IMS performance – taming the beast

Aurora Emanuela Dell’Anno
and who am I…

- Systems engineer on IBM mainframe
- Former application programmer
- Specialisation:
  - IMS
  - DB2 Family
    - LUW
    - for z/OS
    - DB2 Server for VSE and VM
  - Data Warehousing
  - Performance Tuning
The Performance Challenge

Who told you that?
Can you DIG IT?
And this is how we do it...
A Review
The Performance Challenge
Performance is a moving target!!

- Business growth
- New applications
- Mergers/acquisitions
- New system software
- Distributed integration
- New technologies
- CPU Creep
- Defects and recurring faults

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The Importance of Correcting Performance Problems Early

“The later performance problems are caught in the life cycle, the more costly they are to fix. Inefficiencies introduced in design can cost twice as much to fix during programming, four times more during system testing, and eight times more when the application enters production.”

Accenture
Impact of Ineffective Performance Tuning

When performance issues are not dealt with:

- Poor customer satisfaction
- Increased processing costs
- Missed SLAs – penalty charges
- Lost business due to poor reputation
- Inability to scale to business requirements and growth

### Cost of Problem Resolution

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Design</th>
<th>Development</th>
<th>Testing</th>
<th>Production</th>
<th>Resolution cost for 100 defects at x = $100</th>
</tr>
</thead>
<tbody>
<tr>
<td>1x</td>
<td>2x</td>
<td>10x</td>
<td>50x</td>
<td>100x</td>
<td>$1,000,000</td>
</tr>
<tr>
<td>% resolved</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>cost</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$1,000,000</td>
</tr>
</tbody>
</table>

- **Firefighting**
  - % resolved: 0%
  - % cost: 100%
  - Resolution cost: $1,000,000

- **Performance verification**
  - % resolved: 10%
  - % cost: 30%
  - Resolution cost: $601,000

- **Performance-driven development**
  - % resolved: 40%
  - % cost: 5%
  - Resolution cost: $184,000

Source: Forrester Research, Inc.
## Impact of Ineffective Performance Tuning

### Lost CPU Time Summary

<table>
<thead>
<tr>
<th></th>
<th>CPU Time</th>
<th>Lost CPU Time</th>
<th>Faults</th>
<th>Lost CPU Cost</th>
<th>Pct of Total</th>
<th>Worst Case</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; one second</td>
<td>257.94</td>
<td>4429</td>
<td></td>
<td>$53.74</td>
<td>0.8%</td>
<td>1.00</td>
</tr>
<tr>
<td>&lt; five seconds</td>
<td>1,482.04</td>
<td>645</td>
<td></td>
<td>$308.76</td>
<td>4.4%</td>
<td>5.00</td>
</tr>
<tr>
<td>&lt; one minute</td>
<td>2,939.66</td>
<td>159</td>
<td></td>
<td>$612.43</td>
<td>8.6%</td>
<td>56.84</td>
</tr>
<tr>
<td>&lt; five minutes</td>
<td>7,091.06</td>
<td>54</td>
<td></td>
<td>$1,477.31</td>
<td>20.9%</td>
<td>290.80</td>
</tr>
<tr>
<td>&gt; five minutes</td>
<td>22,236.15</td>
<td>13</td>
<td></td>
<td>$4,632.53</td>
<td>65.4%</td>
<td>6,036.36</td>
</tr>
<tr>
<td>Totals:</td>
<td>34,007</td>
<td>5,300</td>
<td></td>
<td>$7,084.76</td>
<td></td>
<td>6,036.36</td>
</tr>
</tbody>
</table>

### Lost CPU Cost Summary

- **Cost of Collection Period:**
  - Annualized Cost: $143,663.20

- **Lost CPU cost for Sample:** $7,084.76
The Performance Management Capability Maturity Model

Where is your IMS?

Level 5
Kaizen
Continually evaluate and improve your performance management program

Level 4
Disciplined
Establish accountability for application performance. Track, measure and report on the APM program

Level 3
Process oriented
Define processes for performance evaluation at established checkpoints

Level 2
Proactive
Reclaim production resources through repeatable projects

Respond to production crises

Organisational Benefits
The Performance Management Capability Maturity Model

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Organisational Benefits
Where is your DB2?

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Let us know our systems...

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Let us know our systems...

GUI Screens or Web Access

Web Server

Distributed Application Server

3270 Interface

IBM z/OS Enterprise Server

Transaction Servers
- CICS
- IMS/TM
- WebSphere MQ
- DDF

VTAM Protocols
- 3270
- TCP/IP
- WebSphere MQ
- APPC

Inventory

Billing

Orders

DL/I

Customers

VSAM

Java

C++

VB

and Others

Customer Information

Product Catalog
And what is IMS Performance?

- When we think about system health, we think about:
  - Efficiency
  - Code path length
  - Speed
  - Lack of bugs in code

- We also consider how easy new features are to use, whether new functions perform well, and how fault tolerant is our system.

An overall health measure for any operating environment, consists of a combination of all these.
Have I got a problem?

“The performance of an IMS system is directly related to a number of internal variables. These variables can be found in the z/OS® operating system, in IMS/TM, in IMS/DM, in the application, or in the hardware. External variables include the network and the physical infrastructure of your private network.”

Getting it straight

A performing system

- CPU and DASD capacity planning
- many tools for tracking and predicting need for future hardware upgrades
- High-performing system = healthy system

**IS NOT HEALTHY IF…**
- No log backups exist
- Most DBs are not registered in DBRC
- You are running IMS Version 6
- Maintenance is current to May 2008
- CPU is running at 100 percent capacity all day, every day

“Most technicians and managers equate health with performance; specifically, an IMS sub-system is healthy if some performance measure or metric remains high

**Organisations that simply equate health = performance**

**spend lots of time on performance tuning**

**and reacting to real or perceived performance issues**

**This deals with SYMPTOMS rather than causes**”
The goal of any IMS installation

**Effective use of system resources!**

- CPU cycles
- real storage
- I/O devices

- Is this goal met?
- What specific performance problems exist in the system?
  - Let us examine the current use of resources

And then, when we implement any changes, we must re-evaluate the use of the resources again.

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Why Tune IMS Applications?

Structure of an IMS application program
Why Tune IMS Applications?

**APPLICATION DESIGN**

80%

- Normalization
- Physical database design
- DL/I design and quality control
- Thread processing
- Dataset implementation
- Utility processing
- Etc...

**IMS SUBSYSTEM**

10%

- DBRC
- Shared queues
- LOG processing
- DB2 connections
- Etc...

**MVS SYSTEM**

10%

- Sub-system definition
- I/O configuration
- Etc...
The Performance Challenge

Who told you that?

Can you DIG IT?

And this is how we do it...

A Review

IMS performance – taming the beast

coloring the picture
Why and how to monitor Performance

Who told you that?
What Is The Value Of Perspective?
What Is The Value Of Perspective?
Performance Monitoring: what we look for

- Performance Metrics
- Baseline Information

Methodology Independent
- Repeatable – Reusable with minimum effort
- Manageable
- High Quality – Reliable
- Easy-to-Implement
- Production-friendly

Cost Effective
- Comprehensive Information
  - Performance Metrics
  - Baseline Information

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World of Monitoring

- MVS tuning
- CICS tuning
- DB2 tuning
- Efficient SQL
- Diagnostic tools:
  - Sysview
  - MAINVIEW
  - TMON
  - IMS PA
Whatever it is, remember TRACES!

- IMS Monitor trace, PI trace, PSB trace, and Fast Path trace provide a wealth of information:
  - Elapsed time and CPU time
  - Buffer pool statistics
  - Wait counts and times (I/O, locks, latches, etc)
  - Region information
  - DL/I count information
  - DB processing information
About IMS Traces and Monitors

Recommended regular reports

- IMS Monitor
  - Buffer pool statistics, general reports, Region/Program/Communication summary, I/O details, VSAM Buffer Pool reports
- KBLA / DFSERA10
  - Log data
- DFSILTA0
  - Log transaction analysis
- DFSKMSC0
  - MSC link response times
- DBCTL
- IRLM locks
- IMSplex information
- IMS Connect information

The Logical Tuning Approach
IMS performance – taming the beast

painting the picture

- The Performance Challenge
- Who told you that?
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Can you DIG IT?

Sub-system and application tuning...
Check this out for a healthy IMS Sub-system

Basically, these are the main things to be monitored
ANYWAY, even if nobody touches the applications…:

<table>
<thead>
<tr>
<th>SMP maintenance</th>
<th>includes looking at all the holldata for stuff that has to be rebound (usually every 3-6 months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bufferpool / message queue pool settings</td>
<td>if you have enough memory to just make them big, check every couple of months</td>
</tr>
<tr>
<td>IMS parameters</td>
<td>some people don't ever change them, but number of log buffers and checkpoint frequency frequency are 2 that can have major impact on performance</td>
</tr>
<tr>
<td>backups</td>
<td>to make sure they run and run correctly – OLDS, SLDS, trace and monitor data</td>
</tr>
</tbody>
</table>
Check this out for a healthy IMS Sub-system

1. DR
   - Co-ordination of logs and IC
   - Existence of a D/R plan
   - Backups

2. Growth
   - Measurement of percent busy
   - CPU-bound vs. I/O-bound
   - Quantity of traffic through DDF
   - Transaction throughput and DL/I calls (query vs. update)
   - Logging activity
   - Memory activity
   - Current bottlenecks
Check this out for a healthy IMS Sub-system

4. Stability
   • Maintenance process (version, currency)
   • Regular upgrades
   • Software maintenance strategy
   • People
     ➢ Business skills – Time management, meetings, communications
     ➢ Problem solving methodology
     ➢ Education, training, certification
   • Process monitoring
     ➢ Documentation: update, upgrade, centralise, review
     ➢ Process measurement

5. Maturity
   • CMM Level
The Mysterious and Complex World of IMS

Typical structure of an IMS online system environment
The Mysterious and Complex World of IMS

CICS-IMS DBCTL environment

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WLM Analysis

First degree of separation:
- long running bad transactions from transactions that run quickly

Then:
- transactions that run quickly into high, medium, and low volume transactions

Service Classes definition:
- for all region types based on transaction class rather than transaction codes

Too many service classes can produce unpredictable results

Response times:
- average host response times for all workloads
- what % of workloads will meet the average response times (SLA)?
- set up the workload using response time % and performance goals
Database Performance agents

- Which access method?
  - HISAM / HD, (P)HDAM / (P)HIDAM, HALDB, OSAM / VSAM
  - If you have HALDB: Partition criteria – Key range is generally appropriate

- Block sizes, CI sizes, and record sizes

- Free space

- Randomization parameters: randomization routine, RAPs, RAA, bytes parm

- Fixed length / variable length segments: what type of data goes in them?

- Pointer options: pointer maintenance

- SCAN= parameter on DATASET statement: free space searches

- Multiple data set groups: do you need them?
Database Performance agents

- Compression: storage, I/O and CPU usage considerations
- Encryption: do you need it?
- Secondary indexes: unique keys, duplicate data fields, shared indexes
- Fast Path performance considerations: VSO, Field calls, Buffers
- Non-recoverable databases
- OSAM or VSAM? OSAM is better with IMS but requires attention
- GSAM performance: PROCOPT, BUFNO, DCB=OPTCD=C
- REORG strategy
Transaction Manager Performance agents

- Call scheduling options: processing, classification, queuing
- Program load options: COBOL, DBLDL, LE, LLA
- TRANSACT macro parms: MAXRGN, SEGNO, PARLIM, PRTY, PROCLIM
IMS TM Performance agents: IMS Parameters

- **Buffer Pools**
  - for Fast Path: DBBF, DBFP, DBFX
  - Dynamic Pool manager (DFSPOOL) thresholds
  - Message format BP parms

- **IMS I/O Activity and Performance**
  - I/O sub-system performance
  - IMS Scheduling and Application I/O performance
  - ECSA / CSA usage
  - Dependent region PST
  - Message Queue buffers
  - RES PSBs and DMBs, page fixing

- **IMS Locking Activity**
  - IRLM lock activity, Claim and Drain activity
  - Lock contention and Lock escalation

- **IMS Logging**
  - Number of logs, single/dual logging, log I/O activity and checkpoint activity

- **DBRC**
DBCTL Performance agents

- DFSPZPxx
  - for Fast Path: FPBUF
  - Overflow buffers
  - Thread parms
- Variable pool allocation parms
- DFSPBxxx
  - Thread parms
  - Storage pool management
- IMS Logging
  - Number of logs, single/dual logging, log I/O activity and checkpoint activity
Logging and IMS

DEPENDENT REGION
USER
APPL
PGM

APPL PROG INTF
(API)

SCHEDULER
PSB
TST
DMB
SMB

EMH
BALG
EMHB

MSG Q MGR
MSGQ

MSC

LOGGER
LOG DATA SET

IMS A
IMS B
IMS C

IMSA
IMSB

Data Communications

TRACES
TRANSACTIONS OR PROGRAM TRACE
LINE OR NODE TRACE
MSC LINK TRACE
OTHER TRACES (SCHEDULER, DISPATCHER, ETC)
IMS Logging Considerations

- Every task in IMS must log
  - IMS has a physical logger and a logical logger
    - Each of these functions has its own TCBs
  - Two types of logs:
    - write ahead data set (WADS)
    - online log data set (OLDS)

A large IMS subsystem can perform enormous amounts of logging

- on CPU with 64-bit support (z/Architecture), log buffers are page fixed above the 2 GB line
- For this, OLDS block size must be multiple of 4096 (without exceeding half track value)
- With previous recommended block size of 26,624 we cannot use storage above the line
- If you increase your log buffers, careful with WADS (size of the WADS must be increased)
- Ensure the correct number of OLDS buffers are defined in DFSVSMxx
## IMS Log Record format

### Log record format

<table>
<thead>
<tr>
<th>LL</th>
<th>ZZ</th>
<th>RECORD TYPE</th>
<th>RECORD SUBTYPE</th>
<th>RECORD CONTENT</th>
<th>STCK</th>
<th>LSN</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Bytes</td>
<td>2 Bytes</td>
<td>1 Byte</td>
<td>1 Byte</td>
<td></td>
<td>8 Bytes</td>
<td>8 Bytes</td>
</tr>
</tbody>
</table>

- **LL** = Variable length field
- **ZZ** = Usually binary zeroes
- **STCK** = Binary value for hardware clock
- **LSN** = Log sequence number

Record Type and subtype show type of log record.
Other IMS Performance agents

- **DBRC - RECONS**
  - Dataset definition
  - Dataset contention issues
    - GRS
  - Dataset maintenance

- **SMF and RMF**

- **Batch applications**

- **IMS Utilities:**
  - Change accumulation, pointer checker, image copy, recovery utilities, etc.
IMS performance – taming the beast

painting the picture

- The Performance Challenge
- Who told you that?
- Can you DIG IT?
- And this is how we do it...
- A Review
And this is how we do it

Re-writing the process
The tools we need to check our IMS’s health

1. **Tick-boxes:**
   - DR practices
   - Capacity Planning
   - Proactive, predictive, self-healing
   - Stability
   - Maturity

2. **Tuning knobs:**
   - Sub-system configuration
   - Catalog and directory
   - Access Paths
   - Data: volumetric and configuration
   - Process objects
The next steps: Autonomic Computing

1. Collect multiple sources of event, threshold, and statistical data
2. Consolidate, analyse, and report data using performance management tools
3. Use correlations and recommendations available from monitoring software and other sources
4. SCRIPT!
5. Integrate components for dynamic management
The objectives of performance testing are defined for specific applications/transactions. Every application/transaction will have its own objectives, and its own limits, according to the use which is made of it.

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The holistic approach: what is at stake?

Quality

- User benefits
  - Service contracts quality assurance
  - User and customer satisfaction

Budget

- Profitability of the data-processing investment
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In short - a review
The ultimate holistic approach

1. Define performance objectives & metrics
2. Create monitoring, testing and tuning procedures
3. Implementation practice – again from the top!
Read the books!!!!!

- http://www.redbooks.ibm.com

Manuals and Redbooks:
- IMS Primer
- IBM IMS Version 12 Technical Overview
- Transaction Processing: Past, Present, and Future
- IMS Performance and Tuning Guide
- DBRC In Practice – from www.bmc.com

- IMS-L: IMS-L@IMSLISTSERV.BMC.COM
Thank you very much!!!

With special thanks to: