Resource Mapping
A Wait Time Based Methodology for Database Performance Analysis

Prepared for NYOUG, 2005

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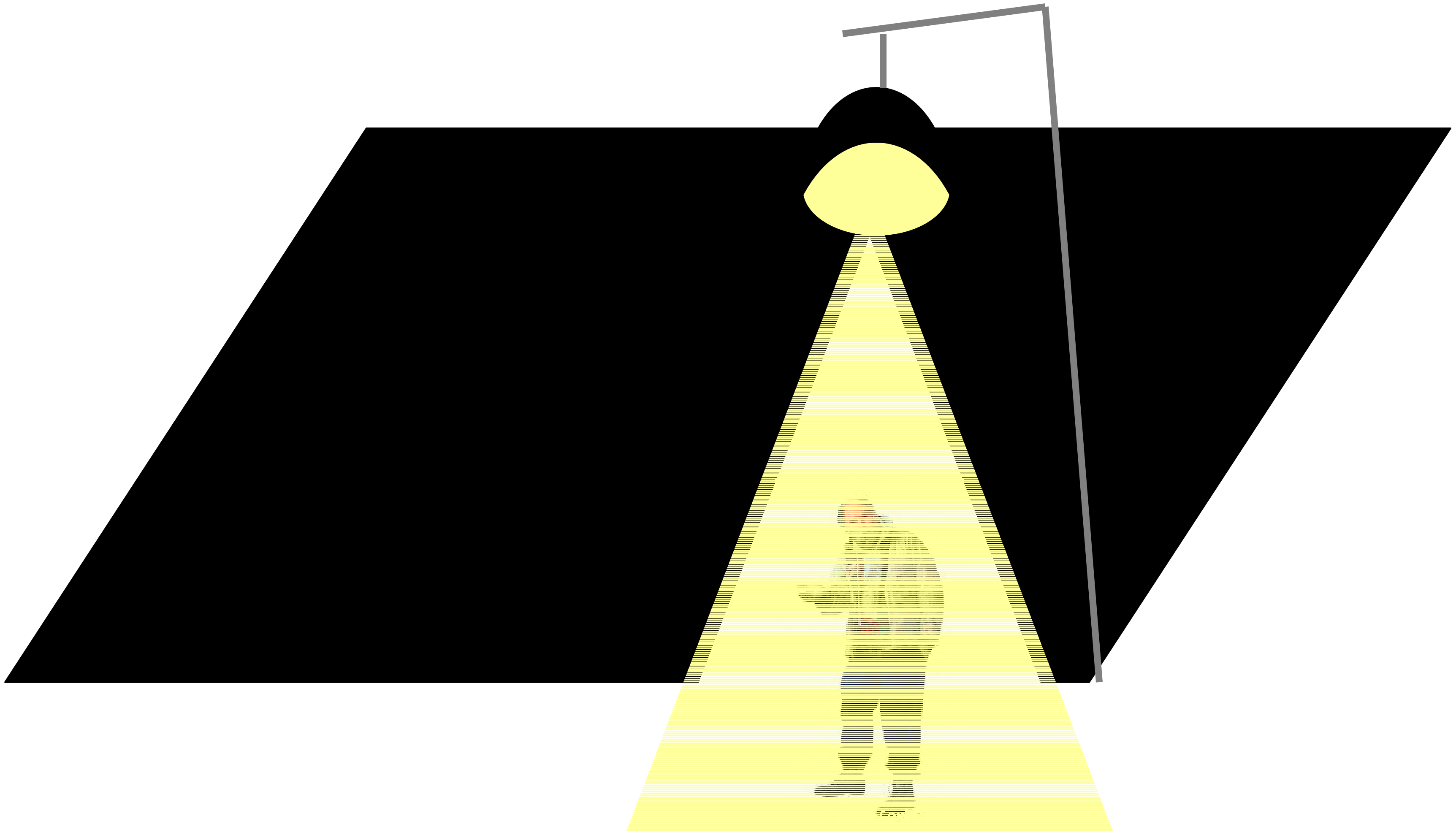
Presentation Agenda

- Introduction
- Conventional Tuning vs. Wait-based Tuning
- Foundation: Resource Mapping Methodology
- 5 Key Steps of Applying RMM

Problems with Conventional Tuning Tools: Like the Drunk Under the Streetlight



You can look where it’s convenient, or look where you will actually find a solution – you choose!

Resource Mapping Methodology

- RMM is...
- A rigorous practice for database tuning using Wait-Event analysis
- A set of requirements defining what you need to know about a database in order to solve the real performance problems
- A tuning approach that focuses on actions yielding most important business impact
- A recipe to Be a Better DBA

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Conventional Tuning

- Art, not a science
- Ratio-based (cache hit ratios, etc.)
- Sometimes fruitless
- It’s “tuned” (I guess?)
- Different tuning/investigation process for each DBA/DBA Team/Company

Problems with Conventional Tuning Tools

- Optimize systems, not business results
- Conventional tools:
  - V$ Views: limited visibility & granularity
  - Statspack: averages across entire database
- Incorrect Data hides real results
  - System-wide averages
  - Event counters
  - Incomplete visibility

What Problems are you Trying to Solve?

- I spend the whole week monitoring and optimizing Oracle configurations, but I have no demonstrable results to show for it - why?
- Will more hardware make my application run faster? By how much?
- Will the new application run efficiently on the production server?
- Why does one application keep impacting my SLA compliance?
- If I could make one (or 2, 3, or 4) changes to my database to have the biggest impact, what would they be?

Working the Wrong Problems

- After spending an agonizing week tuning Oracle buffers to minimize I/O operations, management typically rewards you with:

  - A. An all expense paid vacation
  - B. A free lunch
  - C. A stale donut
  - D. Reward? Nobody even noticed!

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Visibility problem?

- You measure database performance based on:
  - A. Increasing trends in user response time
  - B. Increasing system down time
  - C. Increasing help desk calls
  - D. Increasing decibel levels from irate users

Tuning Success (or lack thereof)

- Your role in the rollout of a new customer facing application results in:
  - A. Keys to drive the CEO’s Porsche
  - B. Keys to use the executive restroom
  - C. A mop to use in the executive restroom
  - D. Your office has been moved to the restroom

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Measuring performance

- You measure the commute time to work based on:

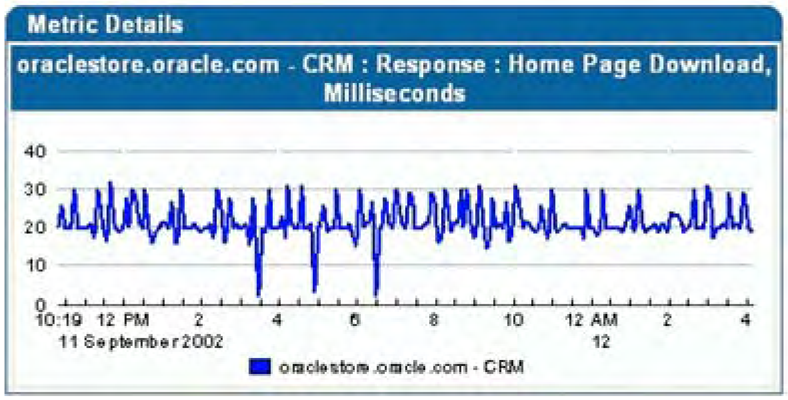
  - A. The time it takes to get there
  - B. Counting the times your wheels rotate
  - C. Monitoring your tachometer
  - D. The number of speeding tickets

Wait-Event Based Performance Analysis

- Emerging best-practice for database tuning
  - "You can't tell how long something took by counting how many times it happened. ... If you're only measuring event counts, then you're not measuring what the users care about."
    — *Cary Millsap, Optimizing Oracle Performance*
- Oracle is starting to build wait-based tuning tools into the database particularly in 10g
- Tune by determining where processing time is spent

Oracle 10g - Moving towards wait-based

- Adding wait-based columns to existing views
- New wait-based views in ASH



Example:
v$session_wait_history

- Provides the last 10 wait events for a session
- Session ID, Username, Event, **Wait_Time**, etc.
- Used to provide wait_time for only a few events

Not all Wait-Event Statistics are Useful

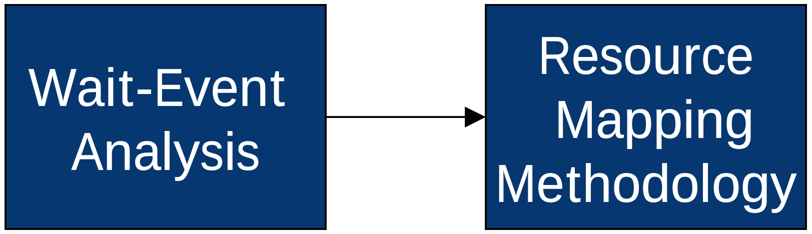
- **Wait Event Analysis is too general**

Example: Sample database-wide statistics (possibly from v$sysstat,v$latch)

db block gets	53023 seconds
physical reads	37734 seconds
shared pool latch	694413 seconds
cache buffers chains latch	3613269 seconds

RMM Defines Practical Requirements for Wait-Event Analysis

Resource Mapping Methodology defines practical requirements to perform Wait-Event Analysis:

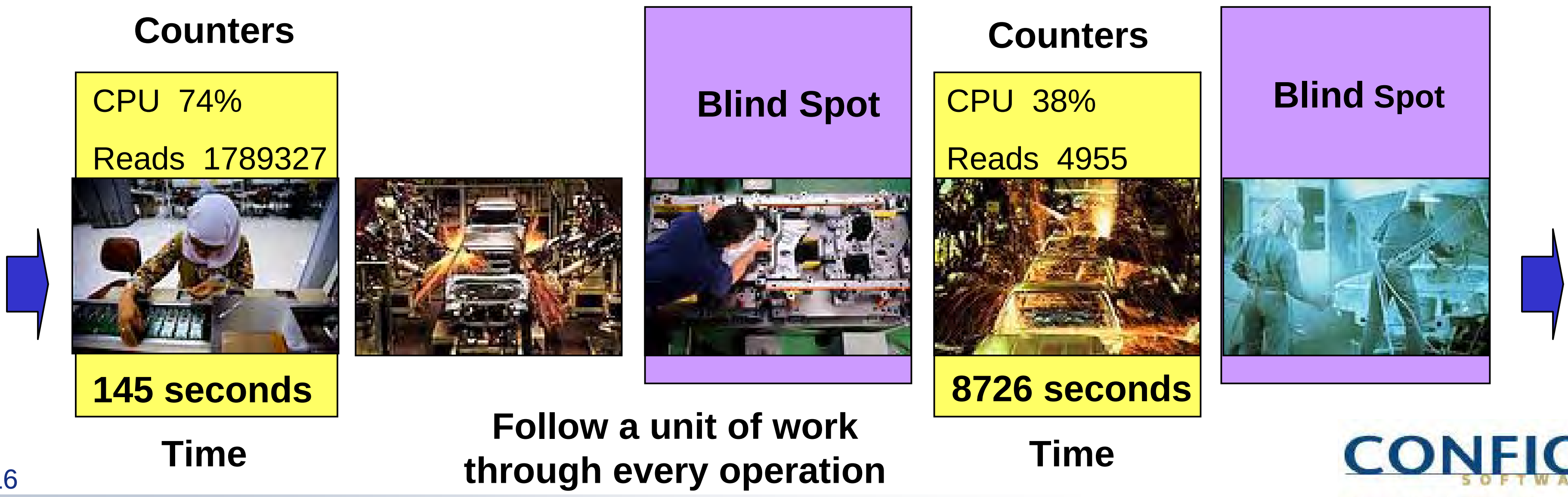


General approach- best practice

Rigorous, complete requirements

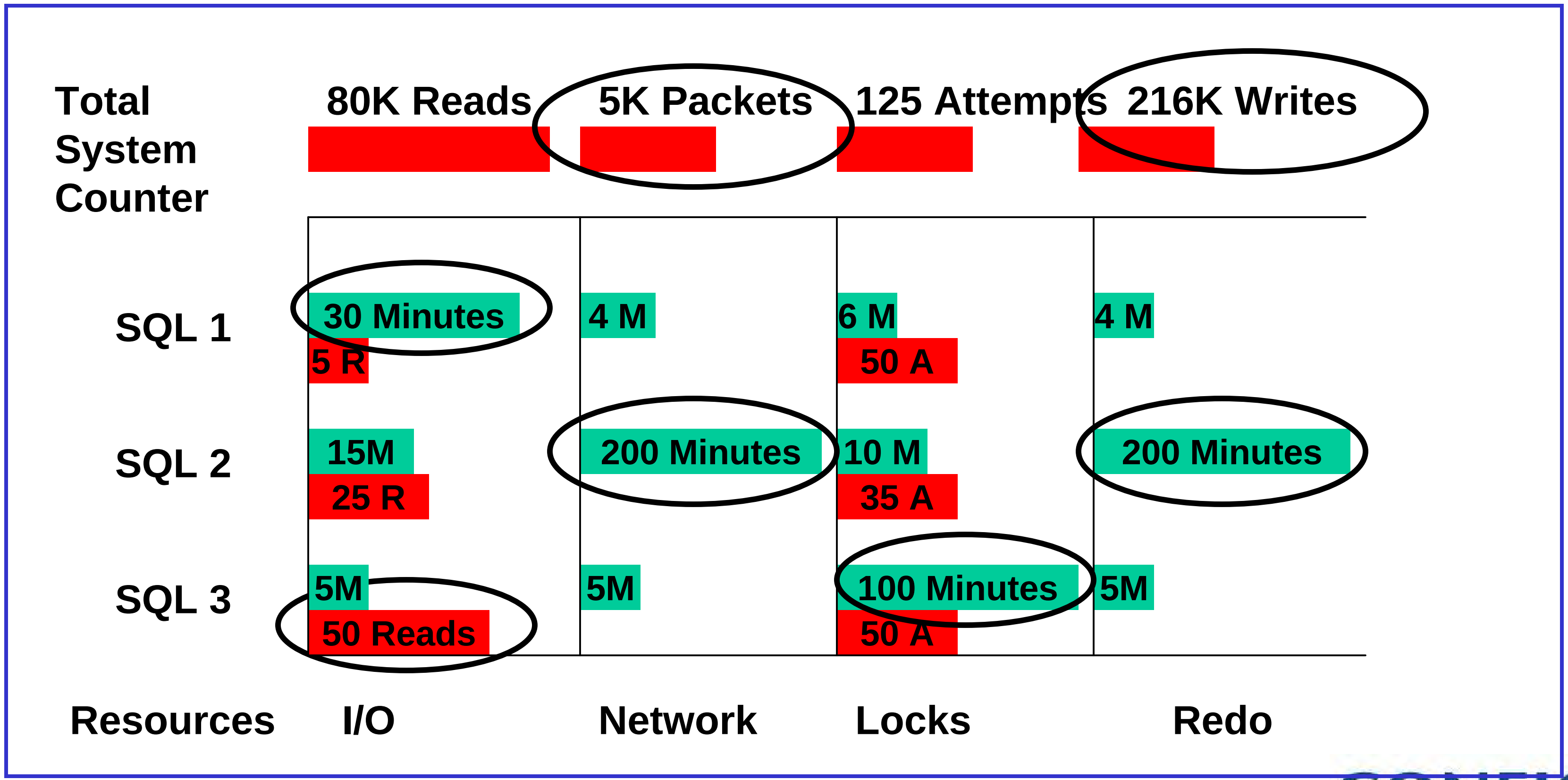
Confio's Resource Mapping Methodology

- Assembly Line: Data In -> Process -> Results Out
- Observe Assembly Line (SQL Statement) at "Unit of Work" Level *(SQL View Principle)*
- Measure time to complete, not number or occurrences *(Time View Principle)*
- Monitor every resource or suffer blind spots *(Full View Principle)*



Track SQL Time, Not System Counters

- Watching Counters leads to wrong conclusions: Time is more relevant
- Total System Counters hide information: Need breakdown to individual SQLs



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RMM-compliant Performance Tool Types

Two Primary Types of Tools

- Session Specific Tools
  - Tools that focus on one session at a time often by tracing the process
  - Examples: Hotsos Profiler, tkprof
- Continuous DB Wide Monitoring Tools
  - Tools that focus on all sessions by sampling Oracle
  - Examples: Confio DBFlash, Veritas Indepth
- Both tools have a place in the organization

Tracing

- Tracing with wait events complies with RMM
- Should be used cautiously in non-batch environments due to session statistics skew
  - 80 out of 100 sessions have no locking contention issues
  - 20 out of 100 have spent 99% of time waiting for locked rows
  - If you trace one of the “80” sessions, it appears as if you have no locking issues (and spend time trying to tune other items that may not be important)
  - If you trace one of the “20” sessions, it appears as if you could fix the locking problems and reduce your wait time by 95+%

Tracing (cont)

- Very precise statistics, may be only way to get certain statistics
- Bind variable information is available
- Different types of tracing available providing detail analysis even deeper than wait events
- Ideal if a known problem is going to occur in the future
- Difficult to see trends over time
- Primary audience is technical user

Continuous DB Wide Monitoring Tools

- Allows DBA to go back in time and retrieve information if problem was not expected
- Not the level of detail provided by tracing
- Most of these tools have trend reports that allow communication with others outside of the group
  - What is starting to perform poorly?
  - What progress have we made while tuning?

Example 1: Problem Observed

- Critical situation: Secure Service Center application performance unsatisfactory
  - Response time between 2400 and 9000 seconds
  - Very high network traffic (3x—4x normal), indicating time-outs and user refreshes
  - “CritSit” declared: major effort to resolve problem

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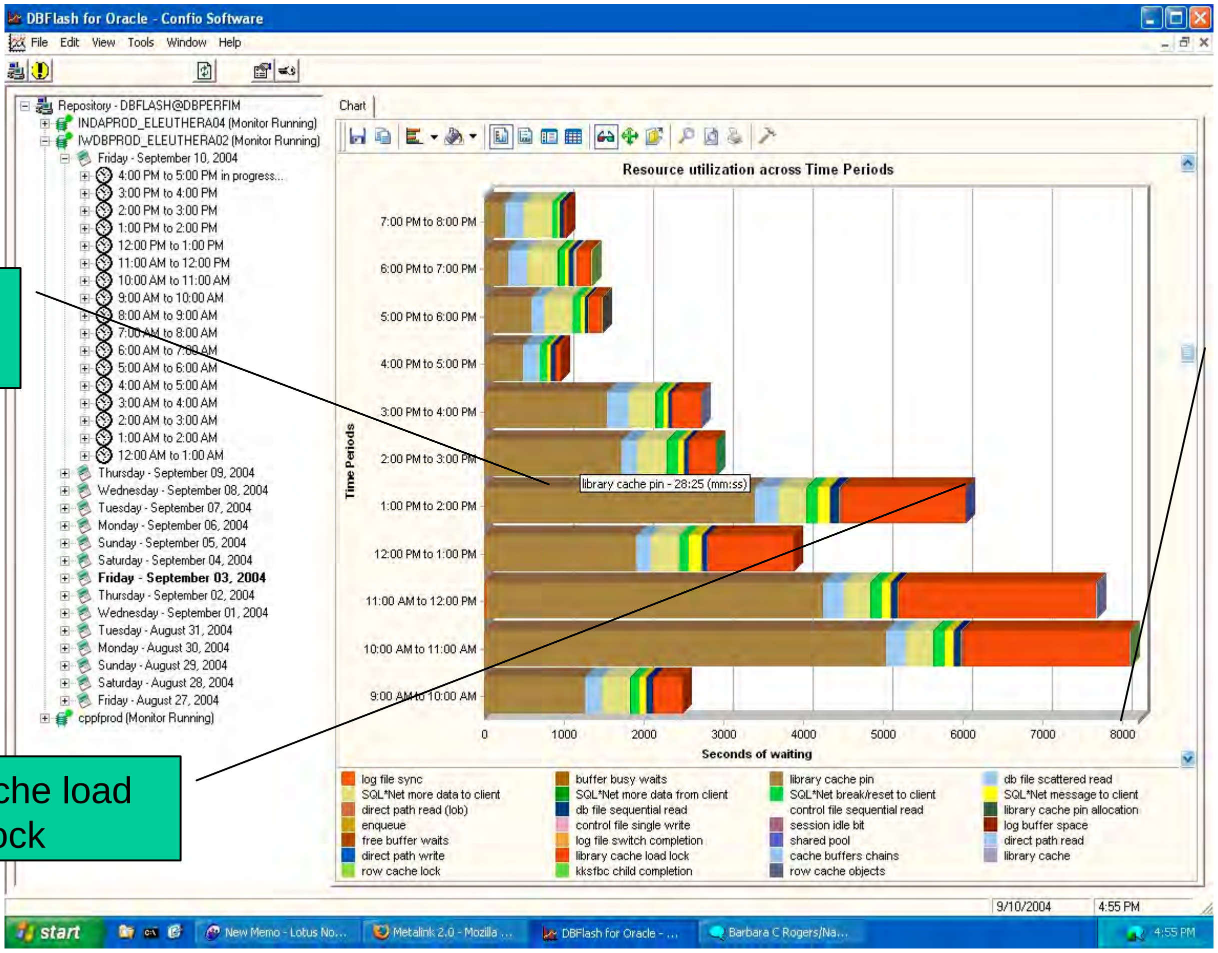
Observations using Resource Mapping Methods

- 1: Identify accumulated Waits
- 2: Identify specific resources used

Lib cache pin wait



Notice scale: > 8000 secs

Lib cache load lock

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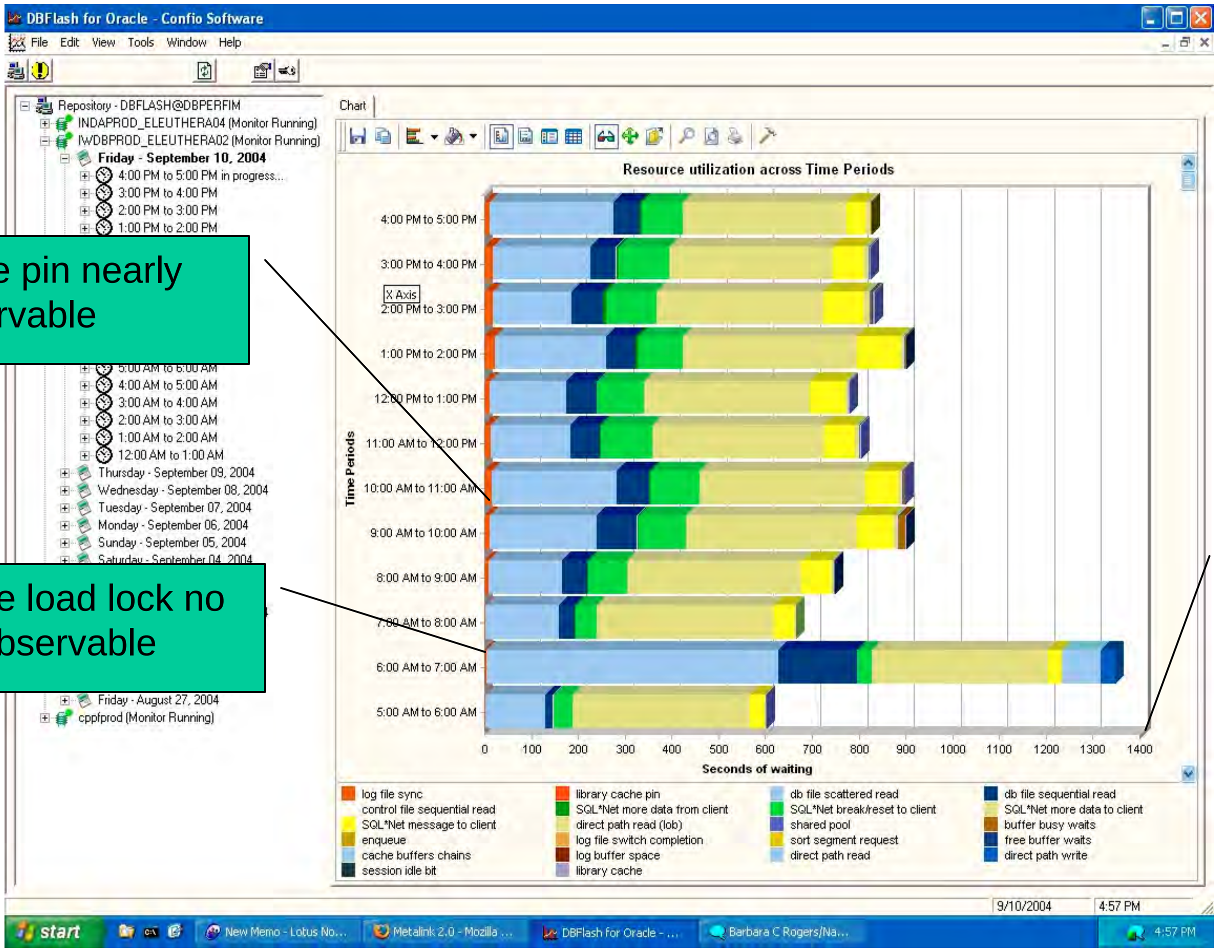
Results



Library cache pin nearly unobservable

Library cache load lock no longer observable

Notice scale: < 1400 secs max vs. 8000 previously

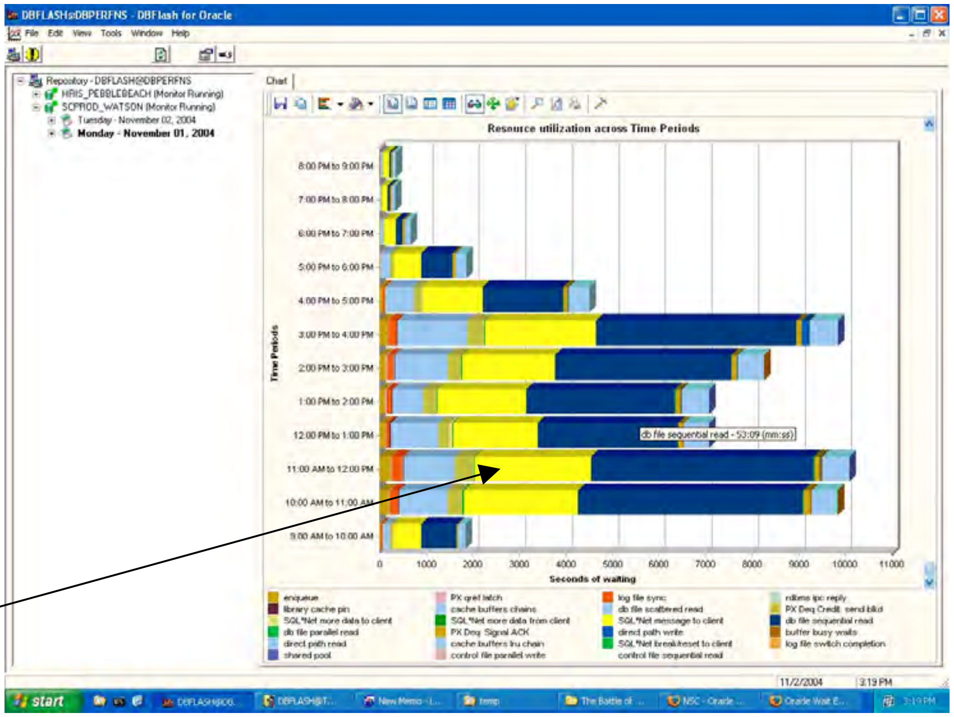
Results

- Response time improvement from 8000 seconds (worst case) to 900 seconds
- *Variance* improvement:
  - *Before:* response time 2400 - 8000 sec
  - *After:* response time 800 - 900 sec

Example 2: Performance Drain – Identify the Source

- Slow response reported
- DBA and database focus of delays
- Database problem?

- No – SQL*Net Message identified as source of delay
- 2nd highest wait event



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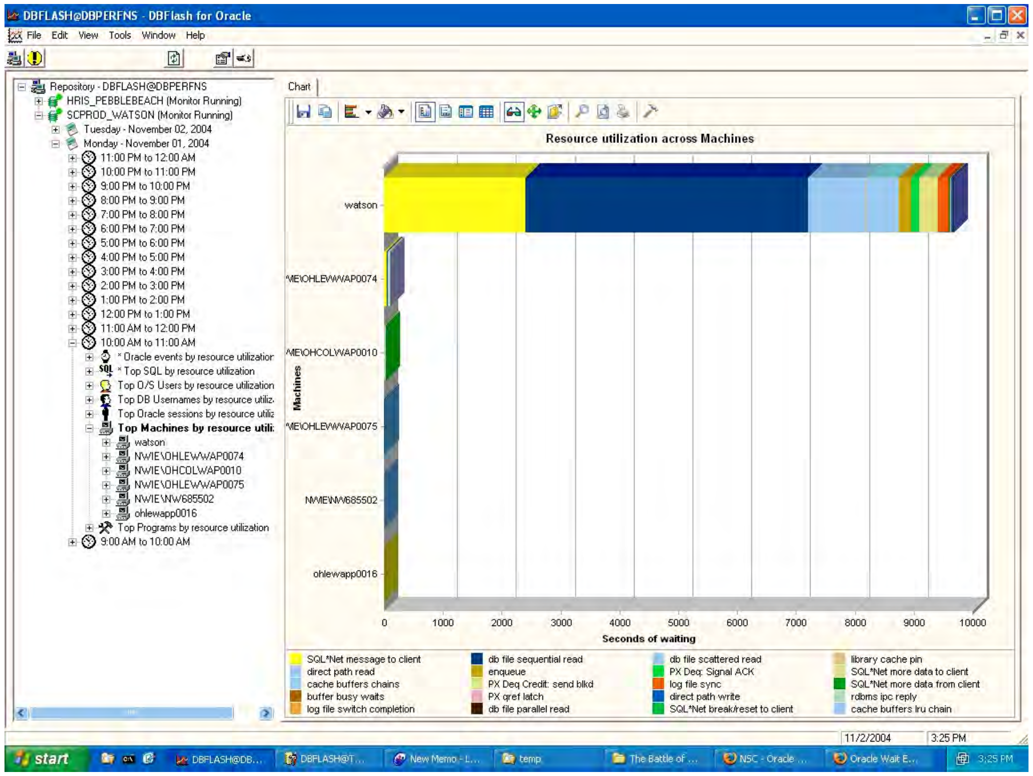
RMM Drill Down identifies source of problem

- Single application generates all SQL*Net Messages
- App on same server as Oracle!

- Answer:
- Misconfiguration – TCP/IP used within server
- Change to IPC, eliminate NIC traffic and 30% of wait time



```
Repository - DBFLASH@DBPERFNS
  HRIS_PEBBLEBEACH (Monitor Running)
  SCPROD_WATSON (Monitor Running)
    Tuesday - November 02, 2004
    Monday - November 01, 2004
      11:00 PM to 12:00 AM
      10:00 PM to 11:00 PM
      9:00 PM to 10:00 PM
      8:00 PM to 9:00 PM
      7:00 PM to 8:00 PM
      6:00 PM to 7:00 PM
      5:00 PM to 6:00 PM
      4:00 PM to 5:00 PM
      3:00 PM to 4:00 PM
      2:00 PM to 3:00 PM
      1:00 PM to 2:00 PM
      12:00 PM to 1:00 PM
      11:00 AM to 12:00 PM
      10:00 AM to 11:00 AM
        * Oracle events by resource utilizatior
        * Top SQL by resource utilization
        Top O/S Users by resource utilization
        Top DB Usernames by resource utiliz
        Top Oracle sessions by resource utiliz
        Top Machines by resource utili:
          watson
          NWIE\OHLEWWAP0074
          NWIE\OHCOLWAP0010
          NWIE\OHLEWWAP0075
          NWIE\NW685502
          ohlewapp0016
        Top Programs by resource utilization
      9:00 AM to 10:00 AM
```

🟨 SQL*Net message to client	🟦 db file sequential read	🟦 db file scattered read	🟫 library cache pin
🟦 direct path read	🟨 enqueue	🟩 PX Deq: Signal ACK	🟨 SQL*Net more data to client
🟦 cache buffers chains	🟨 PX Deq Credit: send blkd	🟧 log file sync	🟩 SQL*Net more data from client
🟫 buffer busy waits	🟥 PX qref latch	🟦 direct path write	🟩 rdbms ipc reply
🟧 log file switch completion	🟫 db file parallel read	🟩 SQL*Net break/reset to client	🟦 cache buffers lru chain

Solution requires knowing: Which SQL, What Wait Time, Which Resource

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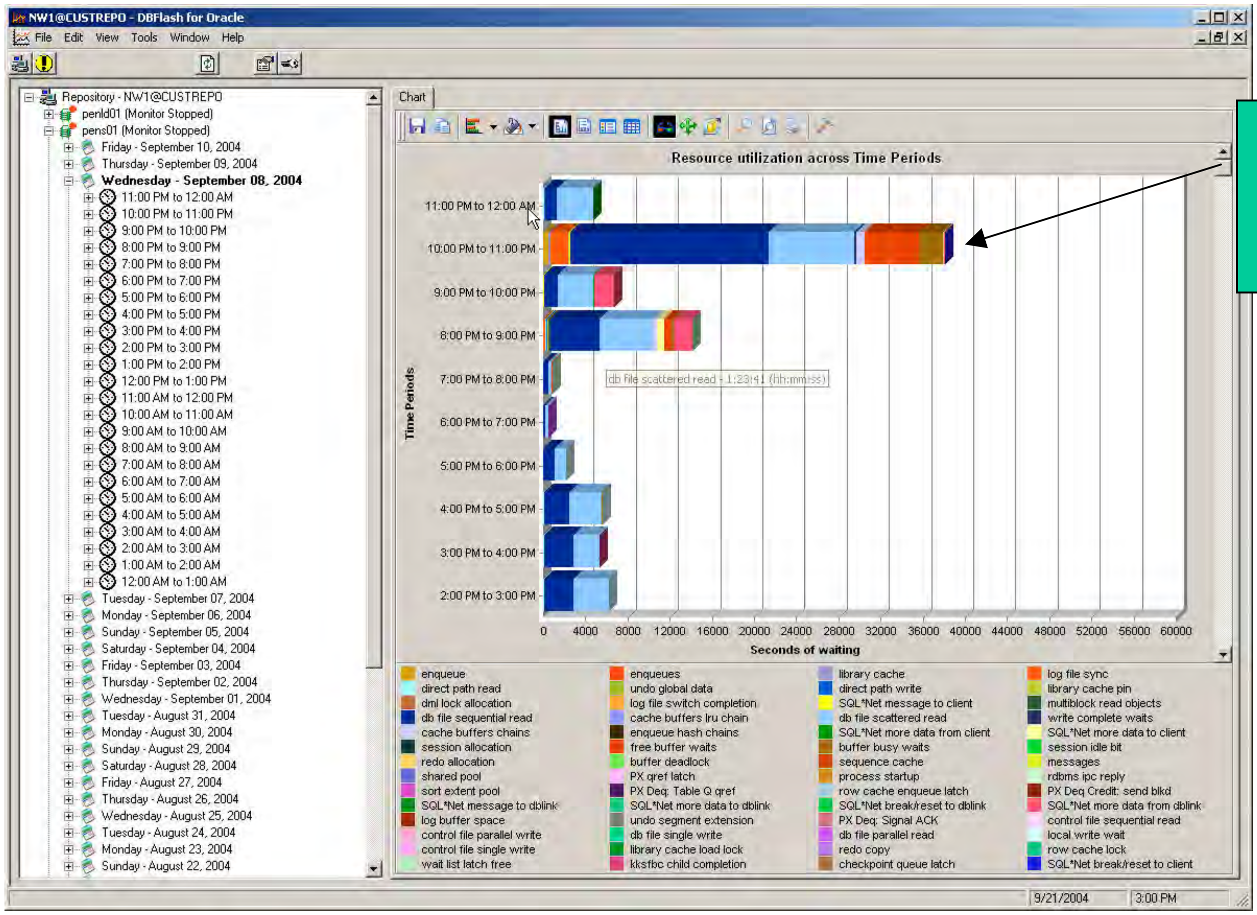
Example 3: Scattered Reads

- Situation: LINS06 database - Hourly profile identifies high wait anomaly
- 3-10x higher than other periods – requires investigation



wait time
42,000 seconds
10:00-11:00

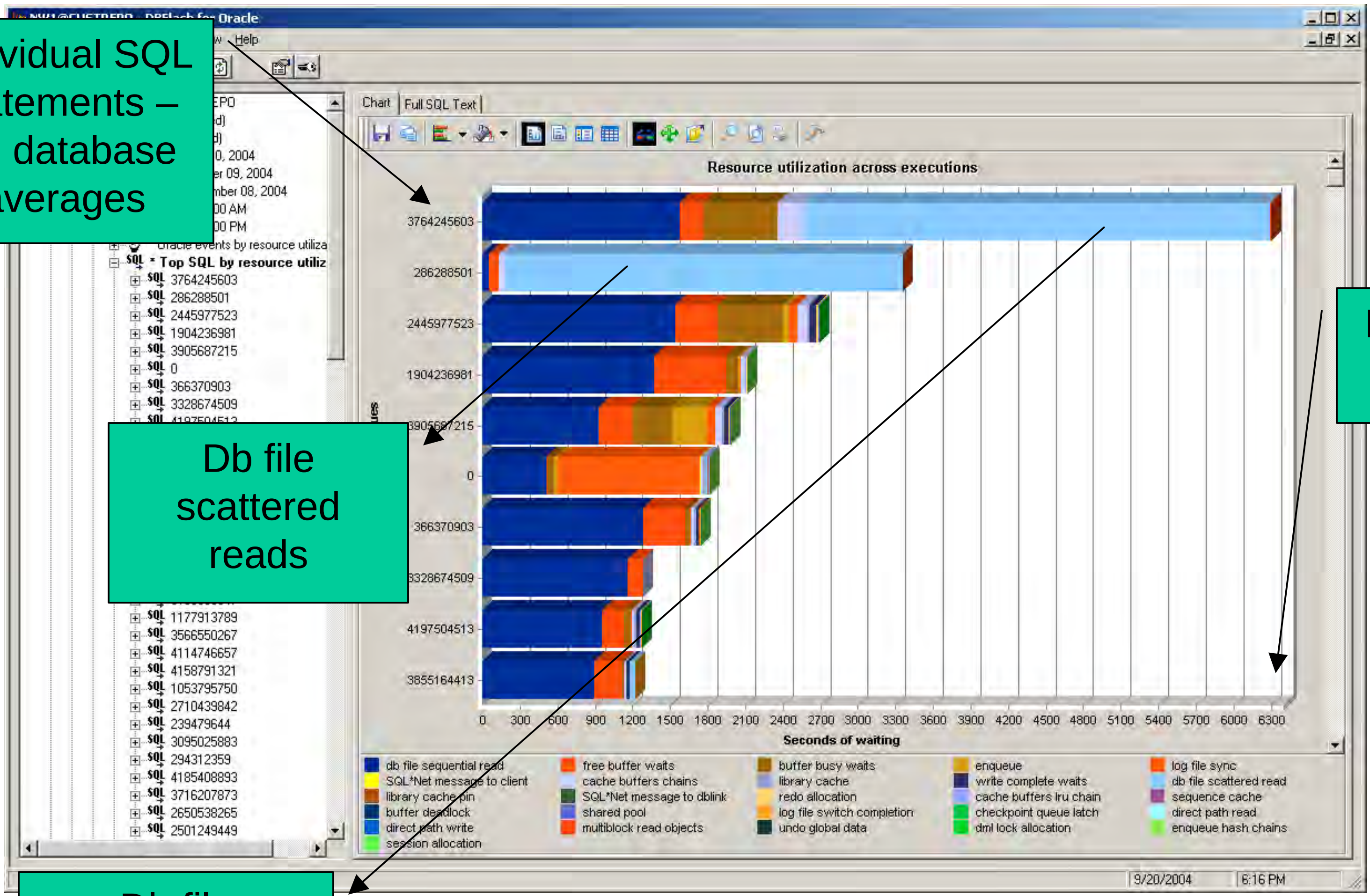
Drill Down to Key RMM Parameters

Individual SQL statements – No database averages

Notice scale: > 6000 secs

Db file scattered reads

Db file scattered reads

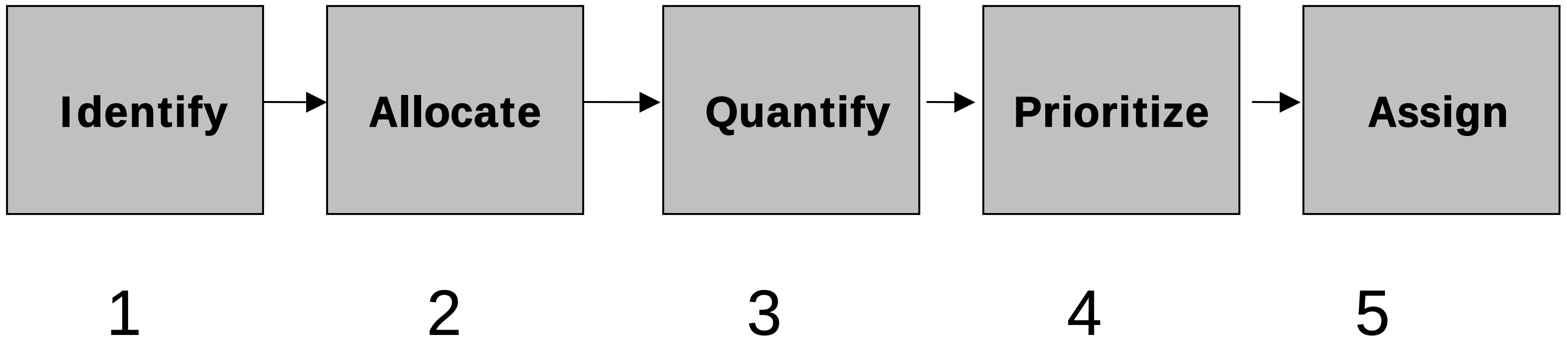


Oracle events by resource utiliza
Top SQL by resource utiliz
- SQL 3764245603
- SQL 286288501
- SQL 2445977523
- SQL 1904236981
- SQL 3905687215
- SQL 0
- SQL 366370903
- SQL 3328674509
- SQL 4197504513
- SQL 1177913789
- SQL 3566550267
- SQL 4114746657
- SQL 4158791321
- SQL 1053795750
- SQL 2710439842
- SQL 239479644
- SQL 3095025883
- SQL 294312359
- SQL 4185408893
- SQL 3716207873
- SQL 2650538265
- SQL 2501249449

db file sequential read	free buffer waits	buffer busy waits	enqueue	log file sync
SQL*Net message to client	cache buffers chains	library cache	write complete waits	db file scattered read
library cache pin	SQL*Net message to dblink	redo allocation	cache buffers lru chain	sequence cache
buffer deadlock	shared pool	log file switch completion	checkpoint queue latch	direct path read
direct path write	multiblock read objects	undo global data	dml lock allocation	enqueue hash chains
session allocation				

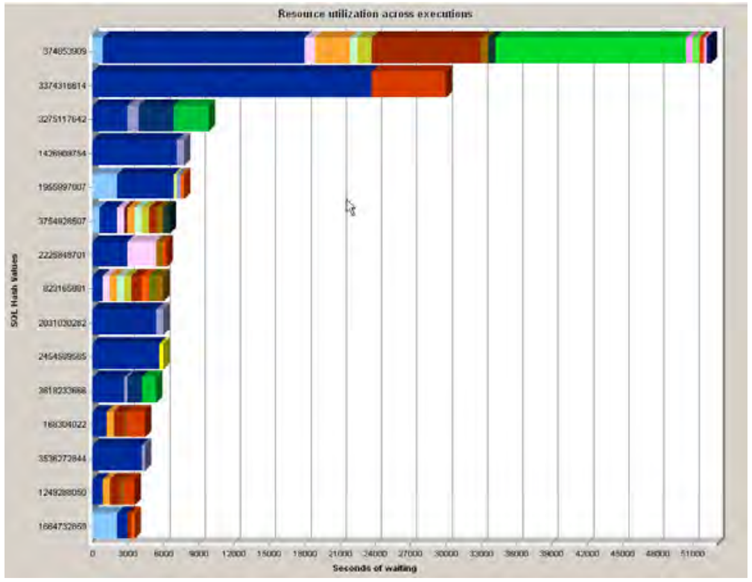
How do you Use it?

Applying RMM for Business Results



Step 1: Identify

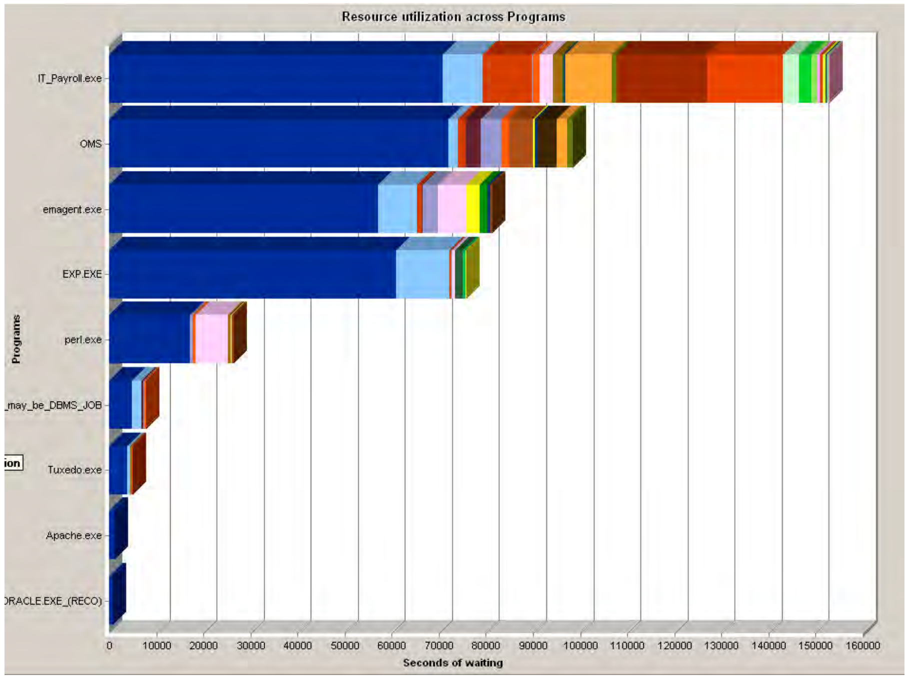
- Find your pain points
- Identify highest impact SQLs (SQL View and Time View principles)
- Longest wait times = most significant “pain points” for customers
- Conversely, low cache hit ratios or high latch usage may not impose high wait times for users (so why fix them?)



SQL statements prioritized by Total Wait Time

Step 2: Allocate

- Fix the problems you get paid to resolve
- Allocate impact to real customers (internal or external)
- Allocate wait time to Program, Session, Machine
  - SQL View principle makes this connection



Programs Prioritized by Total Wait Time

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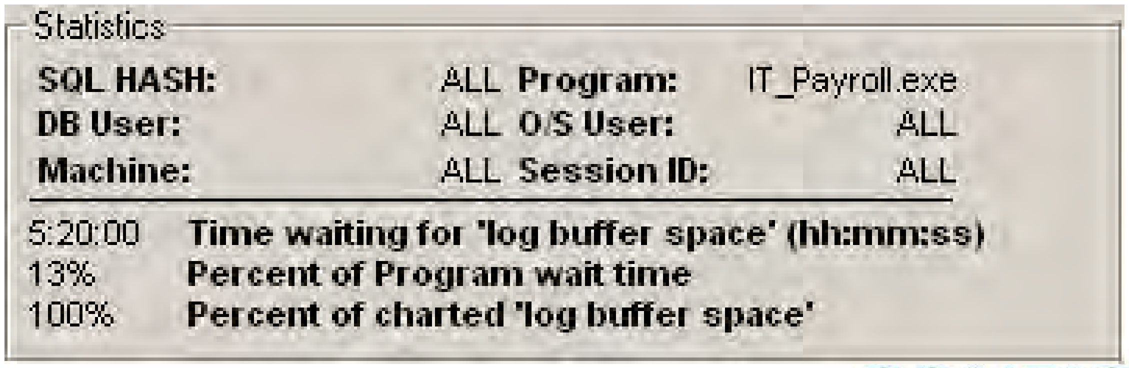
Step 3: Quantify

- Show the $ benefit
- Enabled by Full View and Time View principles
- Soft dollar savings
  - Data entry clerks
  - DBA time spent in problem resolution
- Hard dollar savings
  - Reduce hardware upgrades
  - Meet SLA's avoiding penality
  - Ensure business isn't lost due to poor performing or unavailable system

Quantifiable benefit of Tuning a specific statement



```
Statistics
SQL HASH:          ALL  Program:     IT_Payroll.exe
DB User:           ALL  O/S User:               ALL
Machine:           ALL  Session ID:             ALL

5:20:00   Time waiting for 'log buffer space' (hh:mm:ss)
13%       Percent of Program wait time
100%      Percent of charted 'log buffer space'
```

Quantify your ROI: Hard Cost Example

Input Data

H/W cost (per server)	$60K
Oracle S/W license cost (per server)	$80K
IT Expense (per server)	50%
(Admin, facility, maintenance, project mgt)	
Total Cost (Year 1)	$170K

ROI Results

Eliminate 35% capacity requirement	$59.5K
Reduced External Consulting	$16K
RMM Value to Customer (per server)	$75.5K
RMM Cost of Implementation (per server)	$8K
Generated ROI – 4 months	**943%**

Step 4: Prioritize

- Pick the right projects
- Cut through the clutter of potential new projects, investigations, and trials.
- Justify your priorities
  - (e.g. We aren’t working on your problem since this other has a higher demonstrable business impact)

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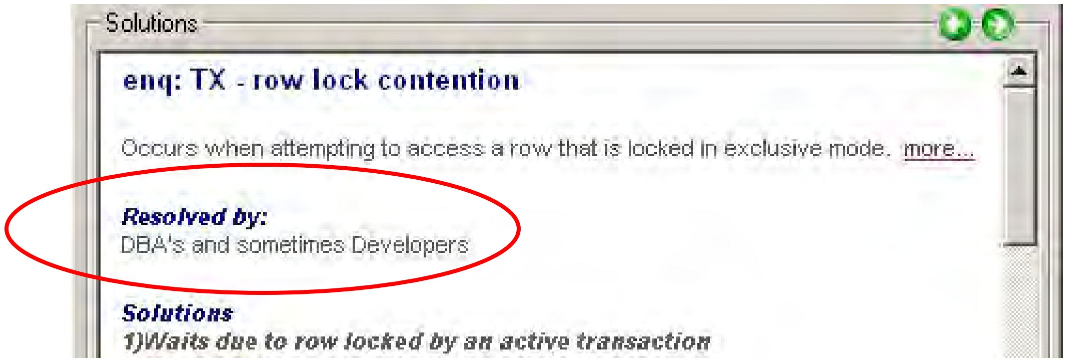
Step 5: Assign

- Assign the right people to the problem
  - DBA / Developer / Network Admin / SysAdmin...
- Enabled by Full View principle



Solutions

enq: TX - row lock contention

Occurs when attempting to access a row that is locked in exclusive mode. more...

Resolved by:
DBA's and sometimes Developers

Solutions
1)Waits due to row locked by an active transaction

- Avoid finger pointing – show the evidence

Conclusion

- Look for what has an impact
- Resource Mapping is more than Wait Time – it must include:
  - SQL level granularity
  - Full Resource granularity
- Isolating the SQL and Resource allows you to find and fix the Root Cause
- DBAs can have an impact and be heroes!

About Confio Software

- Developer of Performance Tools
- Dedicated to helping customers get more out of their existing IT infrastructure
- Oracle product is DBFlash
- Packaged, easy-to-use implementation of RMM
- Based in Denver, customers worldwide
- Free trial at www.confio.com

Thank you for coming

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