Managing z/VM & Linux Performance Best Practices

Mike Sine
IBM, Advanced Technical Skills, Americas

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AGENDA

• Introduction

• Monitoring Requirements
  • Virtual Linux and z/VM performance considerations
  • Don’t forget the hardware
  • Integration from hardware – systems – applications Persistent historical views

• Enterprise Management

• Operational Requirements
  • Centralized Control
  • Including all Enterprise Virtual Machines

• Integrating Monitoring and Operations

• Bringing it all together
Virtual Linux servers have unique challenges versus running on physical machines.

- z/VM System Programmers and Linux Administrators may not be in the same organization.
- We find that it is easy to over allocate resources; therefore, our monitoring examines resource usage of hardware, hypervisor, as well as the virtual machine. Real-time and historical metrics demonstrate peaks periods as well as average runtimes.
- Cross-platform virtualization increases these challenges
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  • Don’t forget the hardware
  • Integration from hardware – systems – applications Persistent historical views
• Enterprise Management
• Operational Requirements
  • Centralized Control
  • Including all Enterprise Virtual Machines
• Integrating Monitoring and Operations
• Bringing it all together
There are 2 types of agents
- There is one z/VM agent per z/VM LPAR
- There is one Linux agent per Linux Guest
- Both types run on Linux
An Integrated Monitoring Approach

- Provides performance monitoring for z/VM and Linux guests
- Executes automated actions in response to defined events or situations
- Integrates well across Enterprise for central control and trending:
  - Specifically focused on z/VM and Linux guests
  - Able to integrate z/VM and Linux into Enterprise Solution
  - Data warehousing for trend analysis
# Workspaces to Manage z/VM and Linux

## z/VM
- Processors
- SYSTEM Utilization, spinlocks
- Workload
  - Linux Appldata
  - Scaled & total CPU values
- LPAR Utilization
- PAGING and SPOOLING Utilization
- DASD
- Minidisk Cache
- Virtual Disks
- Channels
- CCW Translation
- REAL STORAGE Utilization
- NETWORK Utilization (Hiper Socket and Virtual Switch)
- TCPIP Utilization – Server
- TCPIP Utilization – Users
- Resource Constraint (Wait states)
- System Health

## Linux
- Linux OS
- System Information
  - CPU aggregation
  - Virtual Memory Statistics
- Process
- Users
- Disk Usage
- File Information
- Network
Have I allocated enough Virtual CPUs to my guest?

- Do not define more virtual CPUs for a Linux guest than are needed.
  - The use of more than one processor requires software locks so that data or control blocks are not updated by more than one processor at a time.
  - Linux makes use of a global lock, and when that lock is held, if another processor requires that lock, it spins.
  - Set the number of virtual processors based on need and not simply match the number of real that are available.
  - Careful when cloning as some Linux guests require more Virtual CPUs (ex: Running Websphere, Oracle) than others.
Aggregate monitoring of Virtual CPUs
z/VM Processor Utilization

- **Total Processor Utilization**: This is the processor utilization from the VM perspective and includes CP, VM System, and Virtual CPU time.

- **System Time**: This is the processor time used by the VM control program for system functions that are not directly related to any one virtual machine. This should be less than 10% of the total.

- **CP Processor Time**: This is the processor time used by the VM control program in support of individual virtual machines.

- **Virtual Processor Time: (Emulation Time)**: This is processor time consumed by the virtual machine and the applications within it.

- **Total to Virtual Ratio**: The ratio of total processor time to virtual processor time is often used as an indicator of z/VM efficiency or overhead. The closer to 1.0, the better the z/VM efficiency. RoT: Should explore causes of a ratio over 1.30.
System Processor Utilization Workspace
z/VM Workload Workspace
Spin Lock Wait

- **Time Spinning on Locks Percent:**
  - The percentage of time processors spend spinning on formal spin locks. RoT: Should be less than 10%.
  - Increases as number of logical processors increases.
Spinlock Workspace
Is my Linux guest sized correctly?

- In general, do not define the Linux virtual machine larger than you need.
  - Excessive virtual machine sizes negatively impact performance.
  - Linux uses any extra storage for caching of data. For shared resources, this is an impact.
  - Reduce the size of the Linux guest until it starts to swap (use VDISK for swap).
  - A good exercise is to compare Linux memory usage to z/VM working set size for the guest.
Need breakdown of memory use
Working Set Size
Page/Swap Attributes
VDISK

• What is it?
  • FBA (Fixed Block Architecture disk) device emulated in-memory
    • Translation: Very fast “device”.
  • High performance paging device for Linux on z.
  • Memory is allocated by CP from the Dynamic Paging Area
  • Allocated only when referenced
    • Allocating a 10 MB device does NOT instantly consume 10 MB of pages.
    • Pages are allocated when needed.
  • Not recommended in a storage-constrained z/VM system.
Memory Configuration

• Plan on a virtual to real (V:R) memory ratio in the range of 1.5:1 to 3:1.
• Recommend configuring some processor memory as expanded storage:
  • Serves as high speed cache.
  • Increases consistency of response time.
• Rule of Thumb - start with 25% of memory configured as expanded:
  • Typically 2–4GB of expanded storage is sufficient, 1GB minimum.
  • The lower the paging rate, the lower the amount of expanded storage required.
  • The greater the number of page frames available in central storage above 2GB, the higher the amount of expanded storage required.
OMEGAMON Memory Configuration
Paging Subsystem

- Plan for DASD page space utilization < 50%:
  - Page space tends to get fragmented over time.
  - Large contiguous free space allows for greater paging efficiency.
  - Monitor usage with OMEGAMON XE or Q ALLOC PAGE command.
- Do not mix page space with any other space on a volume.
- Recommend using devices of the same size/geometry.
- Calculation guidelines are located in the CP Planning and Administration Manual.
OMEGAMON CP Owned Devices – Paging Subsystem

- Paging and Spooling Space
- Top 5 Page Extent Utilization
- Top 5 Dump Extent Utilization
- Top 5 Spool Extent Utilization
- CP Device Table (Paging and Spooling)
z/VM Page Attributes
Minidisk Cache

• z/VM minidisk cache is a write-through cache:
  • Improves read I/O performance.
  • But it’s not free.
• Not recommended for:
  • Memory constrained systems.
  • Linux swap file disks.
  • Flashcopy targets (see next chart)
• Default system settings are less than optimal.
• Recommended settings:
  • Eliminate MDC in expanded storage.
    • SET MDC XSTORE 0M 0M
  • Limit MDC in central storage – 10% is a good starting point.
    • SET MDC STORE 0M 256M
  • Monitor with product like OMEGAMON XE and/or the Q MDC command.
MDC and FlashCopy Interaction

- FlashCopy requests require z/VM to flush MDC for the entire minidisk.
- MDC Flush processing is very expensive even when there is no data in MDC to flush
  - System Time becomes very high.
- z/OS DFSMS and other utilities can make extensive use of FlashCopy for functions such as defragmentation
- Mitigations
  - Turn off MDC for minidisks that are FlashCopy targets
OMEGAMON MDISK Cache Allocations
### OMEGAMON MDISK Cache Allocations – p. 2

![Cache Allocations Table]

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Direct Access Storage Devices (DASD)

- **Avg Pending Time for DASD**
  - Average pending time for real DASD I/Os. RoT: Should be less than 1 millisecond.

- Items worth keeping an eye on:
  - **Number of I/O’s per Second, Percent Busy**
  - **Avg Service Time** Average service time for real DASD devices (sum of the pending, connect, and disconnect times).
  - **DASD I/O Rate** Rate of traditional real I/Os per second to real DASD devices. Worth monitoring.
DASD I/O Workspace
System Dump & Spool Space

• Dump Space
  • Ensure there is sufficient dump space defined to the system.
  • Dump space requirements vary according to memory usage.
    • Q DUMP – identifies allocated dump space.
    • Calculation guidelines are located in CP Planning and Administration Manual.

• Spool Space
  • Various uses:
    • User printer, punch, reader files (console logs)
    • DCSS, NSS
    • System files
    • Page space overflow

• Spool Management:
  • Monitor with Q ALLOC SPOOL command.
  • SFPURGER utility:
    • Rule based tool to clean up spool space.
    • Included in the no charge CMS Utilities Feature (CUF).
VMDUMP Processing Concern

• VMDUMP is a very helpful command for problem determination.

• Some weaknesses:
  • Does not scale well, can take up to 40 minutes per GB.
  • It is not interruptible
    • APAR VM64548 is open to address this.

• Linux provides a disk dump utility which is much faster relative to VMDUMP.
  • It is disruptive
  • Does not include segments outside the normal virtual machine.

System Dump & Spool Space
Tips—Overall Health of Your System

At a quick glance, you can see the %CPU usage, what your overcommit ratio is, the number of users in a wait state, and paging rates of all your z/VM systems.
Resource Constraint Analysis (Waits)
Do not ignore the hardware!

- Just because Linux resources are virtual, do not ignore the hardware!
  - Hardware is another potential layer of shared resources.
  - LPAR weight, CPU sharing, LPAR load, and other attributes need to be monitored for overall system performance.
  - The measurement should include the entire CEC and not just the LPAR hosting z/VM.
Processors

- Logical Processors
  - LPAR recommendation – no greater than a 4:1 logical to real ratio.
  - z/VM 5.1 - z/VM 5.2 support up to 24 processors.
  - z/VM 5.3 - z/VM 6.1 support up to 32 processors.
LPAR Utilization Workspace
Processor by LPAR name workspace
Persistent Historical Views

This makes it easier to see anomalies, or match spikes. Capturing performance data as a base line is a must:

• General history data – business as usual.
• Detailed raw monitor data prior to and following any major changes.
• Ability to review attributes of a past incident.
Persistent Historical Views
Persistent Historical Views
Tivoli Common Reporting (TCR)

- TCR reports available on the OPAL website
- What is TCR?
  - Tivoli Common Reporting.
  - Consistent approach to viewing and administering reports.
  - Built on top of open source reporting tool called: BIRT.
  - Flexible development environment (Eclipse based) for creating report definitions.
  - Five templates provided for download.
  - Taking suggestions for more
Sample Reports Available

- z/VM VM System CPU Utilization
- z/VM VM System Paging Utilization
- z/VM Linux System CPU Utilization
- z/VM VM System CP-Owned Device Utilization
- z/VM VM System TCP Server Statistics
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  • Don’t forget the hardware
  • Integration from hardware – systems – applications Persistent historical views
• Enterprise Management
• Operational Requirements
  • Centralized Control
    • Including all Enterprise Virtual Machines
• Integrating Monitoring and Operations
• Bringing it all together
Addressing the trend – zEnterprise will enable management of diverse resources across diverse platforms as a single Workload

• A Platform Workload is a grouping mechanism and “management view” of virtual servers supporting a business application
• Provides the context within which associated platform resources are presented, monitored, reported, and managed
• Management policies are associated to Platform Workload
  • Currently supports Performance Policy
Looking at managing the zEnterprise aka “systems of systems“
getting yourself organized..

**Visibility**
See your Business

**Control**
Manage service risk and compliance

**Automation**
Optimize business service delivery

Manage different Hypervisors as Centralized resource.
Monitoring and Managing the Enterprise – zEnterprise will enable the management of Resources across Virtual Servers

- Manage resources across virtual servers to achieve workload goals
  - Detect that a virtual server is part of Workload not achieving goals
  - Determine that the virtual server performance can be improved with additional resources
  - Project impact on all effected Workloads of moving resources to virtual server
  - If good trade-off based on policy, redistribute resources
  - Initially support CPU management
Business views across the zEnterprise

- ITM Infrastructure is shown separate to highlight components, however, each of these ITM components can reside on the zEnterprise.
- OMEGAMON agents can monitor z/OS system and subsystems, z/VM system and LPAR components, and Linux on z.
- ITM agents can monitor Linux on System z, Linux on System x, and AIX on Power7, and supported applications and databases.

Common Interface across the zEnterprise

Note: All statements regarding IBM’s plans, directions, and intent are subject to change or withdrawal without notice, and represent goals and objectives only.
The future is ensembles and multiple hypervisors

System z Hardware Management Console (HMC) with Unified Resource Manager

- zBX
- Select IBM Blades
- z/O S
- z/TPF
- z/VSE
- Linux on Sy s z
- Linux on Sys z
- System z Host
- Blade HW Resources
- z/VM
- Support Element
- IBM Smart Analytics Optimizer
- z HW Resources
- z/OS
- Support Element
- z/VM
- Private High Speed Data Network IEDN
- Unified Resource Manager
- Tivoli Enterprise Portal (TEP)

Manage different Hypervisors as Centralized resource.
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Operations Manager for z/VM

Increase productivity
- Authorized users view and interact with monitored virtual machines without logging onto them
- Multiple users view/interact with a virtual machine simultaneously

Improve system availability
- Monitor virtual machines and processes
- Take automated actions based on console messages
- Reduce problems due to operator error

Automation
- Routine activities done more effectively with minimal operations staff
- Schedule tasks to occur on a regular basis

Integration
Fulfill take action requests from OMEGAMON XE on z/VM and Linux
Features and Functions

- Monitor service machine consoles
- Monitor spool usage
- Monitor system events
- View and interact with monitored consoles from authorized user IDs
- Find and view spool files
- Schedule events/actions
- Dynamic configuration
- Separation of access control
Enterprise level console/syslog management:

- Centralized console/syslog management.
- Message log console for operations and automation.
- Similar to z/OS console management for host based operations.

Operations Manager for z/VM

- View & interact with consoles
- View spool files
- Monitor spool usage
- Schedule tasks
- Console monitoring
- Take action
- Service Virtual Machine being monitored

Note: All statements regarding IBM's plans, directions, and intent are subject to change or withdrawal without notice, and represent goals and objectives only.
Monitor Service Machines

- Define rules to
  - Scan console messages for text matching
    - Includes column, wildcard, and exclusion support
    - Optionally restrict to specific user ID(s)
  - Take actions based on matches
- Multiple rules can apply to one message
  - Rules processed in order of definition in the configuration file
  - FINAL option available to indicate no additional rules should be evaluated
View and Interact with Consoles

- Authorized users can view live consoles of monitored service machines and guests
  - Multiple users can view the same console simultaneously
  - No need to logon to the service machine to see its console
  - Test data and Linux syslog data treated as a “console”
  - Views can be defined to look at a group of consoles in one view
- Full screen mode
  - Scroll up and down to view and search historical data
  - Auto scroll (on or off) as new output is displayed on the console
  - From command line, issue commands back to the monitored console
- Amount of data that is visible depends on specified or default data space size
- Rules/actions may modify the view
  - Suppress messages from the console
  - Hold or highlight messages with color, blinking, etc.
- Authorized users can view the log file
  - Can also request a copy of the log file from today or a previous day
Monitor and View Spool Files

• Create spool monitors to trigger actions when
  • Percent of spool usage falls within a specified range
  • Percent of spool usage increases at a specified rate
• Actions triggered can be the same actions used by console monitoring
• Authorized users can
  • Display a list of spool files based on one or more attributes
    • Owner
    • Size
    • Date created
  • From the list the user can
    • View the contents of an individual spool file
    • Transfer, change, or purge a spool file
Schedule Events and Actions

• Define schedules
  • Hourly, daily, weekly, monthly, or yearly, nth weekday of the month
  • Once on specified month, day, year, and time
  • At regular intervals
    • Every x hours and y minutes
  • Within a specified window of time
    • Specify start time
    • Specify conflicting schedules
    • Specify maximum time to defer this schedule
  • Within limits
    • Restrict to specific days of the week: Monday through Sunday plus holidays
    • Restrict to certain hours of the day

• Specify the action associated with the schedule
  • Actions specified are the same as those for console and spool monitoring
Respond to System Events

- Create monitors for z/VM system events (*VMEVENT) related to user IDs
  - Logon
  - Logoff
  - Failure condition (typically CP READ)
  - Logoff timeout started
  - Forced sleep started
  - Runnable state entered (VM READ)
  - Free storage limit exceeded
- Optionally restrict to specific user ID(s)
- Specify the action associated with the event
  - Actions specified are the same as those for schedules and console and spool monitors
Dynamic Configuration

• Initial configuration file loaded at startup
  • May imbed other configuration files
• Most configuration options can be updated while Operations Manager is running
  • Add, delete, or change:
    • Rules, actions, monitors, schedules, holidays, groups, user authorization
  • Suspend or resume rules, monitors, schedules
• Multiple methods
  • GOMCMD command interface
  • Load a new or updated configuration file
  • Commands in DEFACTN statements
Operations Manager

- Existing Service Virtual Machine 1 being monitored
- Existing Service Virtual Machine 2 being monitored
- Existing Service Virtual Machine 3 being monitored
- Existing Service Virtual Machine or remote system

Authorized Users
- View and interact with monitored consoles
- Find and view spool files
- Update configuration information

Main Server (OPMGRM1)
- Captures consoles
- Evaluates rules
- Triggers schedules
- Monitors events and spool usage
- Executes actions or sends them to action processing servers

Action Processing Server (OPMGRSn)
- 0 to n server instances
- Processes actions as a result of:
  - Console rule matching
  - Spool monitors
  - Event monitors
  - Schedules
Summary

- Use Operations Manager to
  - Automate daily operations
  - Prevent problems rather than react to them
  - Automate reactions to problems when they can’t be prevented
  - Improve problem determination procedures
  - Increase programmer and operator productivity
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Bring it all together

It is often that a unit of work is serviced by multiple applications and databases across multiple operating systems, including z/VM and Linux. Integrated views allow:

- Unit of work, or application tracking
- Business views
- Single skill sets to monitor dissimilar hardware, operating system, and application environments.
Application View: Scaling Scenario

- WebSphere MQ on Linux for System z receives “order requests” in the form of Queue messages, and places them on a queue.
- A WebSphere Application Server is invoked to periodically check the queue for messages and process them to a DB2 on z/OS database.
- The orders are coming too fast for the Websphere application to process.
- A second Linux server is started with another copy of Websphere application server to aid in the processing of requests.
Application View: Scaling Scenario

- Trigger: Queue Depth
- Options for triggering actions can be based on things such as:
  - The number of orders received but not yet processed (the number of messages on the queue)
  - The amount of time it is taking to process the orders
  - The response time of the web application
  - The CPU usage of the z/VM Guest
  - Other things I haven’t given much thought to yet.
Scaling Scenario
Adjusting Resources for a Linux Guest

- Virtual CPU consumption is high for a Linux guest
- Detect the alert
  - Automation receives the message
- Action is triggered by a rule in Operations Manager
- Operations Manager issues CP commands to tune the guest
  - SET QUICKDSP
  - SET SHARE
- Ability to monitor the output is key
Adjusting resources for a Linux guest
OMEGAMON Configuration

- Define a situation (alert) to detect high CPU consumption for Linux virtual machines.
- Define the automated “Take Action” to:
  - Direct a message to console monitored by Operations Manager.
  - Include in the message keywords to trigger Operations Manager rule.
    - Guest Name
    - Guest need CPU priority text
    - Any unique data desired for specific customer environment.
Thank You

Merci

Grazie

Danke

Obrigado

Gracias

Thank You

Thank You

Danke

Merci

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