



Linux @ IBM

# Managing Linux Using 'Hidden' Tools in z/VM

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## Managing Linux Using 'Hidden' Tools in z/VM

### *Abstract*

- 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

IBM z/VM publications are available at [ibm.com/vm/library](http://ibm.com/vm/library)



## System Utilities

### *CMS Command and Utility Reference, SC24-6010*

- 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
- SFPURGER - Manages spool space and spool files



## ACCOUNT

### *System Utilities*

- 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:

Type	Total-Pages		% -Used
	Allocd	In-Use	
SPOL	428040	169905	39.7
PAGE	744120	10278	1.4

\*\* Detail Information:

Volser	Addr	Device	Type	Total-Pages		% -Used
				Allocd	In-Use	
ITSVMR	922C	3390	SPOL	20700	20698	100.0
			SPOL	11340	11338	100.0
			PAGE	15120	4554	30.1
			PAGE	9000	0	0.0
ITSW01	9205	3390	SPOL	396000	137869	34.8
			PAGE	0	0	0.0





# 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 SYSHOLD
* 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

```



## Programmable Operator Facility

### *CMS Planning and Administration, SC24-6042*

- 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](http://ibm.com/vm/perf)
- RTM - Short-term study or problem solving
  - ▶ [ibm.com/vm/related/rtm](http://ibm.com/vm/related/rtm)
- PRF - Long-term trend analysis or capacity planning
  - ▶ [ibm.com/vm/related/prf](http://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](http://ibm.com/eserver/zseries/zos/rmf/rmfhtmls/pmweb/pmlin.htm)
- Performance publication
  - ▶ [ibm.com/vm/perf/docs](http://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](http://ibm.com/vm/download/packages)

- CMSDDR - 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
- LEXX - Live Parsing Editor



## 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



## SMARTX

### *VM Download Packages*

- From Kris Buelens, IBM Belgium
- 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 US
- 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





## VMSERVE

### *VM Download Packages*

- From Les Koehler, IBM US
- VMSERVE is a general purpose Disconnected Virtual Machine (DVM) manager for VM which will handle incoming reader files, messages, and time-of-day events
- VMSERVE has 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
- Although VMSERVE 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



## LEXX Live Parsing Editor

### *VM Download Packages*

- From Mike Cowlshaw, IBM UK
- LEXX lets you manipulate the structure and the appearance of the data you are editing, whether it be a text document, a program, or any other suitable material
- The routines that control the appearance of the data being edited are called Live Parsers
- Included are:
  - ▶ A parser for Generalized Markup Language (GML) documents (SCRIPT files)
  - ▶ A parser for REXX programs, such as Execs and Editor Macros



# LEXX Live Parsing Editor - Screen Image

## VM Download Packages

```

Document: LEXX EXEC B2          At: "/* LEXX: "..          18:15
Command: _

/* LEXX: CMS command to invoke the Live Parsing Editor.    */
/*      Call with argument "?" for further information.    */
/* ..... (C) Copyright IBM United Kingdom Ltd., 1987.   */

Address command
Parse Arg fn ft fm . '(' options ')' rest
If left(fn,1)='?' Then Signal HELPME
options=translate(options)

If cmsflag('SUBSET') Then Do
  Say "LEXX may not be called in CMS SUBSET"
  Exit -2
End

If cmsflag(cmstype) Then cmstype='RT'
  Else cmstype='HT'

txtlibs='LXAMAIN SCEELKD CMSLIB IBMLIB'
lexmod = 'LXAMAIN'
'QUERY STORECLR ( LIFO'; Parse Pull . . storeclr
If storeclr='ENDSVC' Then 'SET STORECLR ENDCMD'

PF1  Help      PF2  Opencil  PF3  Quit      PF4  Copy      PF5  Move      PF6  ?
PF7  Up        PF8  Down     PF9  =         PF10 Select  PF11 Splitj PF12 Focus

M@ b 02/011

```



## LEXX Live Parsing Editor - Additional Packages

### *VM Download Packages*

Package name	Description
LEXXPLXX	Parsers for PL/I, PL/X, Modula-2 and Pascal
LEXXASM\$	Parser for Assembler
LEXXC\$\$	Parser for C
LEXXCFDA	"Commands From Data Area" facility
LEXXCOB\$	Parser for COBOL
LEXXFORS\$	Parser for FORTRAN
LEXRX\$\$	Alternate parser for REXX
LEXXTEX\$	Parser for LaTeX/TeX Parser
LXFINDT	FIND Token command
LXJCL\$	Parser for MVS JCL
LXPRMPT	Prompt command



## 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*

General System Data

1. CPU load and trans.
2. Storage utilization
3. Storage subpools
4. Priv. operations
5. System counters
6. CP IUCV services
7. SPOOL file display\*
8. LPAR data
9. Shared segments
- A. Shared data spaces
- B. Virt. disks in stor.
- C. Transact. statistics
- D. Monitor data
- E. Monitor settings
- F. System settings
- G. System configuration
- H. Exceptions
- I. User defined data\*

I/O Data

11. Channel load
12. Control units
13. I/O device load\*
14. CP owned disks\*
15. Cache extend. func.\*
16. D&SD I/O assist
17. D&SD seek distance\*
18. I/O prior. queueing\*
19. I/O configuration
- 1A. I/O config. changes

User Data

21. User resource usage\*
22. User paging load\*
23. User wait states\*
24. User response time\*
25. Resources/transact.\*
26. User communication\*
27. Multitasking users\*
28. User configuration\*
29. Linux systems\*

History Data (by Time)

31. Graphics selection
32. History data files\*
33. Benchmark displays\*
34. Correlation coeff.
35. System summary\*
36. Auxiliary storage
37. CP communications\*
38. D&SD load
39. Minidisk cache\*
- 3A. Paging activity
- 3B. Proc. load & config\*
- 3C. Logical part. load
- 3D. Response time (all)\*
- 3E. RSK data menu\*
- 3F. Scheduler queues
- 3G. Scheduler data
- 3H. SFS/BFS logs menu\*
- 3I. System log
- 3K. TCP/IP data menu\*
- 3L. User communication
- 3M. User wait states



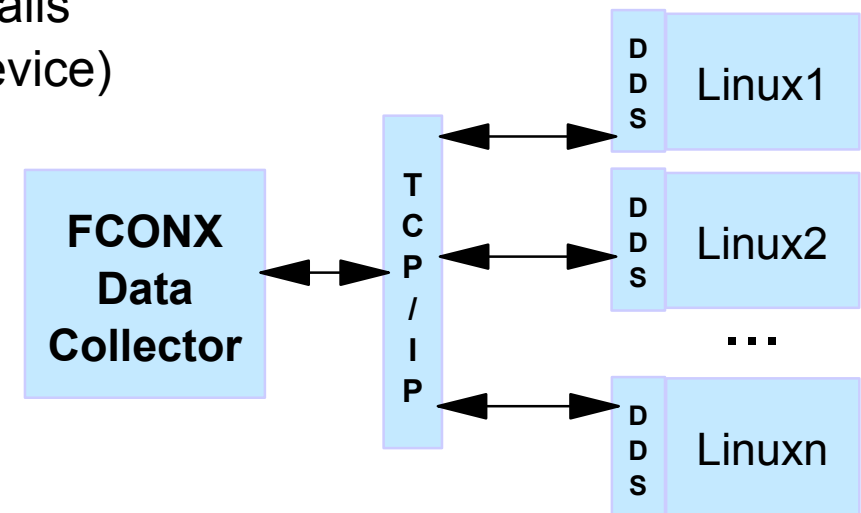
## Monitoring Linux Performance

### *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
* |      |
LINUX1   1.222.333.444:8803
LINUX2   1.222.333.445:8803
...      ...
LINUXn   1.222.333.nnn:8803
  
```





# Linux Performance Data Selection

## *FCON in Performance Monitor Mode*



Linux Performance Data Selection (GDLVMK4)  
 FCXLXI642I Connecting to W3VML at 9.117.32.48:08803

Command Refresh Systems Menu Forw Help  Auto-Refresh

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	<--- Percent CPU Utilization ---->					<-Accumulated (s)->		
	Total	User	Kernel	Nice	Idle	TotTm	UserTm	KernTm
>>Mean>>	0.63	0.33	0.29	0	99.36	---	---	---
cpu0	0.63	0.34	0.28	0	99.36	---	---	---
<b>Process Name</b>								
gpmddsrv.5378	0.28	0.25	0.03	...	---	...	...	...
procgat.646	0.16	0.03	0.13	...	---	32.64	4.79	27.85
gengat.633	0.03	...	0.03	...	---	4.82	...	4.76
gpmddsrv.654	0.01	0.01	...	...	---	...	...	...
gpmddsrv.9810	0.01	...	0.01	...	---	...	...	...
nscd.338	0.01	...	0.01	...	---	208.9	29.04	179.9
gpmddsrv.18180	0	0	0	0	---	...	...	...
gpmddsrv.18181	0	0	0	0	---	...	...	...
gpmddsrv.18182	0	0	0	0	---	2.81	0.84	1.97
gpmddsrv.24455	0	0	0	0	---	...	...	...
gpmddsrv.24456	0	0	0	0	---	3.09	0.9	2.19
gpmddsrv.27167	0	0	0	0	---	...	...	...
gpmddsrv.27168	0	0	0	0	---	2.57	0.84	1.73
gpmddsrv.29851	0	0	0	0	---	...	...	...
gpmddsrv.29852	0	0	0	0	---	...	...	...



# Real Time Monitor

## Real Time Monitor, SC24-6028

- Provides real time performance information and action logging

```

-----+-----
| 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 .0 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 R %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 4 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

----->				----->	
03/10/02	RTM 4.1.0	INTERVAL ANALYSIS LOG		11:51:49	ACTION
1)	PAGE REQUEST LIMIT EXCEEDED:	SYSTEM	32 SEC		12
2)	SUPERVISOR LIMIT EXCEEDED:	USER01	43%		8
3)	SUPERVISOR LIMIT EXCEEDED:	USER04	63%		8
4)	PAGE REQUEST LIMIT EXCEEDED:	USER88	72 SEC		12
5)	EXCESSIVE CHANNEL PATH UTILIZATION:	25%	CTCA-03F0		25

Set LOGMsg nn

ON	LIMIT value	USER userid	MSG
OFF		OFF	VMCF





## 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



## Contact Information

### Jim Elliott

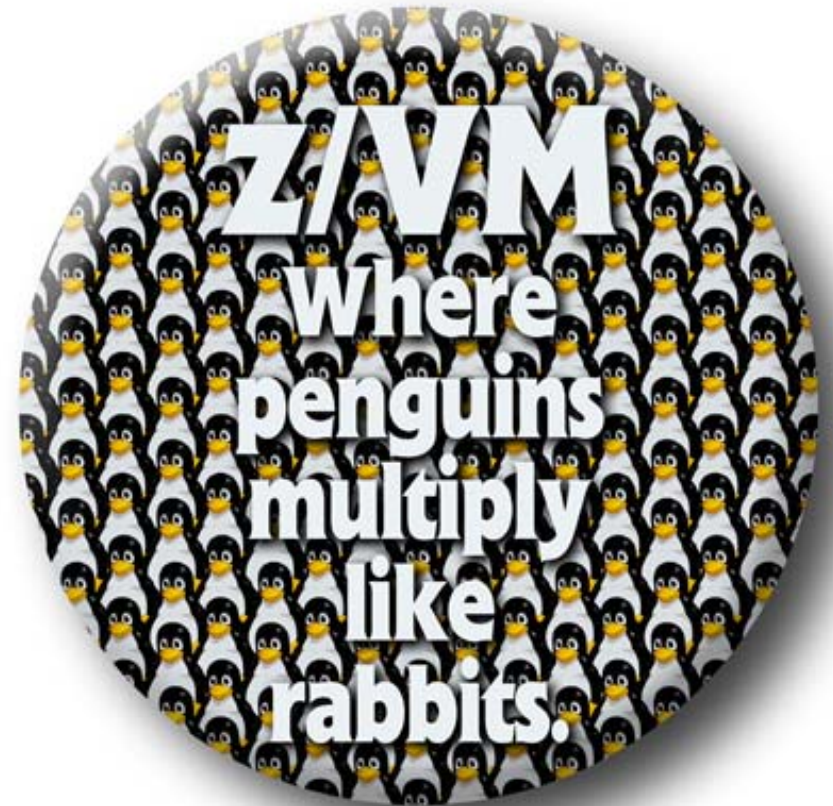
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[ibm.com/vm/devpages/jelliott/](http://ibm.com/vm/devpages/jelliott/)





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