Analyzing Application Performance in RAC

Arup Nanda

Starwood Hotels

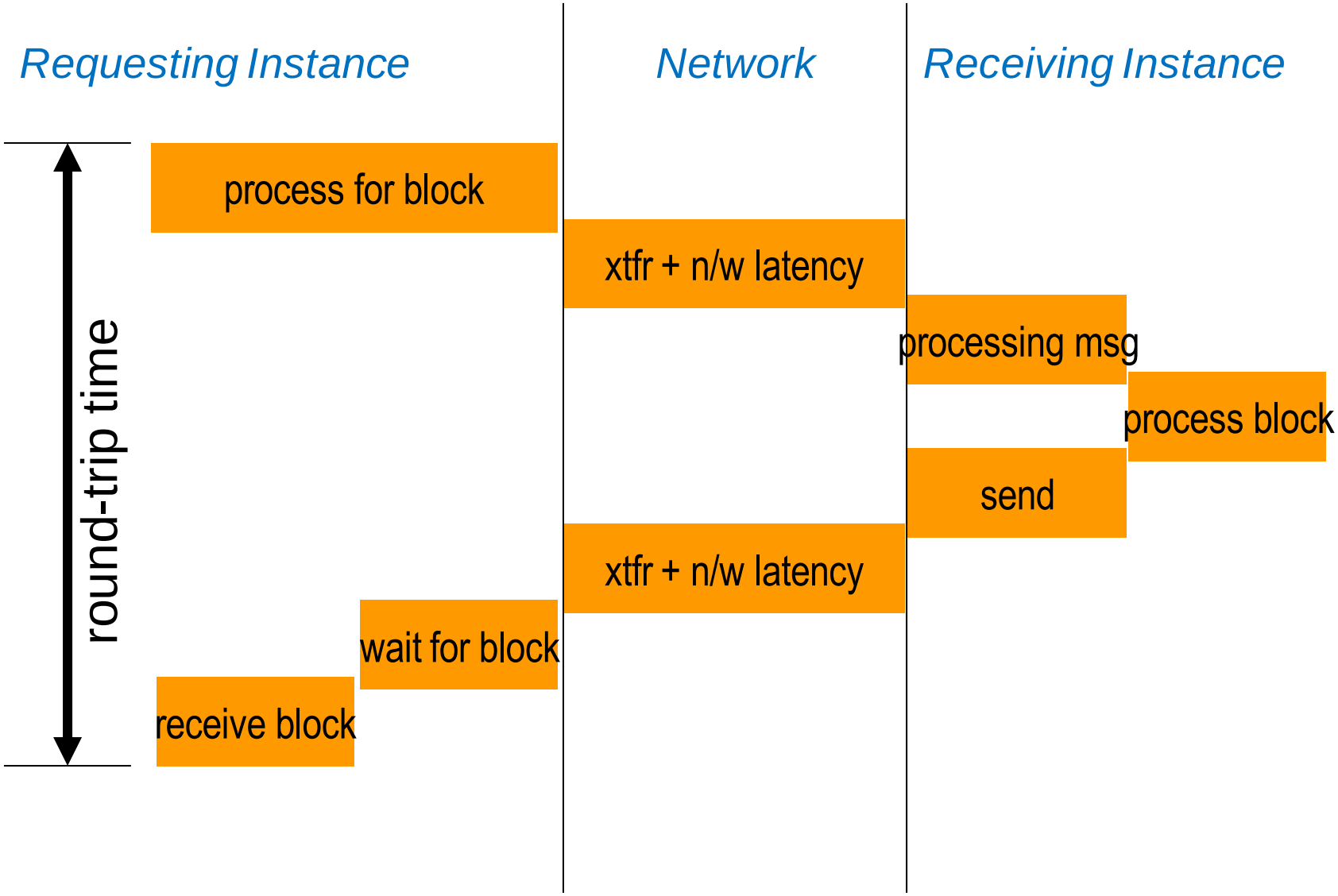
Why Analyze

- "The Database is Slow"!
  - Storage, CPU, memory, runqueues all affect the performance
  - Know what specifically is causing them to be slow
- To build a profile of the application
- To check scalability
  - You have developed against non-RAC
    - Will it scale up in RAC?
  - Currently it runs with 100 users
    - What will happen if we have 1000?
- Effective Tuning
  - take a baseline before some tuning exercise
  - re-measure to see if the tuning was effective
  - check the resource usage of applications

What to Measure

- Timing of Events
  - An Oracle session is in any of these three states
    - Doing something useful (consuming CPU) **U**
    - Waiting for some resource (a block from disk, a latch) **W**
    - Idle (Waiting for some work from the user) **I**
  - Total Time = U+W+I
  - Accurately measure each component
- Resource Usage
  - Latches, Locks
  - Redo, Undo
  - Logical I/O

Inter-instance Round Trip Times



How to Get the Times

- You can get these times by examining the session in real time

```
select state, seconds_in_wait, wait_time, event
from v$session
where sid = <sessionid>
```

- There are several issues
  - You should be watching in real time
  - You will miss the times when these events are past
  - How will you know the sessionID in advance?
- Other Option – Tracing
- There is an event called 10046 which allows you to enable tracing in sessions

Enabling Trace

- SQL Trace can be enabled by
  - `alter session set sql_trace = true;`
- You can set the event at the session level so that it can capture the wait events.

```
alter session set events '10046 trace name context
  forever, level 12'
```

- It produces a trace file similar to sql_trace, but with extended trace data
  - With information on how much time was spent where
- It creates a trace file in the user_dump_dir
  - In 11g, the udump dir is inside the diag structure

Different Session

- To set SQL Trace in a different session

```
dbms_system.set_sql_trace_in_session
        (<sid>,<serial#>,true);
```

- To set 10046 Trace in a different session:

```
dbms_system.set_ev (<sid>,<ser#>,10046,<level#>,null)
```

  - The same effect as

```
alter session set events '10046 trace name context
   forever, level <level#>'
```

DBM_MONITOR

- From 10g onwards, you can enable it any other session by:

```
begin
    dbms_monitor.session_trace_enable (
        session_id      => 131,
        serial_num      => 5879,
        waits           => true,
        binds           => true
    );
end;
/
```

To capture wait events

To capture bind variables

Analyzing

- Tracefiles are not quite readable
- To analyze the tracefile (SQL Trace or the 10046 Trace)
  - A tool called **tkprof**

```
# tkprof D111D1_ora_9204.trc
  D111D1_ora_9204.out
  explain=arup/arup waits=yes
  sys=no
```

- Other Analyzers
  - Trace Analyzer (downloadable from MetaLink)
  - Third party analyzers
    - Hotsos Profiler
    - Trivadis TVD$XSTAT analyzer

```
EXEC
#2:c=3000,e=56090,p=0,cr=0,
ep=1,og=4,plh=2853959010,ti
4696890449895
FETCH
#2:c=0,e=109,p=0,cr=4,cu=0,
og=4,plh=2853959010,tim=128
890450092STAT #2 id=1 cnt=1
obj=18 op='TABLE ACCESS BY
(cr=4 pr=0 pw=0 time=0 us c
card=1)'
STAT #2 id=2 cnt=1 pid=1 pc
op='INDEX RANGE SCAN I_OBJ2
0 time=0 us cost=3 size=0 c
CLOSE
#2:c=0,e=41500,dep=1,type=3
91640
====================
```

Trace Analyzer

- A much better tool to analyze trace files.
- Refer to MetaLink Doc **224270.1** for download and instructions on use
- A small zip file, with bunch of directories
- Connect as SYS and run tacreate.sql to create the Trace Analyzer schema (TRCANLZR)
- Run it

```
cd trca/run
sqlplus trcanlzr/trcanlzr
@trcanlzr <tracefile name in udump dir>
```

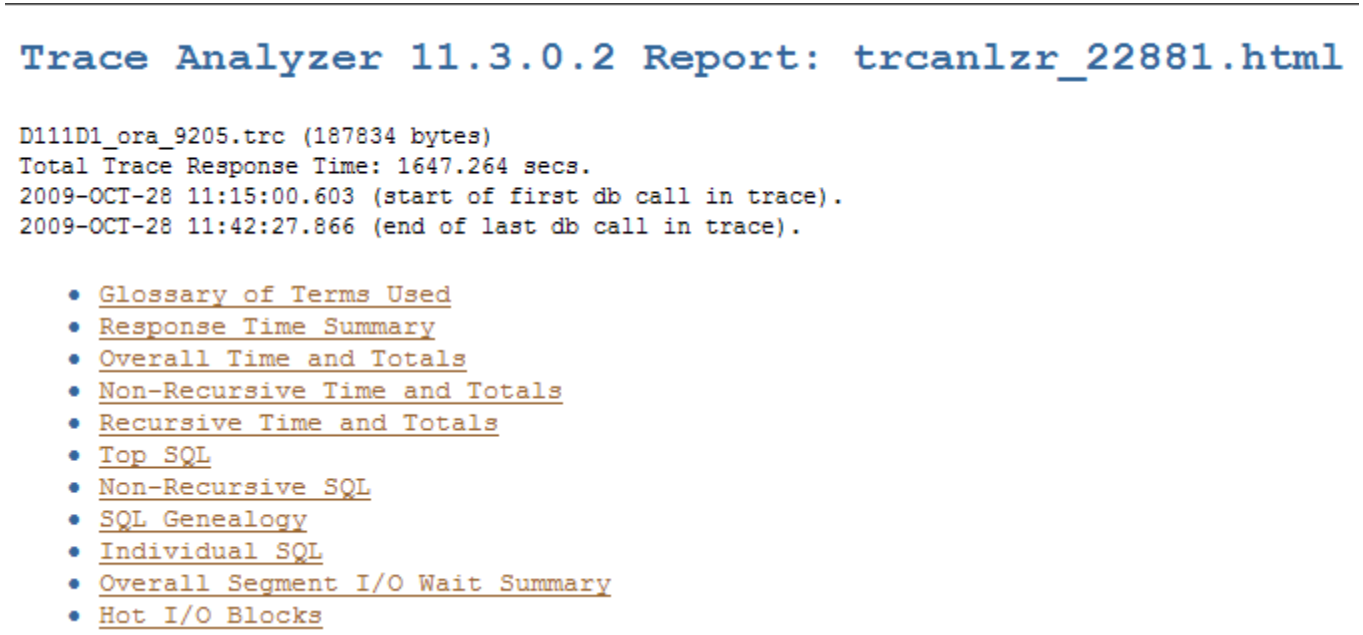
Output

```
Value passed to trcanlzr.sql:
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

TRACE_FILENAME: D111D1_ora_9205.trc

... analyzing D111D1_ora_9205.trc

Trace Analyzer completed.
Review first trcanlzr_error.log file for possible fatal errors.
Review next trcanlzr_22881.log for parsing messages and totals.

... copying now generated files into local directory

TKPROF: Release 11.1.0.7.0 - Production on Wed Oct 28 11:45:05 2009

Copyright (c) 1982, 2007, Oracle.  All rights reserved.

  adding: trcanlzr_22881_c.html (deflated 90%)
  adding: trcanlzr_22881_c.log (deflated 82%)
  adding: trcanlzr_22881_c.txt (deflated 84%)
  adding: trcanlzr_22881.tkprof (deflated 85%)
  adding: trcanlzr_error.log (deflated 72%)
test of trcanlzr_22881.zip OK

... trcanlzr_22881.zip has been created

TRCANLZR completed.
```

These files are produced in the local directory

Trace Analyzer

- It generates
  - The log file of the run. Scan for errors.
  - The tkprof output of the trace file
  - The analysis in text format
  - The analysis in html format



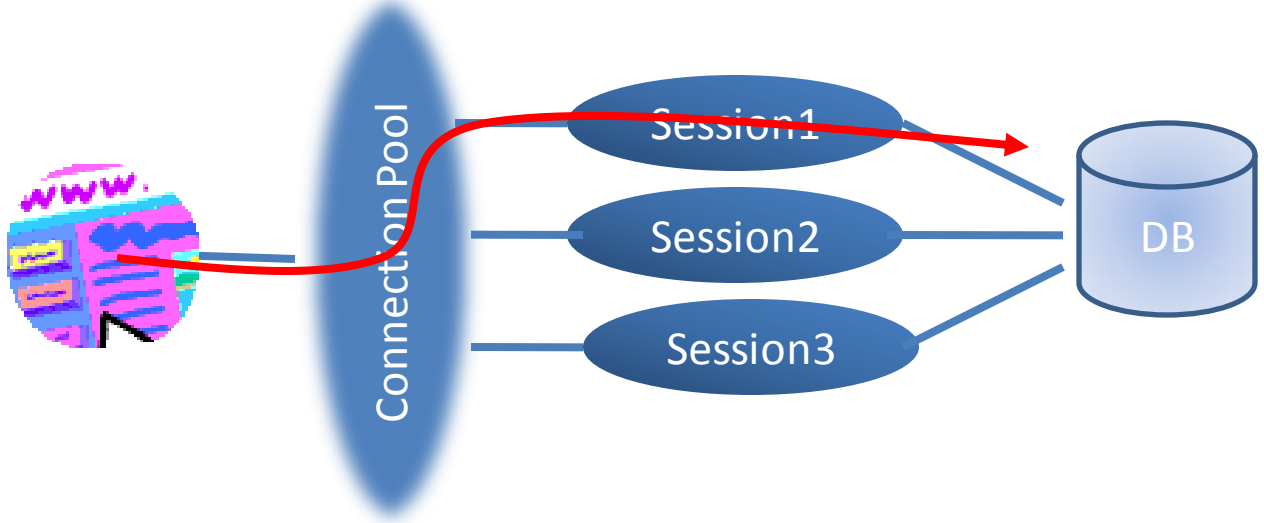
Trace Analyzer 11.3.0.2 Report: trcanlzr_22881.html

D111D1_ora_9205.trc (187834 bytes)
Total Trace Response Time: 1647.264 secs.
2009-OCT-28 11:15:00.603 (start of first db call in trace).
2009-OCT-28 11:42:27.866 (end of last db call in trace).

- Glossary of Terms Used
- Response Time Summary
- Overall Time and Totals
- Non-Recursive Time and Totals
- Recursive Time and Totals
- Top SQL
- Non-Recursive SQL
- SQL Genealogy
- Individual SQL
- Overall Segment I/O Wait Summary
- Hot I/O Blocks

The Connection Pool Effect

- Most applications use connection pool
- A "pool" of connections connected to the database
- When the demand on the connection from the pool grows, the pool creates new database sessions
- When the demand lessens, the sessions are disconnected
- The SID is not known



Enabling Tracing in Future Sessions

- Service Names start tracing when any session connected with that service name will be traced

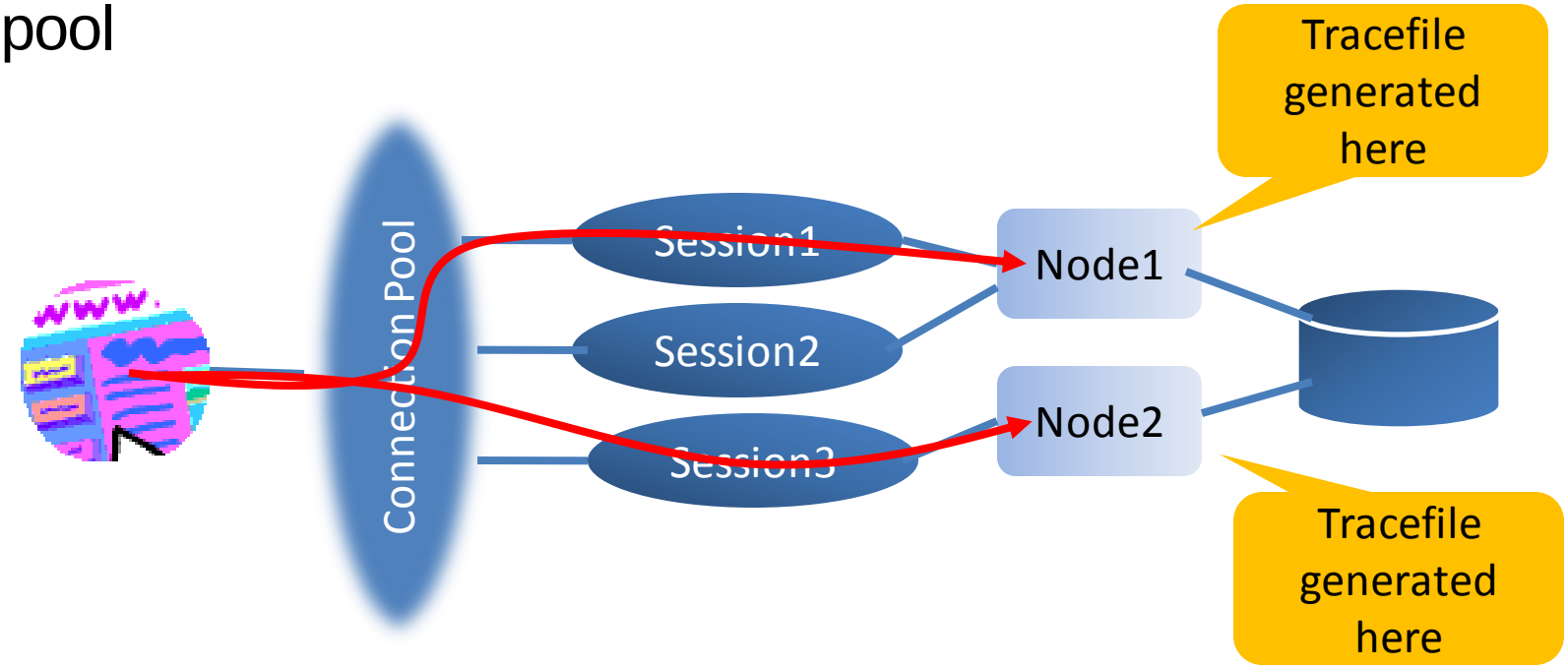
```
begin
    dbms_monitor.serv_mod_act_trace_enable (
         service_name => 'APP',
         action_name  => dbms_monitor.all_actions,
         waits        => true,
         binds        => true
    );
end;
```

Warning: This is case sensitive; so “app” and “APP” are different.

- This will trace any session connected with service_name APP
- Even future sessions!

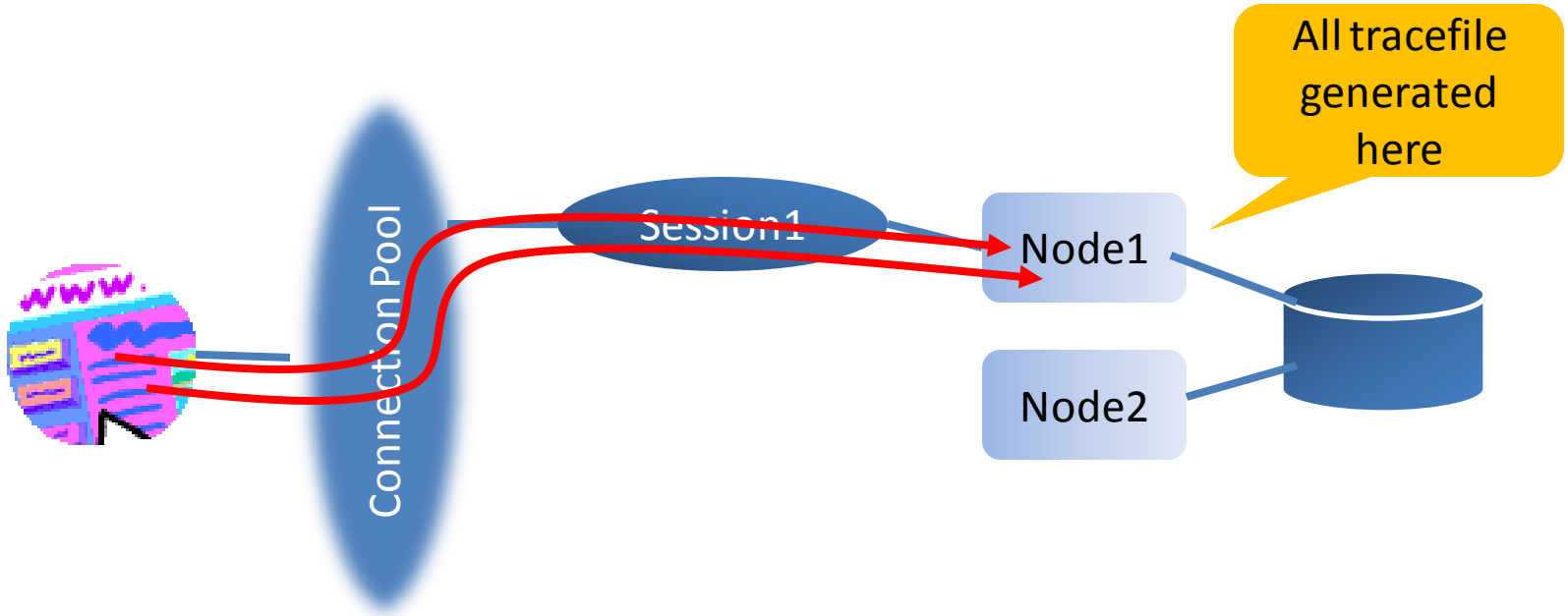
What's Special About RAC

- Multiple Instances multiple hosts
- The tracefiles are on different hosts
- Application connect through a connection pool



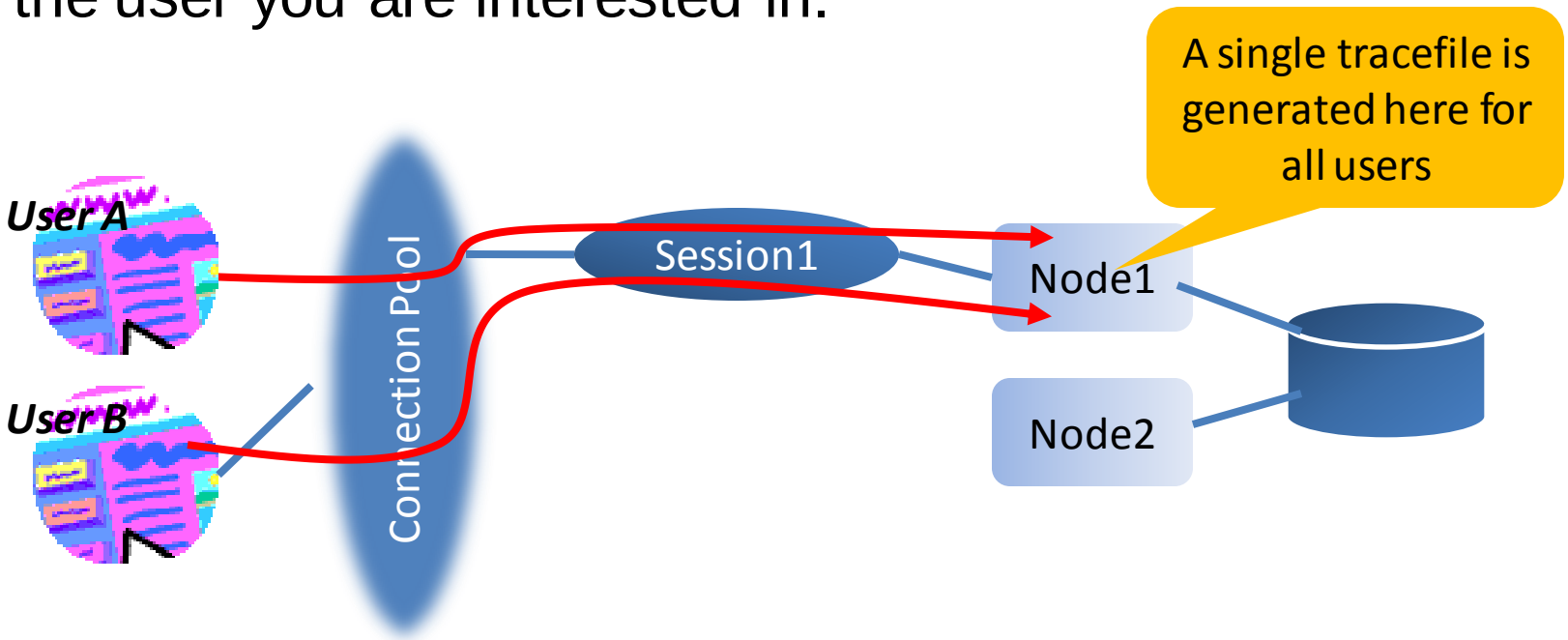
Multiple Tracefiles

- Tracefiles are generated for each Oracle session
- So, a single user's action can potentially go to many sessions many tracefiles
- Workaround: create only one session in the connection pool



Mixed Activities

- But that does not solve the problem
- The single Oracle session will service activities of many users
- So the tracefile will have activities of all users; not just the user you are interested in.



Consolidation of Tracefiles

- The trcsess utility comes handy in that case
  - It combines all tracefiles into one!

```
trcsess output=alltraces.trc service=app *.trc
```

  - It creates the tracefile alltraces.trc from all the tracefiles in that directory where activities by all sessions connected with the **app** service
- Now you can treat this new tracefile as a regular tracefile.

```
$ tkprof alltraces.trc alltraces.out sys=no …
```

TRCSESS

- The utility has many options

```
trcsess [output=<output file name >]
   [session=<session ID>] [clientid=<clientid>]
   [service=<service name>] [action=<action name>]
   [module=<module name>] <trace file names>
```

output=<output file name> output destination default being standard output.

session=<session Id> session to be traced.

Session id is a combination of SID and Serial# e.g. 8.13.

clientid=<clientid> clientid to be traced.

service=<service name> service to be traced.

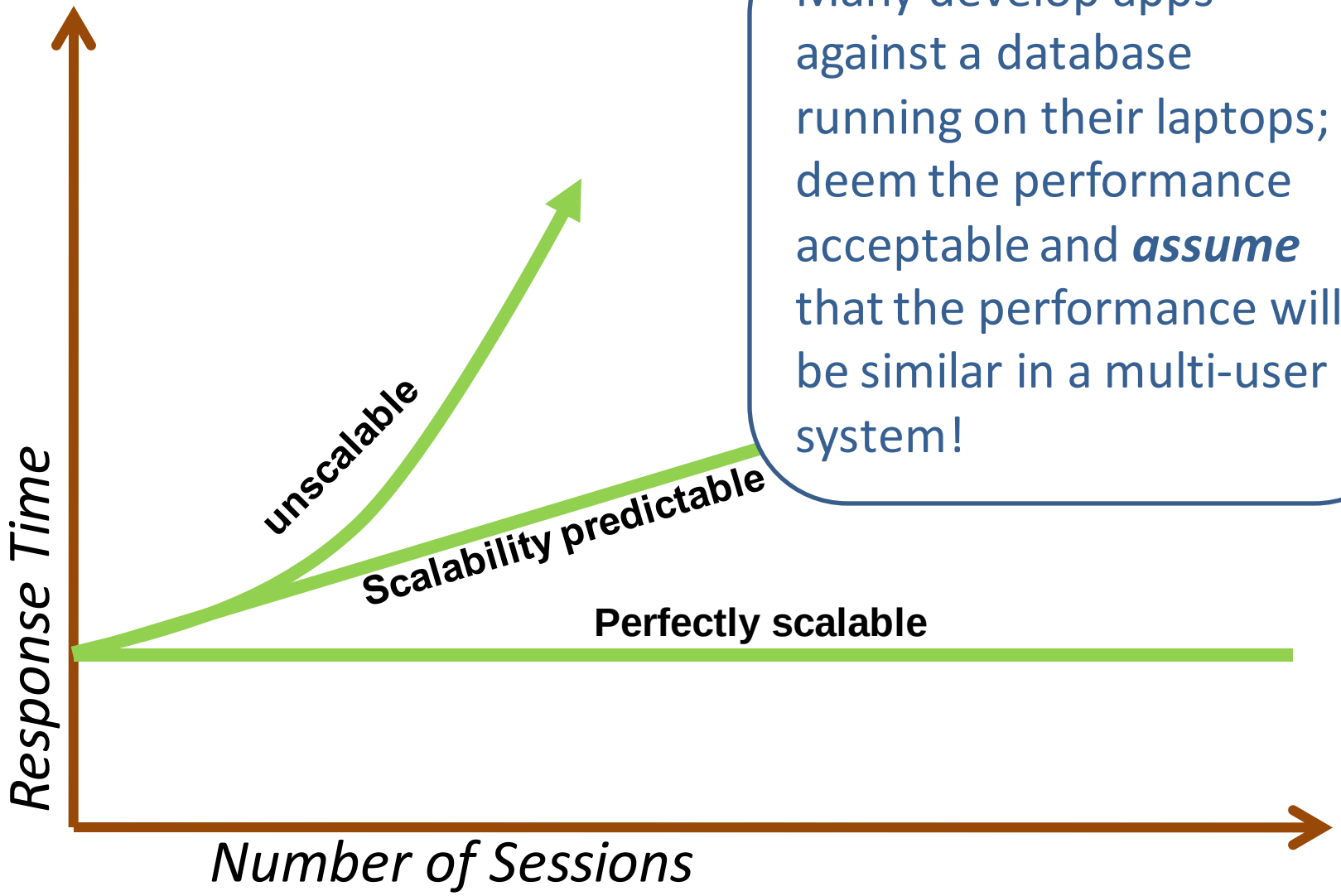
action=<action name> action to be traced.

module=<module name> module to be traced.

Other Profiles

- So far we talked about timings of various activities
- Applications consume resources
  - Buffers (consistent gets)
    - Which in turn drives the I/O up
  - Latches (cache buffer chains, library cache, etc.)
  - Locks
  - CPU
  - Redo Generation
- All these resources affect the scalability of the applications
  - Especially in RAC
- You need to measure these resource stats as well

Scalability



Many develop apps against a database running on their laptops; deem the performance acceptable and ***assume*** that the performance will be similar in a multi-user system!

Source of Resource Stats

- The best source is V$SESSTAT

```
select name, value
from v$sesstat s, v$statname n
where n.statistic# = s.statistic#
and
    n.name in (
        'CPU used by this session',
        'redo size‘
    )
and sid = 149;
```

- Take measurement before and after the application run
- Measure the difference; it’s the resource utilized

Runstats Package

- Tom Kyte has an excellent package that can automate this for you.
  - http://asktom.oracle.com/pls/asktom/ASKTOM.download_file?p_file=6551378329289980701
- This allows you to build a test harness
  1. `SQL> exec runStats_pkg.rs_start;`
  2. Run the application
  3. `SQL> exec runStats_pkg.rs_middle;`
  4. Run the application (changed)
  5. `SQL> exec runStats_pkg.rs_stop;`
- It shows the difference between the two runs for latches and statistics

Output

NAME	VALUE
LATCH.enqueue hash chains	1,579
LATCH.row cache objects	1,678
STAT...bytes received via SQL*Net from client	1,935
LATCH.cache buffers chains	3,688
STAT...undo change vector size	4,420
STAT...bytes sent via SQL*Net to client	4,560
STAT...Elapsed Time	6,900
STAT...table scan rows gotten	8,002
STAT...redo size	70,944
STAT...session uga memory max	131,036
STAT...session pga memory max	131,072

- Shows the resources have been consumed – latches and other stats.
- Remember –latches are not for this session; they are systemwide. So, if you have other sessions running right now, you will not be able to see the effects of this session alone on latches.

What about Future Sessions

- Another procedure in DBMS_MONITOR

```
begin
    dbms_monitor.client_id_stat_enable('CLIENT1');
end;
```

- It enables statistics collection for all client calls with client identifier CLIENT1
- You set the client identifier by

```
begin
    dbms_session.set_identifier('CLIENT1');
end;
```

Recording of Stats

- The stats are exposed through V$CLIENT_STATS

```
SQL> desc v$client_stats
 Name                                      Null?    Type
 ----------------------------------------- -------- ----------------------
 CLIENT_IDENTIFIER                                  VARCHAR2(64)
 STAT_ID                                            NUMBER
 STAT_NAME                                          VARCHAR2(64)
 VALUE                                              NUMBER
```

- The stats are aggregated, i.e. all the stats are for a specific client_identifier; not individual sessions
- A subset of the stats; not all

V$CLIENT_STATS

```
SQL> select stat_name, value
  2  from v$client_stats
  3  where client_identifier = 'CLIENT1';

STAT_NAME                                                  VALUE
---------------------------------------------------------- ----------
user calls                                                          4
DB time                                                         2614
DB CPU                                                          4000
parse count (total)                                                5
......
application wait time                                              0
user I/O wait time                                                 0

27 rows selected.
```

Only 27 stats were captured; not all.

Other Stats Collection

- On Service Name and/or Module Name and Actions
- Here we want to capture sessions starting with

```
begin
  dbms_monitor.serv_mod_act_stat_enable (
    service_name   => 'APP',
    module_name    => 'SQL*Plus',
    action_name    => 'UPDATE'
  );
end;
```

Default is all actions

Checking Stats Collection

- To find out which type of aggregation is enabled

```
SQL> desc DBA_ENABLED_AGGREGATIONS
 Name                                      Null?    Type
 ----------------------------------------- -------- ----------------
 AGGREGATION_TYPE                                   VARCHAR2(21)
 PRIMARY_ID                                         VARCHAR2(64)
 QUALIFIER_ID1                                      VARCHAR2(48)
 QUALIFIER_ID2                                      VARCHAR2(32)
```

Other Sessions

- How do you start measuring when the session is not yet connected?
  - When the stats on individual sessions is desirable
  - When the client id, service, etc. are not alterable
- BYOT - Build your own tool
  - Create a post-login trigger to write the stats at the beginning of a session to a table
  - Write the values at the end of the session using a pre-logoff trigger
  - Measure the resource usage(the difference)
- Download the scripts to build the complete tool from my blog.
  - http://arup.blogspot.com/2010/09/other-day-i-was-putting-together-my.html

Inference from Resource Usage

- Watch out for stats that increase with load
  - Redo size
    - More the redo, more time for I/O and redo latches
  - Session Logical Reads
    - More I/O, indicates more buffers
    - More inter-instance locking, messaging
    - DW environment: more buffer flush
  - Cache Buffer Chain Latch
    - More latching  more CPU usage
  - If these stats and latches are high, the application will scale negatively
  - If you test in a small environment, you must measure it to test its scalability on a much bigger system.

Putting it all Together

- Profile Components
  - 10046 Tracing
  - Combining Traces to a Single File
  - Getting the time spent at different components
  - Gather Resource Usage
- Strategy
  - Capture all the profile components
  - Make changes to your app
  - Capture all the profile components
- Decision
  - Better, worse?
  - How much?
  - Decide on the next course of action – the scientific way.

Thank You!

Questions?

Email: arup@proligence.com

Blog: arup@blogspot.com