Analyzing Application Performance in RAC

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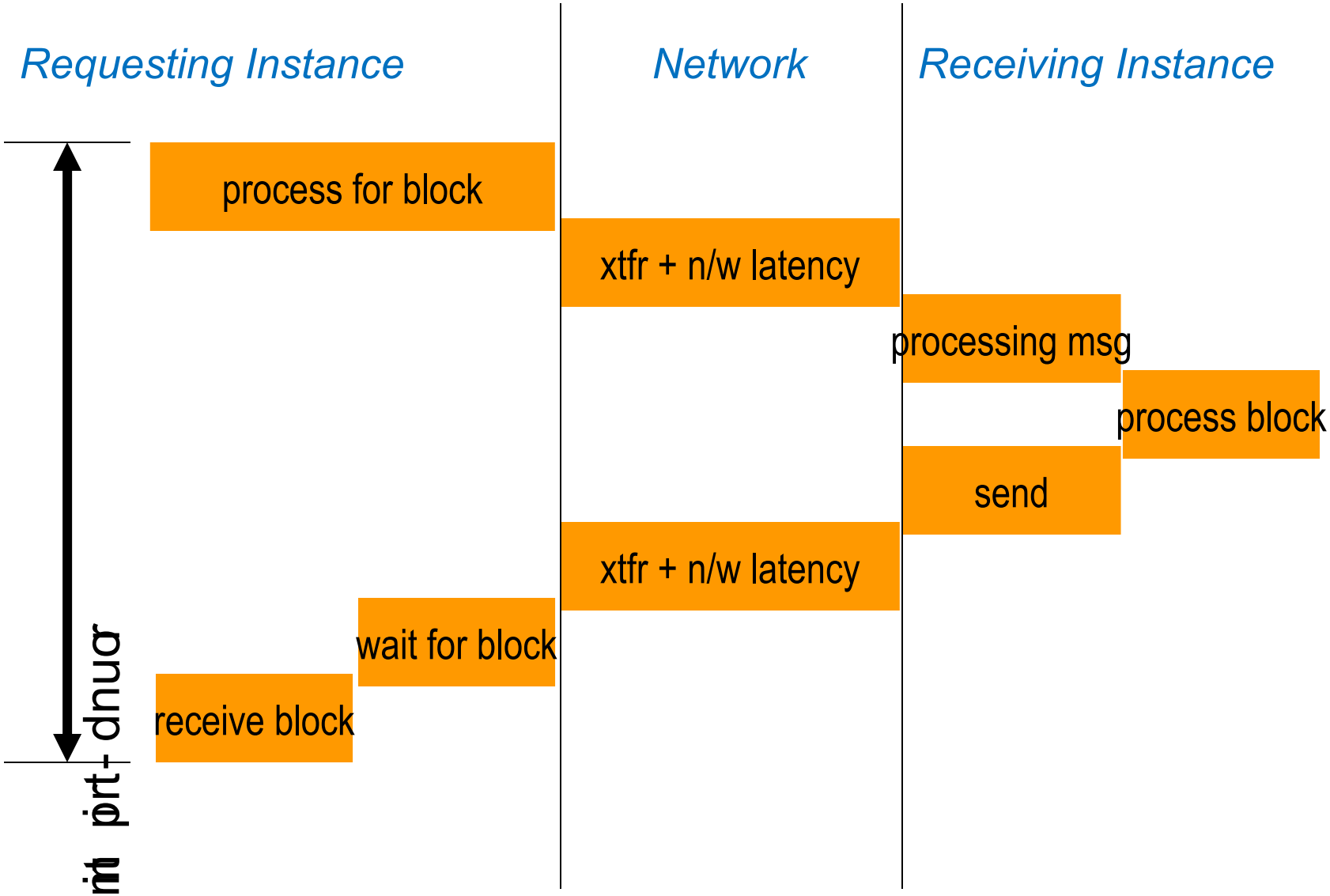
Why Analyze

- "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
  - `after session set sql_trace = true;`
- You can set the event at the session level so that it can capture the wait events.

```
after 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

```
after 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     => 5830,
        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 D11D_ora_9204.trc
  D11D_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,
1,r=0,dep=1,og=4,pfh=2
128
4696890449895
FETCH
#2:c=0,e=109,p=0,cr=4,
,dep=1,og=4,pfh=285395
96
89045092 STAT #2 id=1
pos=1 obj=18 op='TABLE
INDEX ROWID OBJ$ (cr=4
time=0 us cost=4 size=
STAT #2 id=2 cnt=1 pid
obj=37 op='INDEX RANGE
(cr=3 pr=0 pw=
0 time=0 us cost=3 siz
CLOSE
#2:c=0,e=41500,dep=1,t
6968904916 40
=====================
```

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

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

RACE_FILENAME: D11D_ora_9205.trc

.. analyzing D11D_ora_9205.trc

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

.. copying now generated files into local directory

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

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 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%)
```
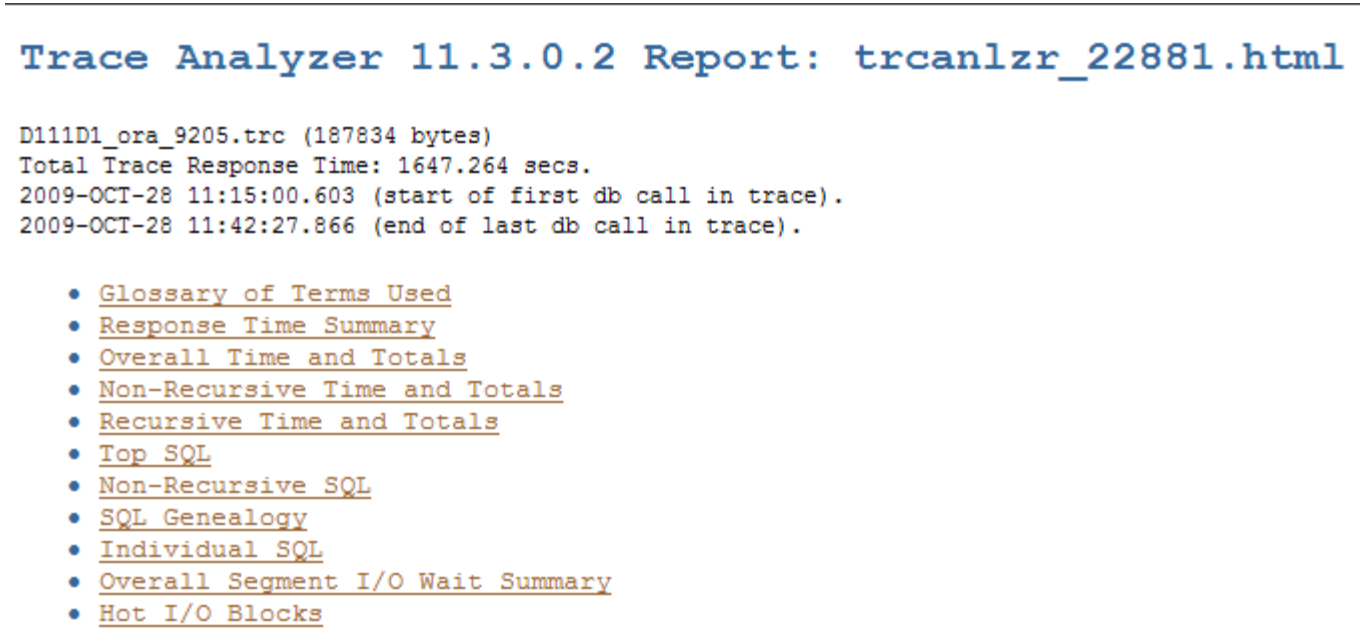

These files are produced in the local directory

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



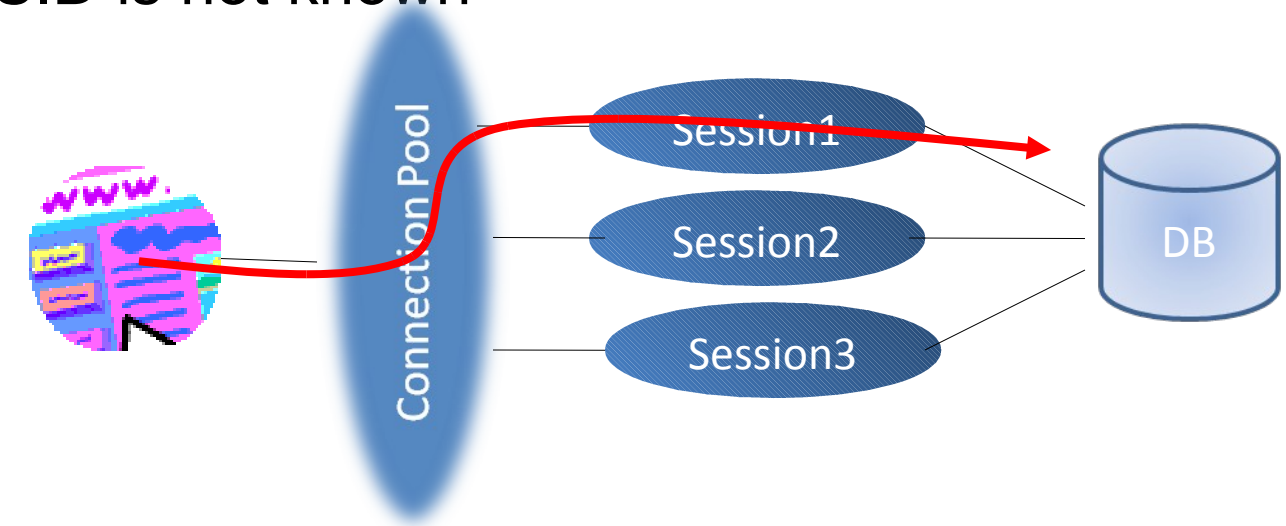
Trace Analyzer 11.3.0.2 Report: trcanlzr_22881.html

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

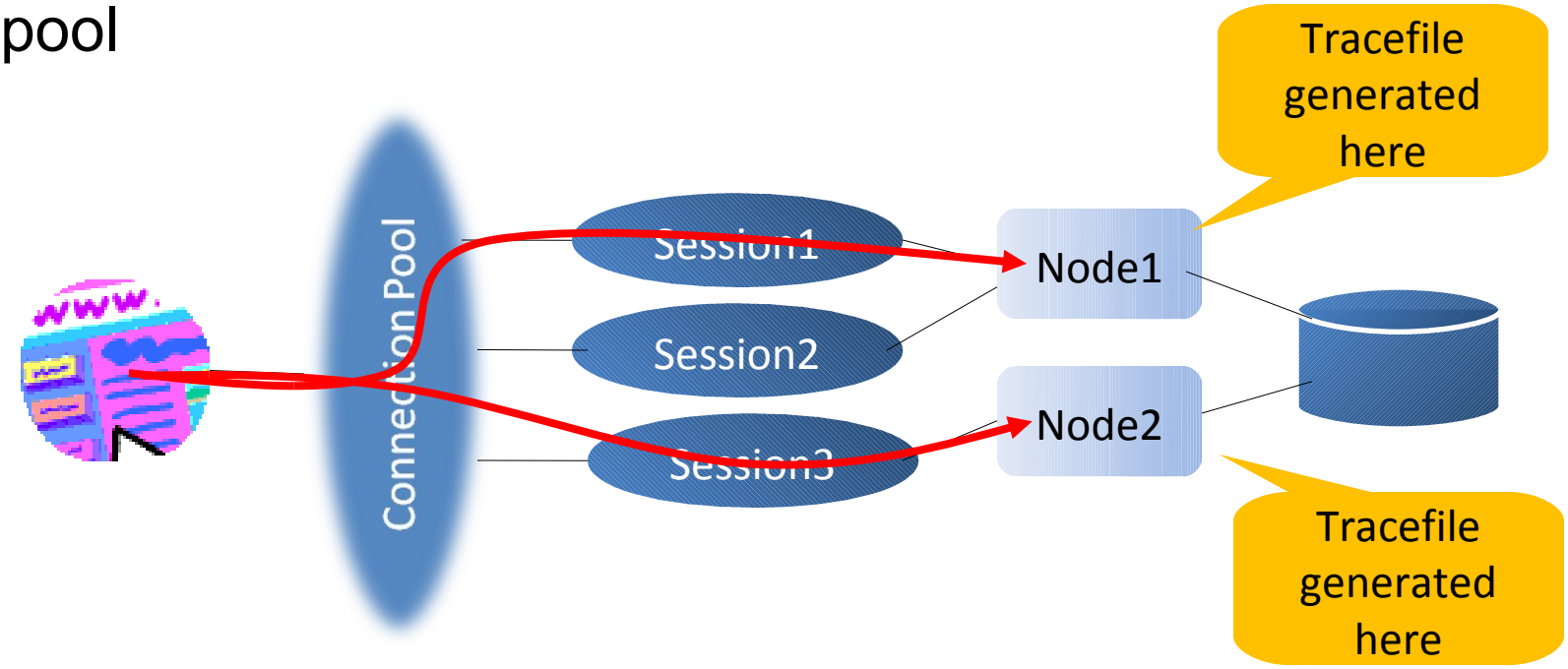
- Service Names start tracing when any session connected with that service name will be traced

```
egin

    dbms_monitor.serv_mod_act_trace_enable (

        service_name    => 'APP',

        action_name     =>
dbms_monitor.all_actions,

        waits           => true,

        binds           => true
```

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

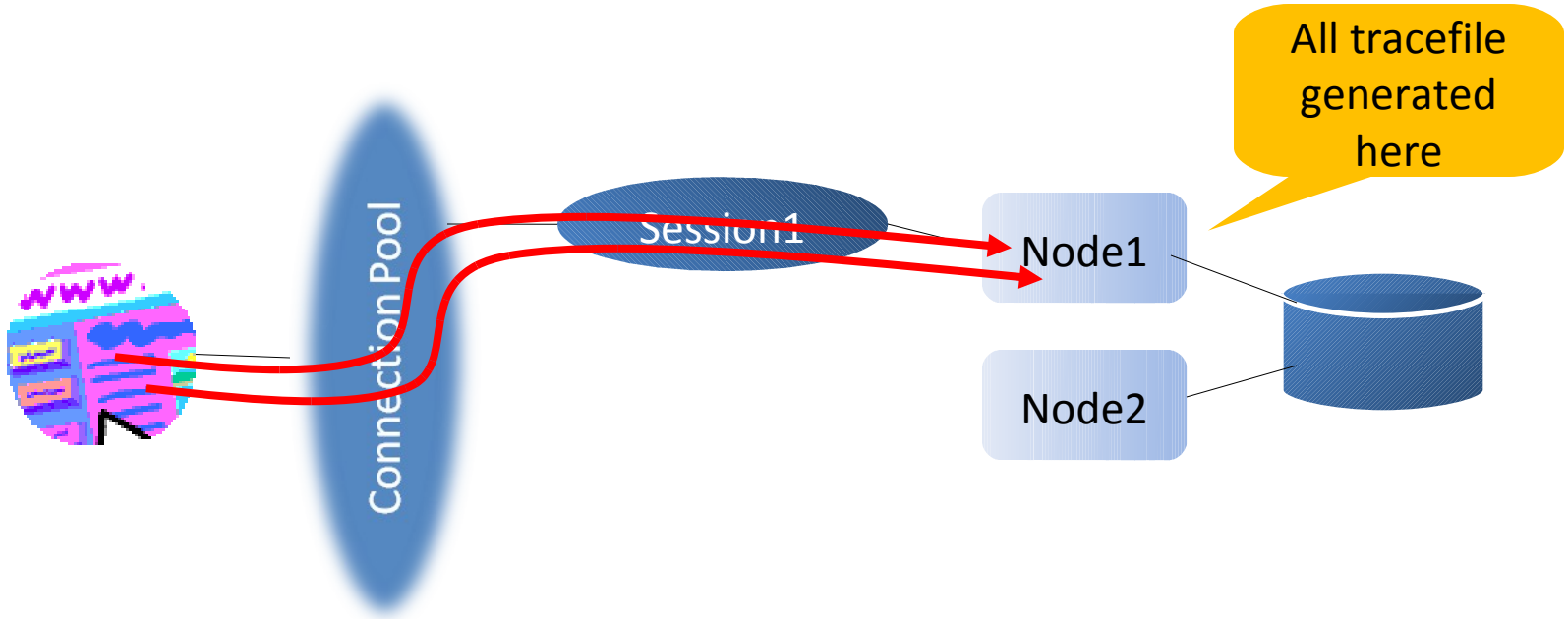
What's Special About RAC

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



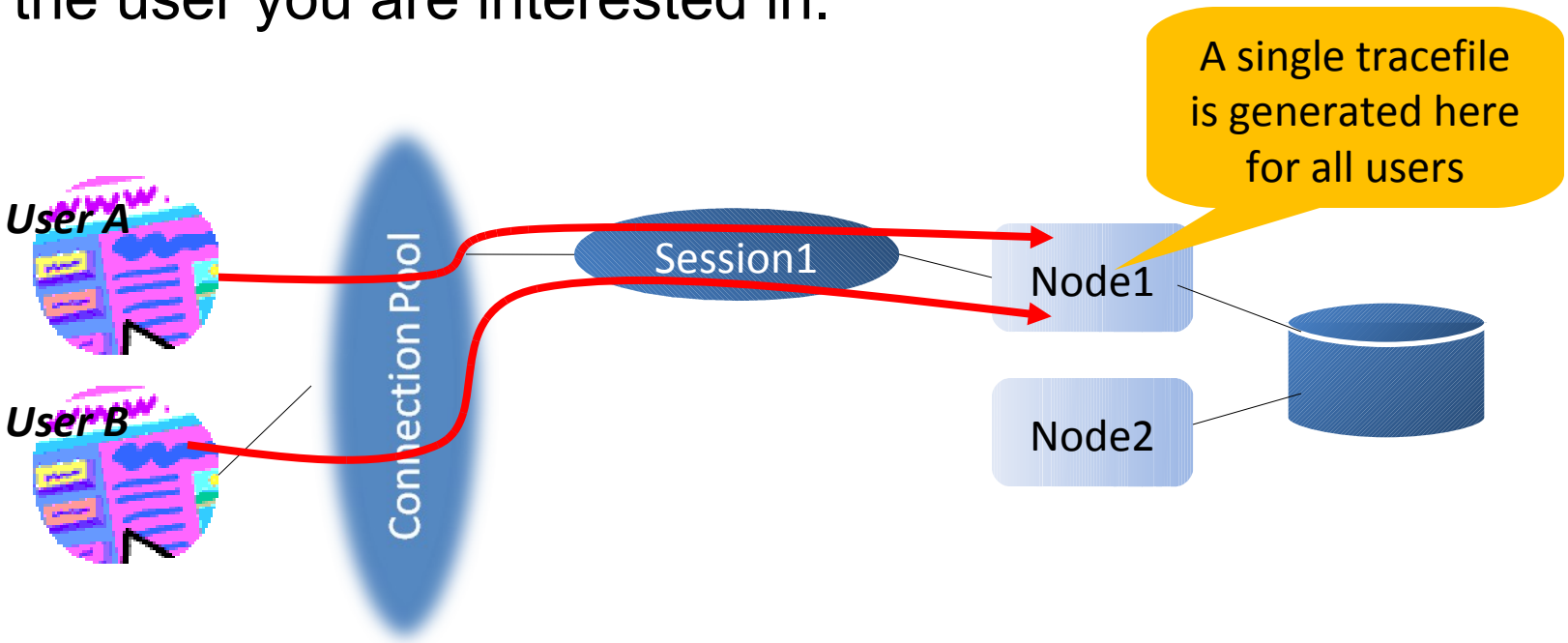
Multiple Tracefiles

- 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.

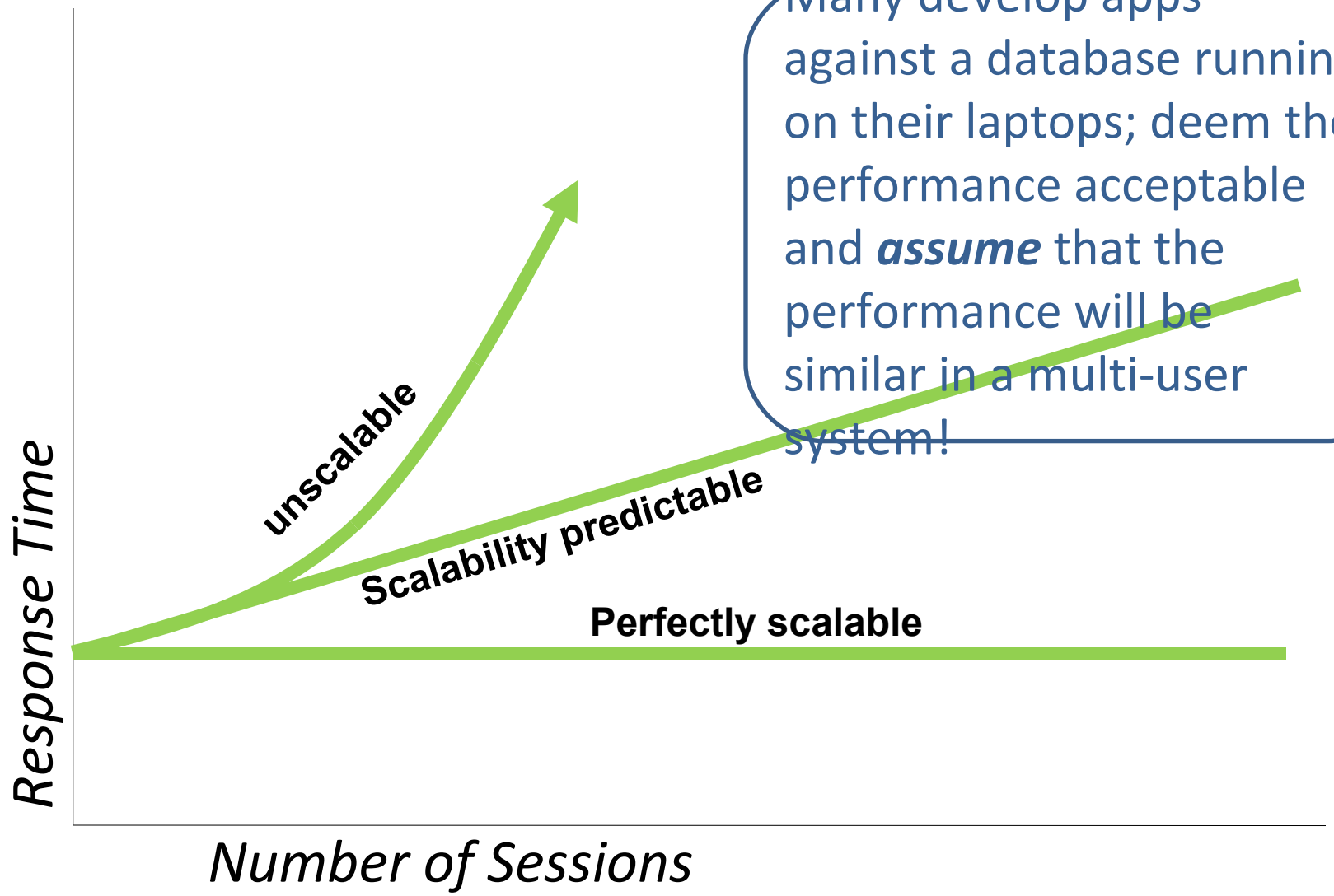
action=<action name> action to be traced.

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_
- 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.

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
   VARCHAR(64)
 STAT_ID                                            NUMBER
 STAT_NAME
   VARCHAR(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
```

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?

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