Managing Linux Using 'Secret' Tools in z/VM

Session 9302
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Jim Elliott
Linux Advocate
@server Strategic Initiatives
IBM Canada Ltd.
Over the years IBM has added a lot of utility functions to what is now z/VM and its features. For most people, these utilities remain a hidden secret as they are buried in the large library of z/VM's documentation. Topics will include the using the FCON tool, the z/VM RealTime Monitor (RTM) feature and the AUDITOR, ACCOUNT and PROP utility functions of CMS, among many others! This session will bring to light these utilities and provide an overview of how they can be used to make your life easier in managing and monitoring your Linux for zSeries and Linux for S/390 images.

This session qualifies for the Linux on S/390 certificate track.
Agenda

- System Utilities
- PROP
- Operating a Linux Virtual Machine
- VM Download Packages
- FCON
- RTM

Note: IBM z/VM publications are available at ibm.com/vm/library
System Utilities

ACCOUNT - Provides basic processing of z/VM accounting records

AUDITOR - Monitors virtual machine status

DIRMAP - Creates a map of all minidisk and link statements in the user directory

QSYSOWN - Maps system disk space

SF PURGER - Manages spool space and spool files
ACCOUNT

Processes accounting records collected using the CP RETRIEVE command from the *ACCOUNT system service

Only basic accounting records are processed
  - Virtual machine resource use, Dedicated device use and temporary disk space use (codes 01, 02 and 03)
  - User written application required for processing of all accounting records (defined in HCPACOBK)
    - REXX exec or use DTRYACC ASSEMBLE on MAINT 393 as a base

Selective processing possible by userid, account number and project number

Use VMSERVE to issue CP ACNT CLOSE command at end of shift to enable shift reporting
  - VMSERVE can also be used to initiate automatic processing of accounting records
AUDITOR

System Utilities

- Monitors status of selected virtual machines
  - Running properly
  - Logged off
  - Disabled wait state
  - Failed user tests
- Restart virtual machines which fail test
- Automated tool with operator command support

************************************************************************
* AUDITOR CONTROL
************************************************************************

* MACHINE  TEST AUTO FORCE TEST MAX NOTIFY
* ID INTERVAL LOG &AUTO EXIT ERRS USER ID
************************************************************************
APACHE  00:01:00 1 1 WEBTEST 10 OPERATOR
LINUX1  00:30:00 1 1 NONE 10 OPERATOR
SMBSRV  00:01:00 1 1 SMBTEST 10 OPERATOR
************************************************************************
DIRMAP
System Utilities

- MDISK/LINK mapping utility
- Processes the USER DIRECT file
- Output files
  - MDISKMAP - Map of all MDISKs
  - LINKMAP - Cross reference of all LINK statements
  - GAPFILE - List of all available "gaps"
- See also the DISKMAP command in the *CP Command and Utility Reference, SC24-6008*
QSYSOWN
System Utilities

- Reports availability and use of system disk space
  - Page and spool space
  - Number of pages available and in use
  - Percent of pages in use

- CP QUERY ALLOC command for detailed information

** Summary Information:

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<thead>
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</table>
SFPURGER
System Utilities

- Manage spool space and spool files
- Purge, ignore or place holds on a spool file
- User-written action routines supported

*******************************************************************************
* Sample SFPURGER CONTROL File *
*******************************************************************************
* Ignore any spool files found in the NSS queue (privilege class E) *
  QUEUE NSS ACTION IGNORE
* Purge any spool files found in class 0 *
  CLASS 0 ACTION PURGE
* Keep spool files owned by maintenance user IDs *
  USERID MAINT* ACTION IGNORE
* Purge dump files after 4 weeks. Ignore the rest *
  TYPE DMP DAYS 29 ACTION PURGE
  TYPE DMP ACTION IGNORE
* Change console logs to system hold after 1 week *
  TYPE CON DAYS 8 ACTION SYS HOLD
* Purge any reader files in USERHOLD after 4 weeks. Ignore the rest *
  QUEUE RDR DAYS 28 HOLD USER ACTION PURGE
  QUEUE RDR ACTION IGNORE
* Purge any other print files after 2 weeks. Change the rest *
  to USERHOLD *
  QUEUE PRT DAYS 15 ACTION PURGE
  QUEUE PRT ACTION USERHOLD
PROP is designed to increase the efficiency of system operation by intercepting all messages and requests directed to its virtual machine and by handling them according to preprogrammed actions.

The tasks that can be performed by the programmable operator facility include:

- Logging messages
- Suppressing message display and routing messages to a logical (real) operator
- Executing commands
- Responding with preprogrammed message responses
Operating a Linux Virtual Machine

Running Guest Operating Systems, SC24-5997

- Problem determination
  - Application documentation
  - Linux console messages
  - /var/log
  - Linux distributor or service organization
- Automatically booting Linux
  - CP XAUTOLOG command
  - AUTOLOG1 userid
- Analyzing performance
- CP commands to know at the Linux operator’s console
Analyzing Performance
Operating a Linux Virtual Machine

- Performance tools from IBM
  ibm.com/vm/perf
  - RTM - Short-term study or problem solving
    ibm.com/vm/related/rtm
  - PRF - Long-term trend analysis or capacity planning
    ibm.com/vm/related/prf
  - FCON - The best of both, coming soon to z/VM!
  - RMF PM with support for Linux
    ibm.com/eserver/zseries/zos/rmf/rmfhtmls/pmweb/pmlin.htm

- Performance publication
  ibm.com/vm/perf/docs
Analyzing Performance ... Operating a Linux Virtual Machine

- CP commands to enhance performance
  - INDICATE - Broad overview of how system resources are being used
  - LOCK - Lock in real storage selected pages
  - SET SHARE - Control percentage of system resources a guest receives
  - SET QUICKDSP - Designate guests that don't wait in the eligible list
  - SET RESERVED - Set number of pages resident in real storage
  - DEDICATE - Allocate a processor to a guest
CP Commands to Know at the Linux Operator's Console

Operating a Linux Virtual Machine

- **COUPLE**
  - Connect a virtual channel-to-channel adapter (CTCA) to a compatible virtual CTCA
  - Connect a virtual adapter (NIC) to a compatible virtual LAN segment

- **DEFINE**
  - Change the configuration of your virtual machine
  - Change the configuration of your operating system
  - Add a new VM LAN to your system

- **DETACH**
  - Virtual processors from your virtual machine
  - Real and logical devices from the host system
  - Real, logical and virtual devices from your virtual machine
  - A VM LAN segment from the host system
CP Commands to Know at the Linux Operator's Console ...

Operating a Linux Virtual Machine

- **ATTACH**
  - Real or logical device to a virtual machine
  - Disk to the host system

- **DISPLAY**
  - The contents of first-level storage
    - The real storage of the processor
  - The contents of second-level storage
    - The storage that appears real to the operating system running in your virtual machine
  - The contents of third-level storage
    - The storage that appears virtual to the operating system running in your virtual machine
  - The old and new PSWs, interrupt information and registers
CP Commands to Know at the Linux Operator’s Console ...

Operating a Linux Virtual Machine

- TERMINAL HOLD
  - Control whether CP displays the HOLDING status when the terminal screen is full

- TERMINAL MORE
  - Change the number of seconds that elapse between the time when CP issues the MORE... state and sounds the terminal alarm before CP clears the screen

- TRACE
  - Monitor events that occur in your virtual machine

- VMDUMP
  - Dump all or selected pages from second-level storage

- CP Command and Utility Reference, SC24-6008
VM Download Packages

ibm.com/vm/download/packages

- CMSDDDR - Enhanced DDR program to simulate DDR tapes via CMS files
- SMARTX - An XEDIT-based front-end for RTM
- SPOOLCHN - System programmer and system operator extended spool query commands
- VMSERVE - A service virtual machine manager that handles reader files, messages and time-of-day events
CMSDDR

VM Download Packages

- From Gerhard Widmayer, IBM Germany
- This package provides you with a kind of I/O redirection for DDR tapes into CMS files via a modified DDR Module
- It comes with a sample EXEC to perform DDR DUMP and RESTORE for minidisks
- A help file explaining the additional features is included
The purpose of SMARTX is twofold:
- Help the occasional users of RTM to find and execute the available RTM commands
- Keep the data returned by RTM in an XEDITed CMS file.

When in the XEDIT file, PFkeys are available for various functions:
- Obtain description of the RTM keywords
- Plot data using GDDM/REXX
- Automatically repeat an RTM command
- ...

The PROFSMRT XEDIT macro can be very useful when viewing saved SMART reports.
SPOOLCHN

VM Download Packages

- From Richard Ross, IBM
- SPOOLCHN is a VM system programmer utility (class C or E) which will display files in the spool system
- SPOOLCHN has the following advantages over the standard spool Query commands:
  - can show spool usage (blocks of spool data)
  - shows more information than the spool Query commands
  - output can be directed to terminal, stack, disk, or variables in REXX
  - output can include an exec for manipulating the spool files
  - more search criteria than spool Query, such as number of records, age of file, etc.
  - wildcard searches allowed
  - does not tie up system resources like Q RDR ALL
VM SERVE

VM Download Packages

- From Les Koehler, IBM

- VM SERVE is a general purpose Disconnected Virtual Machine (DVM) manager for VM which will handle incoming reader files, messages, and time-of-day events

- Some of the features of VM SERVE are:
  - A set of command options to: Define the application name, Initiate extended console spooling, Turn internal tracing on, Perform a check of the run-time definitions, Override the internal interrupt priority scheme, Override the internal Reader and Message security checking sequence
  - A PROFILE file is used to specify the details of what to do when a reader file or message arrives, and who is allowed to send what
  - A LOG file can be kept for auditability
  - Common pieces of the PROFILE can be placed in separate files and shared amongst many VM SERVE driven machines
  - User exits are available to enhance the operation of VM SERVE
  - A TIMES file may be used to trigger repeating tasks

- Although VM SERVE provides the facilities to accomplish the above, it is up to the application developer to properly implement the facilities necessary to meet their business needs
FCON

Coming to z/VM as a Feature Soon!

- The 'Full Screen Operator CONsole and Graphical Real Time Performance Monitor' (FCON) is a CMS utility designed to assist operators and systems programmers or analysts in the following areas:
  - System console operation in full screen mode
    - Designed to facilitate the operation of VM systems, thereby improving operator efficiency and productivity
  - Performance monitoring on z/VM systems
    - An enhanced real time performance monitor allows systems programmers to monitor system performance and to analyze bottlenecks
    - Designed to improve the systems programmer's productivity when analyzing the system, and to allow even a more casual user to work efficiently with the tool
    - Helps systems programmers to make more efficient use of system resources, to increase system productivity and to improve end-user satisfaction
System Console Operation in Full Screen Mode

FCON for General System Operating

- General system output (informational messages and replies to commands entered) can automatically be scrolled, using an enhanced scrolling logic.
- Messages from other virtual machines are numbered and left pending at the top of the screen until explicitly deleted, even if automatic scrolling is active.
- The last few important "action" messages (number can be specified) can also be left pending at the top of the screen until explicitly deleted.
- Optionally additional processing of output lines which meet certain user specifications.
- A redisplay facility allows browsing through the day's accumulated console log, or through previous day's logs.
# Initial Performance Data Selection Menu

**FCON in Performance Monitor Mode**

<table>
<thead>
<tr>
<th>Category</th>
<th>Data Options</th>
</tr>
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<tbody>
<tr>
<td>General System Data</td>
<td>I/O Data</td>
</tr>
<tr>
<td>1. CPU load and trans.</td>
<td>11. Channel load</td>
</tr>
<tr>
<td>2. Storage utilization</td>
<td>12. Control units</td>
</tr>
<tr>
<td>3. Storage subpools</td>
<td>13. I/O device load*</td>
</tr>
<tr>
<td>4. Priv. operations</td>
<td>14. CP owned disks*</td>
</tr>
<tr>
<td>6. CP IUCV services</td>
<td>16. DASD I/O assist</td>
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<tr>
<td>7. SPOOL file display*</td>
<td>17. DASD seek distance*</td>
</tr>
<tr>
<td>8. LPAR data</td>
<td>18. I/O prior. queueing*</td>
</tr>
<tr>
<td>9. Shared segments</td>
<td>19. I/O configuration</td>
</tr>
<tr>
<td>A. Shared data spaces</td>
<td>20. I/O config. changes</td>
</tr>
<tr>
<td>B. Virt. disks in stor.</td>
<td>User Data</td>
</tr>
<tr>
<td>C. Transact. statistics</td>
<td>21. User resource usage*</td>
</tr>
<tr>
<td>D. Monitor data</td>
<td>22. User paging load*</td>
</tr>
<tr>
<td>E. Monitor settings</td>
<td>23. User wait states*</td>
</tr>
<tr>
<td>F. System settings</td>
<td>24. User response time*</td>
</tr>
<tr>
<td>G. System configuration</td>
<td>25. Resources/transact.*</td>
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<tr>
<td>H. Exceptions</td>
<td>26. User communication*</td>
</tr>
<tr>
<td>I. User defined data*</td>
<td>27. Multitasking users*</td>
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<tr>
<td></td>
<td>28. User configuration*</td>
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<td></td>
<td>29. Linux systems*</td>
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<td></td>
<td>History Data (by Time)</td>
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<td>31. Graphics selection</td>
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<td>32. History data files*</td>
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<tr>
<td></td>
<td>33. Benchmark displays*</td>
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<tr>
<td></td>
<td>34. Correlation coeff.</td>
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<tr>
<td></td>
<td>35. System summary*</td>
</tr>
<tr>
<td></td>
<td>36. Auxiliary storage</td>
</tr>
<tr>
<td></td>
<td>37. CP communications*</td>
</tr>
<tr>
<td></td>
<td>38. DASD load</td>
</tr>
<tr>
<td></td>
<td>39. Minidisk cache*</td>
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<tr>
<td></td>
<td>3A. Paging activity</td>
</tr>
<tr>
<td></td>
<td>3B. Proc. load &amp; config*</td>
</tr>
<tr>
<td></td>
<td>3C. Logical part. load</td>
</tr>
<tr>
<td></td>
<td>3D. Response time (all)*</td>
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<td>3E. RSK data menu*</td>
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<td>3F. Scheduler queues</td>
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<td>3G. Scheduler data</td>
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<td>3H. SFS/BFS logs menu*</td>
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<td>3I. System log</td>
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<td>3K. TCP/IP data menu*</td>
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<td>3L. User communication</td>
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<td>3M. User wait states</td>
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</table>
Monitoring Linux Performance

*FCON in Performance Monitor Mode*

- Based on the Linux DDS interface from RMF PM
  - DDS installed and active on all Linux systems monitored
  - Performance data is stored on the Linux systems
  - Performance data retrieved in XML format

- Performance reports
  - System data
  - CPU utilization details
  - Memory utilization and activity details
  - Network activity (overall and by device)
  - File system size and utilization

---

FCONX LINUXUSR:
*Linux-ID IP Address

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<th>Linux-ID</th>
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<td>...</td>
</tr>
<tr>
<td>LINUXn</td>
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</tr>
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</table>
Linux Performance Data Selection

FCON in Performance Monitor Mode

Interval 18:32:00-18:33:00, on 2002/08/06  (Select average for mean data)

Linux Performance Data Selection for System W3VML

System Data
Processes created per second  0.083
Context switches per second  113.1
Apache: Requests per second  ...
Bytes per request  ...
Busy threads  ...
Idle threads  ...
404 Errors per minute  ...

S Perform. Reports       Description
_ LXCPU    W3VML          CPU utilization details
_ LXMEM    W3VML          Memory utilization & activity details
_ LXNETWRK W3VML          Network activity (overall & by device)
_ LXFILSYS W3VML          File system size and utilization
**Linux CPU Utilization Overview**

**FCON in Performance Monitor Mode**

---

**Interval 18:33:00-18:34:00, on 2002/08/06**  (Select average for mean data)

**Linux CPU Utilization for System W3VML**

| Processor | Total | User | Kernel | Nice | Idle | <--- Percent CPU Utilization ----> | <--- Accumulated (s)--->
<table>
<thead>
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<td>0.34</td>
<td>0.28</td>
<td>0</td>
<td>99.36</td>
<td>***</td>
<td>***</td>
</tr>
</tbody>
</table>

**Process Name**

- gpmddsrv.5378: 0.28 0.25 0.03 ...
- procgt.646: 0.16 0.03 0.13 ...
- gengat.633: 0.03 ... 0.03 ...
- gpmddsrv.654: 0.01 0.01 ... ...
- gpmddsrv.9810: 0.01 ... 0.01 ...
- nscd.338: 0.01 ... 0.01 ...
- gpmddsrv.18180: 0 0 0 0 ...
- gpmddsrv.18181: 0 0 0 0 ...
- gpmddsrv.18182: 0 0 0 0 ...
- gpmddsrv.24455: 0 0 0 0 ...
- gpmddsrv.24456: 0 0 0 0 ...
- gpmddsrv.27167: 0 0 0 0 ...
- gpmddsrv.27168: 0 0 0 0 ...
- gpmddsrv.29851: 0 0 0 0 ...
- gpmddsrv.29852: 0 0 0 0 ...
- gpmddsrv.29853: 0 0 0 0 ...

---
### Linux Memory Utilization and Activity

**Chart 28**

**Interval 18:33:00-18:34:00, on 2002/08/06**  (Select **average** for mean data)

**Linux Memory Util. & Activity Details for System W3VML**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value 1</th>
<th>Value 2</th>
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<tbody>
<tr>
<td>Total memory size</td>
<td>61MB</td>
<td>Swap space size</td>
</tr>
<tr>
<td>Total memory used</td>
<td>59MB</td>
<td>% Swap space used</td>
</tr>
<tr>
<td>Used for buffer</td>
<td>3MB</td>
<td>Swap-in rate</td>
</tr>
<tr>
<td>Used for shared</td>
<td>51MB</td>
<td>Swap-out rate</td>
</tr>
<tr>
<td>Used for cache</td>
<td>12MB</td>
<td>Page-in rate</td>
</tr>
<tr>
<td>Total free memory</td>
<td>1MB</td>
<td>Page-out rate</td>
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</table>

<table>
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<tr>
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<th>MajPgFlt</th>
<th>MinPFltC</th>
<th>MajPFltC</th>
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</tbody>
</table>
## Real Time Monitor

**Real Time Monitor, SC24-6028**

- Provides real time performance information and action logging

### Performance Data

```
+------------------------------------------------------------------------------+
| z/VM CPU2064 SERIAL 123456  512M DATE 03/10/02   START 03:19:12 END 03:19:43 |
| *                                                                            |
| USERID  %CPU  %CP  %EM  ISEC  PAG  WSS  RES  UR  PGES  SHARE  VMSIZE  TYP,CHR,STAT |
| USER52   92   45   47    .0    .0   70   70    .0  254   100    4M  VUB,---,DISP |
| USER41   37    0   37    18    18   41   41    .0   0    100    3M  VUX,---,SIMW |
| USER90   36    2   34    19    .0   365  365   .0  257   100    6M  VUB,QDS,DISP |
|                                                                              |
|<--- DEVICE ---> <----- DEVICE  RDEV  DATA ------> <-- MEASUREMENT FACILITY -->|
|                    *                                                         |
| DEV  TYPE  VOLSER  IOREQST  SEC  %Q  %ER  %LK  LNK  PA  %UT  ACC  FPT  DCT  CN  %CN |
| 01A0 3380  PGPK02   1958   61  .00  .00   .00   1   4   15    2   0   0    2   15 |
| 0206 3380  DISK01   1458   45  1.7  .00  .00   92   4   69   15    0  12   2   12 |
| 0225 3350  DISK92   817    25  13  .00 .00  1140   4  10   15    0   0    3   9.4 |
| 03E2 3380  PGPK23   750    23  28  .00 .06  202   4   39   17    0  14   2   6.3 |
|                                                                              |
|<-------- CPU STATISTICS ------> <-- VECTOR ---> <STORAGE><XSTORE>            |
| NC  %CPU  %US  %EM  %WT  %SY  %SP  XSI  %SC  NV  %VT  %OT  RSTR  %ST  PSEC  %XS  XSEC  TTM |
|->  6  491  204  268  109   12  .06  45K  99   0  0  0  0  28   356  96  568  1.420 |
|<--  290  76  203  110  11   03  28K  98   .0  0  0  15  130  96  411  3.650 |
+-----------------------<-- 08 LOG ACTIONS INDICATED --+----------------------+
```
Action Logging
Real Time Monitor

- RTM will monitor selected counters for "above limit" situations
- When the limit is exceeded, a message can be sent to a service machine to handle the exception

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Log Type</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>03/10/02</td>
<td>11:51:49</td>
<td>INTERVAL ANALYSIS LOG</td>
<td>ACTION</td>
</tr>
<tr>
<td>1) PAGE REQUEST LIMIT EXCEEDED: SYSTEM 32 SEC</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2) SUPERVISOR LIMIT EXCEEDED: USER01 43%</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3) SUPERVISOR LIMIT EXCEEDED: USER04 63%</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4) PAGE REQUEST LIMIT EXCEEDED: USER88 72 SEC</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5) EXCESSIVE CHANNEL PATH UTILIZATION: 25% CTCA-03F0</td>
<td>25</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Selected Log Messages

Real Time Monitor

LOGMSG  STATUS  LIMIT  MSGCT  USERID-→  LOG MESSAGE 12:00:00 → 14:38:37
0      ON      100   0       IO RATE EXCEEDED nnnn
1      ON      0      0 OPERATOR INTERVENTION REQUIRED:
3      ON      0      0 OPERATOR USERID DISCONNECTED AND DISABLED
5      ON      50     82 STORAGE LIMIT EXCEEDED:
8      ON      40     0       SUPERVISOR LIMIT EXCEEDED:
10     OFF     120   0       userid HAS BEEN IDLE FOR nnn MINUTES
12     ON      25     0 PAGE REQUEST LIMIT EXCEEDED:
13     ON      90     12 CPU UTILIZATION nnn%
16     ON      100   0 STORAGE UTILIZATION nnn%
18     ON      0      0 VOLUME volser MOUNTED:
19     ON      100   43 I/O RATE LIMIT EXCEEDED:
21     ON      0      0       PROCESSOR VARIED OFFLINE:
22     ON      75     0 EXCESSIVE DEVICE PERCENT UTILIZATION: nnn%
23     ON      500    56 EXCESSIVE DEVICE DISCONNECT TIME: nnnn
24     ON      100    310 EXCESSIVE QUEUING IN CHANNEL SUBSYSTEM: nnnn
25     ON      20     42 EXCESSIVE CHANNEL PATH UTILIZATION: nnn%
26     ON      0      0 OPERATOR DISPATCH LIST ABSOLUTE SHARES NOT AVAILABLE
27     ON      0      0 OPERATOR TABLE LIMIT EXCEEDED –
34     ON      0      0 XSTORE BLOCKS UNAVAILABLE nnn TIMES
35     ON      3000   4 AVERAGE TRANSACTION TIME: n.nnn SECONDS
36     ON      0      0 DEVICE DYNAMICALLY DELETED
Jim Elliott
Linux Advocate
@server Strategic Initiatives
IBM Canada Ltd.

jelliott@ca.ibm.com

ibm.com/vm/devpages/jelliott/
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