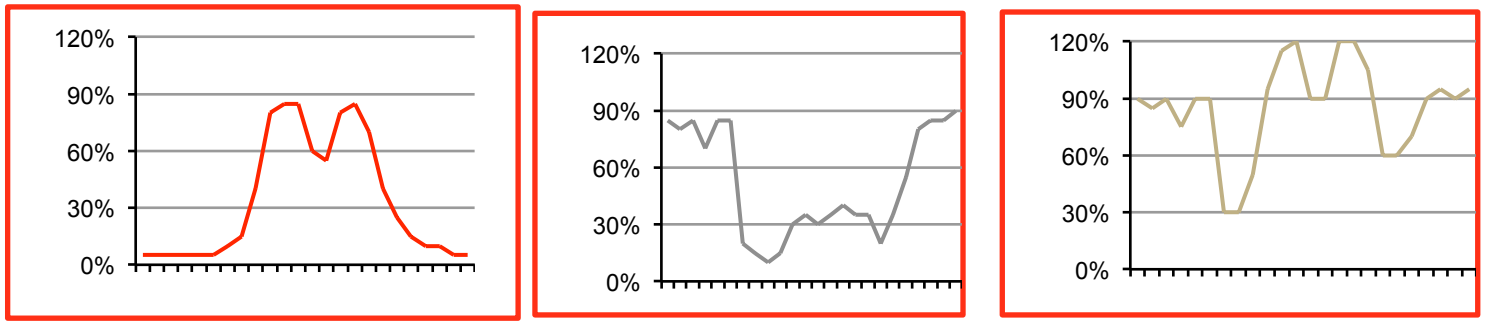
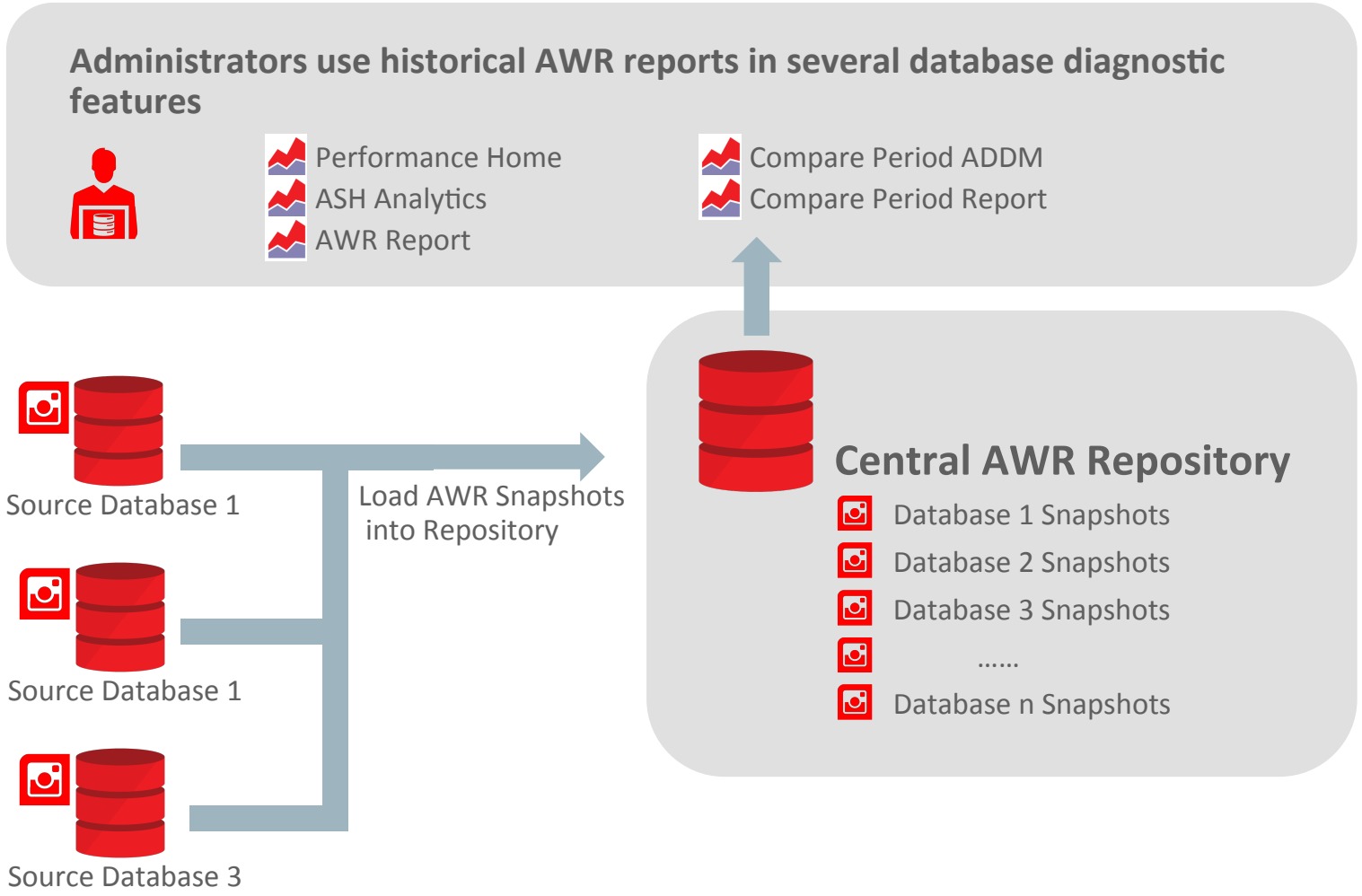
AWR Warehouse - Business Drivers



- Automatic Workload Repository (AWR) is the standard for performance diagnostics for Oracle databases since 10g
- Default retention period of 8 days prevents diagnosis of long term performance problems ("Compare performance during this quarter's books close with last quarter's")
- Increasing AWR retention period increases overhead and cost in critical production environments

AWR Warehouse – Features



- Central warehouse configured for long term AWR data retention
- Historical and ongoing AWR snapshots collected from databases enabled for AWR warehouse
- ETL jobs moves snapshots from source databases into AWR warehouse
- Retention period configurable for weeks, months, years or forever (default)

AWR Snapshot ETL

Enterprise Manager

Job in EM Job Service that pulls file from Source Target and then pushes to AWR Warehouse Target Directory

DBMS Job on Source Database to directory

AWR snapshot export

AWR snapshot export

AWR snapshot export

Source Target

AWR Warehouse

Final DBMS Job Inserts data into AWR Warehouse.

Extract and Transfer

Extract by Source Database

- DBMS Scheduler Job Name: MGMT_CAW_EXTRACT
- Frequency
  - 3 hour Interval (for initial setup)
  - 24 hour interval (ongoing)
- Stop extracts if problems encountered, e.g. file system full

Transfer by EM Agent

- Runs 12hr intervals from time source target is added to AWR Warehouse
- Agent to Agent Direct Push
- Cleans up after successful transfer
- Re-attempts transfers 3 times upon failures and then stops

AWR Warehouse Schema Objects

- CAW_SPACE_USAGE: Populates resource consumption dashboard for AWR.
- CAW_PROPERTIES : Information about location of dump files, interval, retention time, etc. for AWR Warehouse.
- CAW_PRIV_GRANTS : View privileges within the EM Console
- CAW_LOAD_WORKERS : Only used during an actual ETL load process to the AWR Warehouse.
- CAW_SRC_DBS : Main info about source db's, version, ETL status, etc.
- CAW_SRC_DB_INSTANCES: Instance information about source databases.
- CAW_LOAD_METADATA : AWR dump file local, last load, etc.
- CAW_LOAD_ERRORS : Populates the errors view in the console.
- CAW_DBID_MAPPING : Used to map all data between Enterprise Manager, AWR Warehouse and Database Identifiers.

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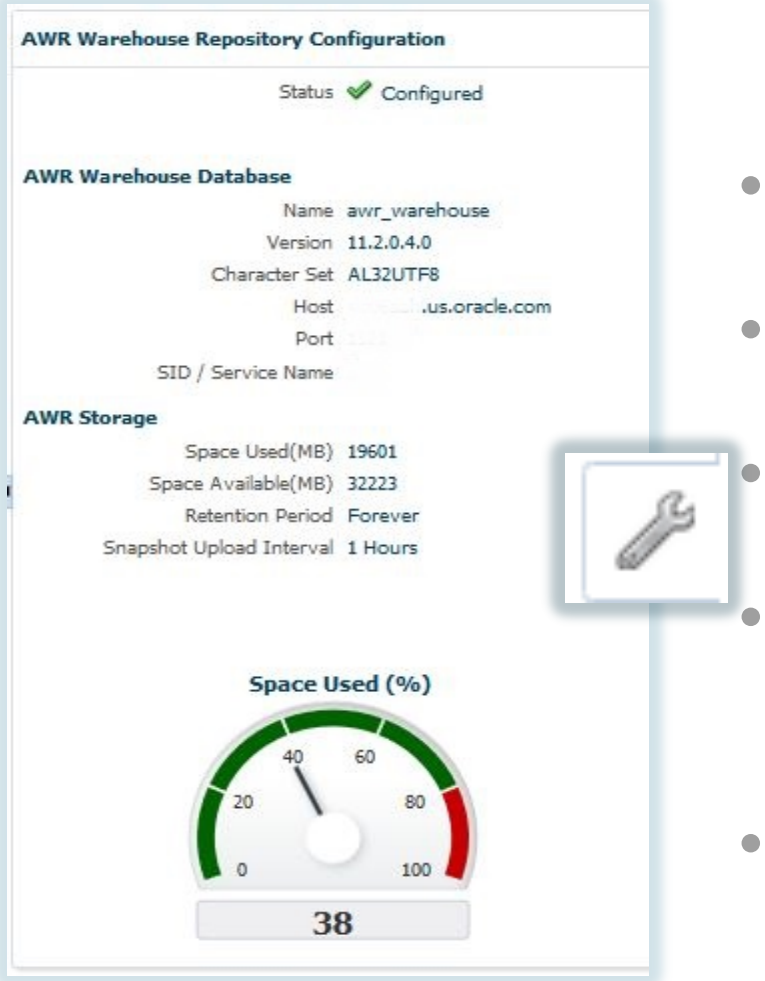
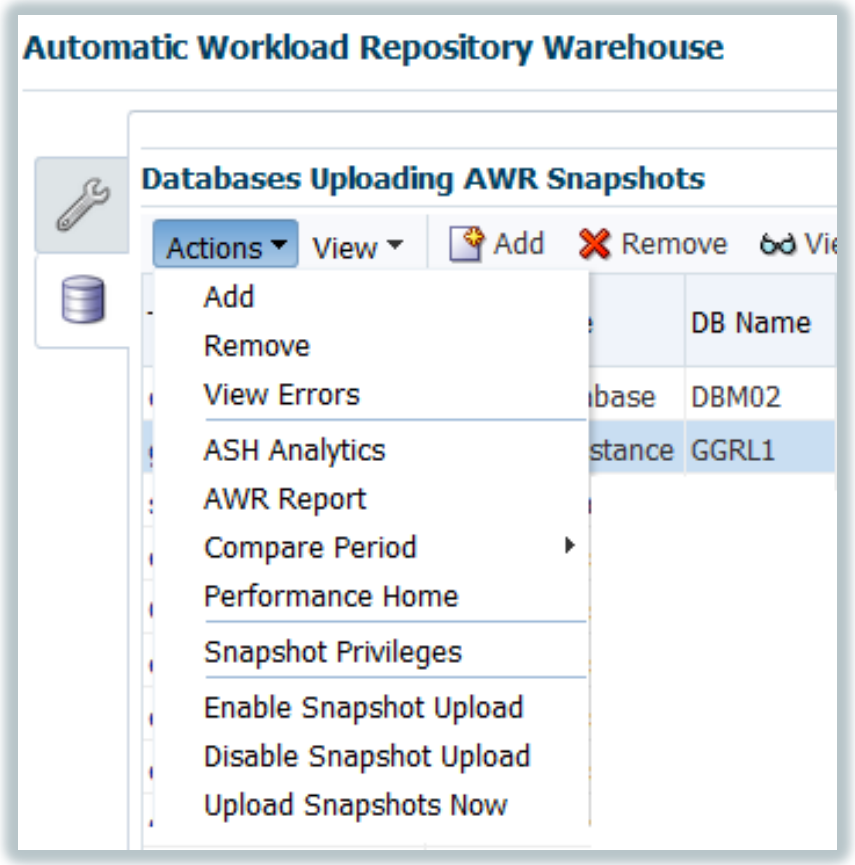
Configuring AWR Warehouse



- Supported DB versions:12.1.0.2 & 11.2.0.4 (+patch)
- DB Credentials: SYS
- Storage: SYSAUX tablespace
- Default retention period: Forever (can be set to weeks, months or years)
- Track overall space utilization

Configuring AWR collection into AWR Warehouse



- Pre-configure database (DBA privileges) and host (save snapshots) credentials for source databases
- Add source database via **Actions** menu (v10.2 & above supported)
- Define snapshot collect interval (24 hr default)
- **Upload** snapshots via immediate run of ETL job on any source target in AWR Warehouse.
- **Disable** or **Enable** in the event of problems

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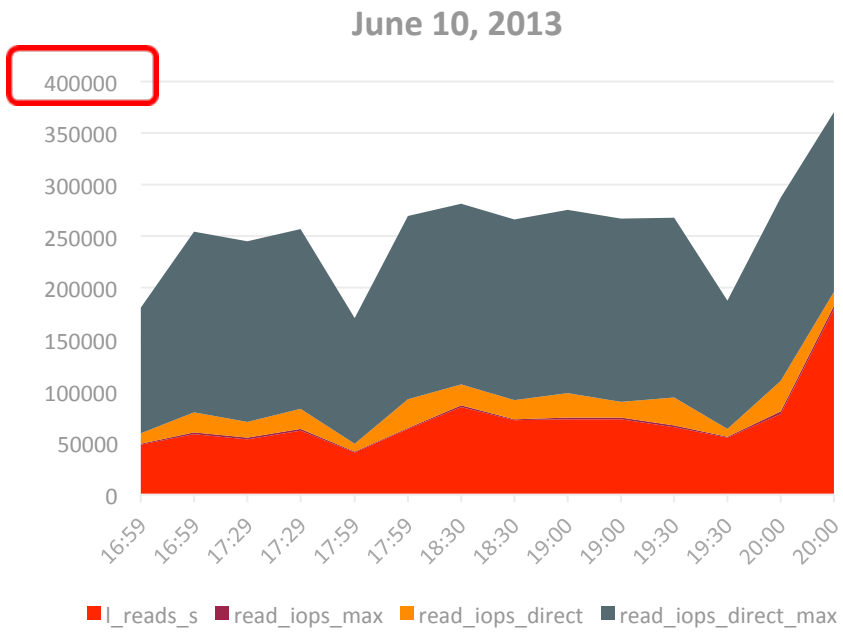
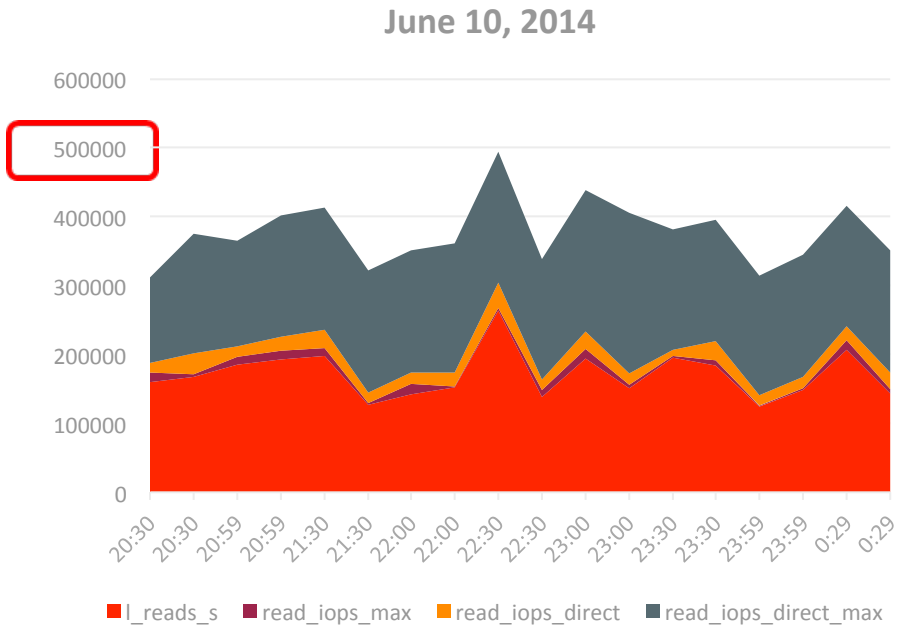
Performance Diagnostics with AWR Warehouse

- All AWR features available on long term AWR data
  - Performance page
  - AWR report
  - ASH analytics
  - Compare Period ADDM
  - Compare Period Report
- Integrated seamlessly into EM UI

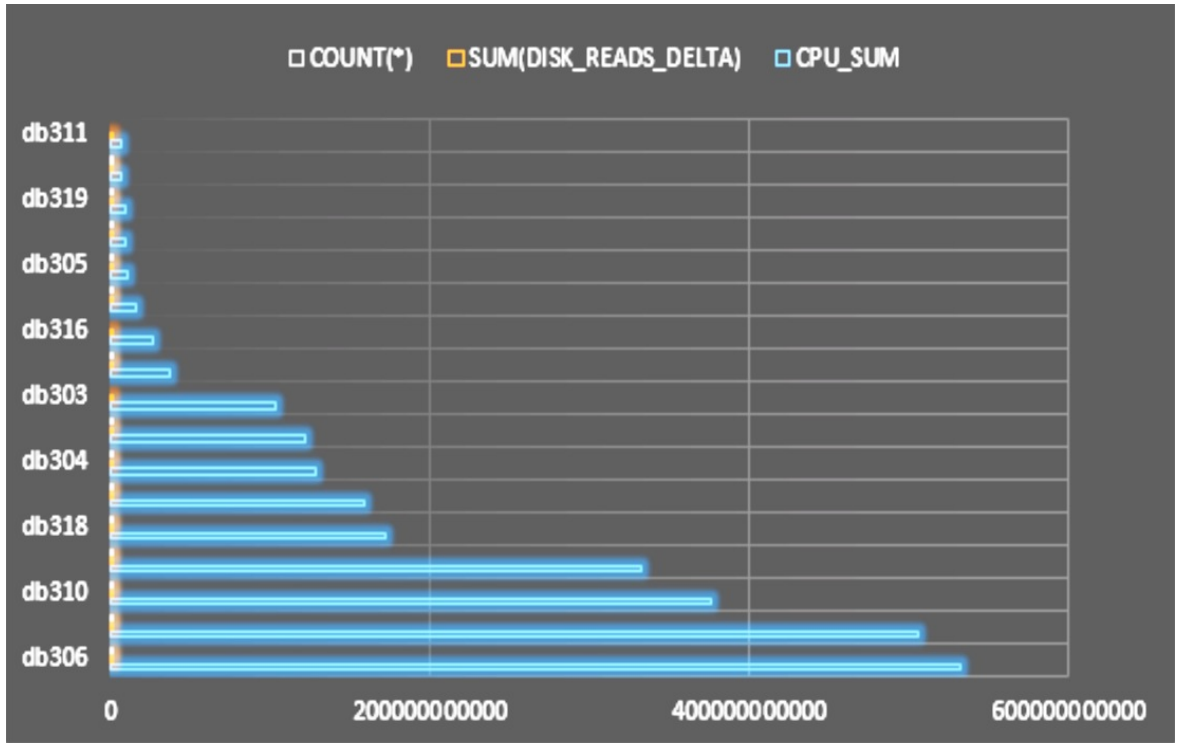
Long Term Comparative Analysis of workload





- How has my I/O workload changed year to year?
  - Changes to overall load
  - Changes to the character of the load (reads vs. writes)

Performance Analysis of DBs on Shared Infrastructure



- Which resource usage shows greatest variations across DBs?
- Which databases on my shared host generates the highest CPU load?
- Should these databases moved into dedicated servers?

How Current AWR Queries Change in the AWR Warehouse

```
from   dba_hist_sys_time_model stm,    dba_hist_snapshot s,  gv$parameter p,   dbsnmp.caw_dbid_mapping m

       where  stm.stat_name in ('DB CPU','background cpu time')

       and    LOWER(m.target_name)= '&dbname'

       and    s.dbid= m.new_dbid     and    s.snap_id = stm.snap_id

       and    s.dbid = stm.dbid          and    s.instance_number = stm.instance_number

       and    p.name = 'cpu_count'   and    p.inst_id = s.instance_number)
```

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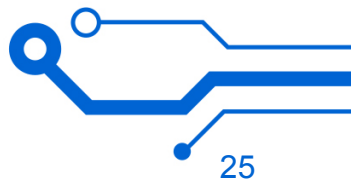
About ebay inc and me (Samrat Roy)

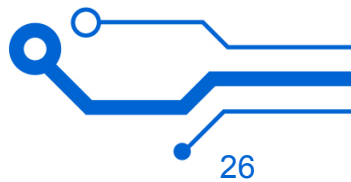
ebay inc is a global commerce platform and payments leader

- Senior Engineer in ebay inc's Database Engineering team
- Working with Oracle Database for more than 10 years
- Helped create and maintain the Custom AWR/DB metadata database



Production Environment

- Mostly 11g RAC, ASM and Exadata
- One of the busiest OLTP database
- 500+ database instances, from 10 – 130 TB each
- 5-10K processes per instance
- Execs 100K/sec, Redo 5-10MB/sec
- Growing workload 40% year-on-year
- EM 12c monitors 100+ db targets including 5 critical databases running payment system, user data applications



Business and DBA Requirement for custom AWR Warehouse

Business Problem:

- Find and fix database performance degradation proactively and post upgrade
- Proactively add capacity (storage/compute) in a timely planned manner
- Compare application schemas between stage and production

which when translated to DBA problem statements and solutions :

- Monitor and capture W-o-W, (Week-over-Week) and M-o-M (Month-over-Month) deviation for DB metrics, enabling following reports
  - W-o-W deviation weekly and on-demand
  - SQL profiling for W-o-W deviation in execs, lio, pio, cpu, elapsed time
  - Daily ASH trend for significant wait events and W-o-W comparison
  - Daily W-o-W “Busy-ness” report from Time Model statistics for all databases
- Track storage growth to generate storage TTL (Time to Live), compute add or storage uplift for Primary as well as Standbys
- Follow GoldenGate trail from source to each downstream db
- Schema comparison report between stage and production db
- Compare AWR data pre/post upgrade for new database wholly or partially (moving only few schemas)

Also answer DBA type questions for ongoing operations, for e.g:

- When table A was dropped, renamed or what column was added and when
- Table “busyness” by time of day for scheduling table maintenance across both Production and Active DataGuard Standbys
- Compare Initialization parameter, patch, compute, storage between Current Primary and Switchover Target
- Global Database Metadata: Version, Type, Role, CPU, Memory, Storage (Primary/Standby, etc.)

Track health across all dbs W-o-W

Time Model Stats - WoW

DBNAME	NAME	PMDAY	VALUE(Secs)	% diff	DELTA_DBTIME	DB PCT%
DB_A_LIVE	DB time	09-09-2014 TUESDAY	32182100	-49%	32182100	-48.61%
		09-16-2014 TUESDAY	46089640	43%	46089640	43.22%
		09-23-2014 TUESDAY	55498930	20%	55498930	20.42%
	sql execute elapsed time	09-09-2014 TUESDAY	26196035	-50%	32182100	70.4%
		09-16-2014 TUESDAY	36871712	42%	46089640	81.4%
		09-23-2014 TUESDAY	49219127	31%	55498930	88.68%
DB_B_LIVE	DB time	09-09-2014 TUESDAY	43825650	2%	43825650	2%
		09-16-2014 TUESDAY	44263906	1%	44263906	1%
		09-23-2014 TUESDAY	43821266	-1%	43821266	-1%
	sql execute elapsed time	09-09-2014 TUESDAY	35060520	3%	43825650	80%
		09-16-2014 TUESDAY	35411125	1%	44263906	80%
		09-23-2014 TUESDAY	35410117	-0.1%	43821266	80%

Track top waits and SQL profile across all dbs

DBNAME	EVENT_NAME	time:HH	WAITTIME	WAITPCT
DB_A_LIVE	enq: TX - row lock contention	09-SEP-2014 TUE	5943	23%
		16-SEP-2014 TUE	41771	68%
		23-SEP-2014 TUE	80101	92%
	Streams miscellaneous event	09-SEP-2014 TUE	18358	71%
		16-SEP-2014 TUE	17956	29%

DBNAME	EVENT_NAME	time:HH	WAITTIME	WAITPCT
DB_B_LIVE	db file sequential read	09-SEP-2014 TUE	40	6%
		16-SEP-2014 TUE	32	3%
		23-SEP-2014 TUE	28	5%

SQL Profile Trend report - WoW

DBNAME	DAY	SQL_ID	Ex%	Buf%	Elp%	Cpu%	Phy%	Ex#	Buf#	Phy#	Elp#	Cpu#
DB_A_LIVE	09-09-2014 TUE	dktb2hv6v9d46	.30	3.27	2.39	2.40	3.74	82	1	3	2	2
		fbhuck3ryu014	1.79	2.89	1.92	1.67	1.15	6	2	14	4	7
	09-16-2014 TUE	1kuyk21zwn1ac	9.50	9.01	15.02	9.37	8.00	9	1	1	1	5
		dktb2hv6v9d46	.50	4.10	3.89	3.20	4.54	83	3	3	2	2

Further drill down on sql_id

Turns out SQL is a “SELECT-FOR-UPDATE” causing high enqueue waits impacting overall higher SQL execute elapsed time and higher CPU time

@sqlbyid

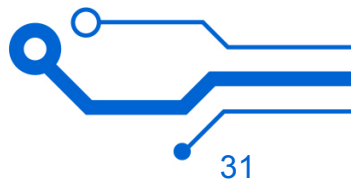
Enter value for sql_id : 1kuyk21zwn1ac

/* sample sql for sql_id 1kuyk21zwn1ac*/SELECT * from A FOR UPDATE;

SNAP_ID	DBNAME	EXECS_DELTA	AVG_BG	AVG_IO	AVG_ROWS
118140	DB_A_LIVE	9256	100.4	.7	7.6

Future

- OEM AWR Warehouse being considered
- May use for performance tracking and integrated dashboard
- Will need to extend the AWR Warehouse for functionality like ADG performance monitoring



AWR Warehouse Resources

- Support Master Note on AWR Warehouse Doc ID: 19074335.1
- Oracle Database 12c Documentation: 2 + Performance Tuning Guide – Chapter 10
- Oracle Learning Library video: Analyze Long-term Performance Across Enterprise Databases Using AWR Warehouse

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