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SPOTLIGHT ON DEVELOPERS

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“Jumping the Gapp”

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Who I am...

- Started as DBA at Dedicate (later called Parity) for 1.5 years
- Worked for 5 years at Oracle The Netherlands
  - First 1.5 year as RDBMS analyst
  - Rest worked as ARE EBS Performance and RAC
    - This included Content Lead of EBS with RAC world wide
- Worked for 2 years at IBM
  - Business Consultancy Services
- Now working for almost 2 years at AMIS Services BV in the Netherlands (tech. blog is well known)
  - Technical Architect
Agenda…

- What Means GAPP ??
- Introduction To The Practical Case
- Wait Time And Method-R
- Telling A Story
- The GAPP Analyses
- GAPP Used In Service Oriented Architectures
- Conclusions
- Q/A
What Means GAPP…

- To be able to talk about the approach I need to have a name, see a post of Cary Millsap:

http://carymillsap.blogspot.com/2008/02/how-ofa-began-part-1.html

*Marketing Rule #1: If it doesn't have a name, it doesn't exist.*

“General Approach Performance Profiling”
- *in short* -
  “GAPP”
Jumping The Gap With GAPP…

Problem

Too slow….  

Solution

Jumping the GAPP…

No way to pinpoint where the problem is the regular way….  

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Introduction To The Practical Case
Coming in at the Customer Site…

Coming in at a customer with the assignment to find proof for certain performance bottlenecks.

- The most important business process had a performance with a high variance, and on occasion an unacceptable performance.

The most important business process was:

- Login to an E-Banking application should never take longer than 5 seconds to complete.
- When taking more than 5 seconds, old bank account balance information is provided.
The high variance in response time…

Percentage logins (PCT_GT_5SEC) which took longer than 5 seconds:
What was going on...

- Not able to change anything in the application.
- Not allowed to trace (only very limited)
- A Test environment, not resembling the production system.
- The architecture is complex due to the high amount of different technologies and tiers
  - Two Oracle 9.2.0.6 databases
  - DB2 with LDAP
  - Web Sphere
  - Generated SQL (CoolGen)
  - Etc.
What data was available to use…

- From the system there was months of system metrics’ available in nmon files.
  - Nigels Monitoring Tool (not officially supported by IBM)
  - Measurement on 5 minutes snapshot base
- From the business process were percentages available, how many times the response time (R) was above 5 seconds
  - Moniforce Data by external party
  - Measurement on 5 minutes snapshot base
- Stats pack data was available on the backend database.
Data Sources…

- Web Users
  - (Moniforce Data = R)
- Front end machine
- “E”
- Network
- back end machine
- “Q”
- (NMON Data)
- SAN
- Storage
- (NMON Data)

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What can GAPP do…

- Based on the available data, able to find out due to what in the (SOA) architecture the high variance in R was caused.
- In the end able to predict R from the business process, only based on available metrics’
- Jump the Gap:
  - Not allowed to trace
  - Not allowed to change anything in the application
  - Not having a representative test environment

HOW WILL GAPP DO THAT ??
Wait Time And Method-R
Method-R and the sequence diagram…

- The Business Processes are shown in different colors.
- \( R = S + W \) or \( R = R_1 + R_2 + \ldots \)
  - Response Time (R)
  - Service Time (S)
  - Wait Time (W)

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Highlighted the “Red” process…
Increasing Response Time…

- “Service Time” stays within limits the same, given the fact that the process is doing every time something similar.
- “Wait Time” is caused by resource business
- “Wait Time” is causing the significant part of the variance in R
Illustrative M/M/m Model Simplified...
The Complexity...

- Basically we should know how busy (utilization) each resource is in the architecture.
  - This to have an indication of the “Wait Time” on that resource.
- Only measuring how much we read, write, transfer or process is not enough.
  - Think about a cache in a Storage Server for example.
    - Read request from server is only getting data from the Storage Server cache.
    - In other cases the read request will go to the physical spindles
- Time Synchronization is very important
  - For Example, compare numbers by aggregating
Telling A Story
The Story of Bob the Merchant…

- Every working day going to the market
- Spending every time 200 $ to go there
- A Profit between -100 $ (loss) and 500$
- Simon says Bob should always write down:
  - The month
  - The temperature
  - The amount of rainfall
  - The profit
The “GAPP” Analyses
How could we use the system metrics…

- **From the CPU (aggregated and per CPU):**
  - **User% =** Percentage Application code (kernel programmers call this user mode) of total CPU time. This includes programs and RDBMS
  - **Sys% =** Percentage Kernel code of total CPU time. This is invoked by either a system call or hardware interrupt including the regular clock interrupts
  - **Wait% =** Percentage Wait for I/O of total CPU time. This really is idle but there is outstanding disk I/O
  - **CPU% = USER% + SYS% →** Basically the real CPU utilization.
How could we use the system metrics...

- For the I/O:
  - Disk Busy% = The percentage of the time the disk was found in use

- For the Memory:
  - Percentage used memory

- For the Network:
  - read kB/s and write kB/s = The kilobytes read and written on the network
  - packin and packout = The number of network packets (in=received, out=sent)
The to be compared graphs…

© Graphs by G. Hendriksen 2008
Steps for the GAPP Analyses...

● Collecting
  ▪ Which parts of the technical infrastructure are involved in the business process
  ▪ What data is available and in which granularity

● Synchronization
  ▪ Aggregation on lowest granularity of all used data

● Data Mining

● Interpretation
What was done in the practical case...

- Creation of 11G Database
- Inserting all records from system metrics and business process
  - Nmon files (using external tables)
  - Moniforce data (using external tables)
Using DBMS_PREDICTIVE_ANALYTICS...

- Another Data Mining engine could be used
  - Open Source, etc. (e.g. http://www.r-project.org/)

DBMS_PREDICTIVE_ANALYTICS *

- Procedure EXPLAIN
  - Ranks attributes in order of influence in explaining a target column

- Procedure PREDICT
  - Predict the value of a column. By filling in for some cases the value of the to be predicted column, the not filled in values will be predicted. So the procedure creates a self learning model.

* Part of Oracle Data Mining (ODM)
Calling the procedures...

BEGIN
    DBMS_PREDICTIVE_ANALYTICS.EXPLAIN(
        data_table_name => 'ghh_model_augsepoct_TS',
        explain_column_name => 'PCT_GT_5SEC_CHD',
        result_table_name => 'ghh_test52_expl');
END;
/

DECLARE
    v_accuracy NUMBER(10,9);
BEGIN
    DBMS_PREDICTIVE_ANALYTICS.PREDICT(
        accuracy => v_accuracy,
        data_table_name => 'ghh_model_augsepoct_TS',
        case_id_column_name => 'TIME',
        target_column_name => 'PCT_GT_5SEC_CHD',
        result_table_name => 'ghh_predict_mod_augsepoct_TS');
    DBMS_OUTPUT.PUT_LINE('Accuracy = ' || v_accuracy);
END;
/

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Back to the big variance in R…

Percentage logins (PCT_GT_5SEC) which took longer than 5 seconds:

% PCT_GT_5SEC per time

1-9-2007 0:00 6-9-2007 0:00 11-9-2007 0:00 16-9-2007 0:00 21-9-2007 0:00 26-9-2007 0:00
August, September, October Explained...

Factors of Explanation

WAIT_Q HDISK2_Q HDISK3_Q SYS_Q HDISK4_Q WAIT_E HDISK5_Q HDISK10_Q HDISK1_E HDISK0_E HDISK3_E HDISK2_E SYS_E HDISK5_E USER_Q HDISK4_E HDISK6_E HDISK8_Q HDISK7_Q HDISK0_Q HDISK6_Q HDISK9_Q HDISK1_Q

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Understanding The Explanation Index number...

• Basically we search for the block with the biggest variance

• The factor with the biggest variance in the “Wait Time”, will have the highest index number.

• So the higher the Index number, the higher the impact on the total variance of R, and so worth investigation.
The big variance in R...

Percentage logins (PCT_GT_5SEC) which took longer than 5 seconds:
A Simple Model Used…

Percentage logins (PCT_GT_5SEC) which took longer than 5 seconds:

One Week in September…

Percentage logins (PCT_GT_5SEC) which took longer than 5 seconds:
Modeled with a simple model...

Percentage logins (PCT_GT_5SEC) which took longer than 5 seconds:

The Model, now alone (in red)...

Percentage logins (PCT_GT_5SEC) which took longer than 5 seconds:

When 25% I/O Reduction…

Percentage logins (PCT_GT_5SEC) which took longer than 5 seconds:

September 22:00 – 02:00 Explained…

Index number

Factors of Explanation

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What does this mean…

- The top explaining variance factors are outside “WAIT_Q”, the following disks:

<table>
<thead>
<tr>
<th>Disk</th>
<th>Volume Group</th>
<th>Mount Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>HDISK3_Q</td>
<td>Q_index_vg</td>
<td>/u02</td>
</tr>
<tr>
<td>HDISK10_Q</td>
<td>Q_rman_vg</td>
<td>/u04</td>
</tr>
<tr>
<td>HDISK2_Q</td>
<td>Q_data_vg</td>
<td>/u01</td>
</tr>
</tbody>
</table>

- Based on the above it became very clear, that the big peaks found are caused by the backup:
  - RMAN reads from /u01 and /u02, and writes to /u04
  - The heavy utilization of /u01 and /u02 causes the heavy response time variance
August, Sept., Oct. 9:00 – 15:00 Explained...

Factors of Explanation

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Enhancements in the system...

- The research has shown that something was going on at the Storage layer
- Memory was added to the machines
  - More I/O was cached
    - But was still covering up some of the Storage issues
  - Database buffer cache size increase
- The Storage has been reconfigured, which solved a lot of the trouble
- Due to the growth of the business, now the system is hitting new performance variance from other causes
Variance of R in Jan 2008…

Percentage logins (PCT_GT_5SEC) which took longer than 5 seconds:
November, Dec., Jan. 9:00 – 15:00 Explained…
What to do with the found information…

- Basically we should start to investigate what each component has in common
  - So what has HDISK2_E to do with CPU_E
  - HDISK2_E is part of datavg and has mount point /u01

- The CPU and /u01 of the front-end machine (E) are the most explaining factors for the variance in the “Response Time” (R)

- This is the mount point with the data of the front-end database.
Very Recently Used GAPP At A Customer…

**Web Users**

**Network**

**GH200**
- Oracle Internet Directory (shared)
- OID Database (shared)
- Portal Database (shared)

**GH300**
- Application Server OID (shared with other applications)
- Portal (shared with other applications)
- Application Server ADF

**GH400**
- Two database, which are shared for several applications

**SAN**

**Storage**

**Business case:**
- Employee information screen too slow response times
- Logging in to the whole application too slow
The Factorial Analyses (Explain)…
The Model (Predict)...
Interpretation...

- Some peaks are not explained:
  - The data was on an 15 minute granularity
  - Not all involved factors were part of the analyses
  - Some OC4J container crashes have been caused by low memory settings

- The GAPP analyses showed that memory issues on the machine with the application servers and the portal database are having high impact on the response time of the researched business process.
GAPP Used In Service Oriented Architectures
What about SOA, A Simple BPEL Process...

- BPEL Process steps are stored in dehydration store

- This data can be mined via the “GAPP” method
“GAPP” vs. Service Oriented Architectures…

- The dehydration store contains data of BPEL processes and the timing data of the process steps. This information can be found in the “ORABPEL” schema.

- The dehydration store contains also timing data of the Enterprise Service Bus (ESB). This information can be found in the “ORAESB” schema.

- “GAPP” will make it possible to find bottleneck steps within the BPEL process for specific times and conditions.
The Timing data per instance within SOA Suite...

- Audit trail data can be found via the BPEL Process Manager
- Timing data is stored in the dehydration store in table WORK_ITEM and XML-files
Conclusions
Pro’s of GAPP...

- GAPP can be used to determine where the most “WAIT Time” is spent for a certain business process in very complex architectures.
- GAPP can be used without special tracing, it can use system metrics’, ASH data, etc.
- GAPP can find relations between components, which look not to be related at all (e.g. email and ERP system which share storage, network).
- GAPP is not database dependant.
- GAPP can use data mining software from all sources.
- GAPP can be used as a last resort.
Con’s of GAPP...

- GAPP can only be used when data has already been gathered over time.
- GAPP has no use for performance investigation of business processes which have no stable “Service Time”.
- GAPP only works when the workload overtime has a repetitive pattern.
- To use GAPP, knowledge of the infrastructure is needed, changes can be a big problem.
- Time differences between components in the architecture can be a big problem.
Conclusions…

- GAPP is a nice way of business process profiling in complex architectures (SOA architectures).
- Within the restrictions of GAPP, GAPP can be very powerful and can be used in a general way, independent of the technology
- GAPP can be a nice add on to Performance Management systems
- GAPP can predict possible future scenarios
- Although there are very expensive tools which could possible do this, this is a much cheaper approach
Reference...

- **AMIS Technology blog:**
  - [http://technology.amis.nl/blog/](http://technology.amis.nl/blog/)

- **NMON tool:**

- **Method-R:**

- **Oracle Data Mining:**
  - **Package DBMS_PREDICTIVE_ANALYTICS**
    - Oracle® Database PL/SQL Packages and Types Reference
    - 11g Release 1 (11.1) (Part Number B28419-03)
    - Chapter 89
Thank you for your attention.
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