Linux System Management for the Mainframe Systems Programmer

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Agenda

• Cultural Differences & Similarities
• Terminology
• How Does Linux/390 Compare to Unix System Services?
• How Does Linux/390 Compare to Other Linux platforms?
• What is a Distribution, and why doesn't IBM have one?
• What Hardware Does Linux/390 Support?
• What Networking Connections Does Linux/390 Support?
• Where’s SYS1.PARMLIB Kept?
• Do I **Really** Have to Know All This Stuff?
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- Linux/390 DASD Management
- Backup and Restore
- Software and Maintenance Management
- Data Sharing with Linux/390 and Other OS
- Job Scheduling
- Security and User Management
- Diagnostic Information Available (or not)
- Editors
- Basic vi Concepts
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- Scripting Languages
- System Logs
- Basic Commands
- Advanced Commands
- Kernel Modules, Loading and Unloading
- System Startup and Shutdown
- Performance Management
- Creating Additional Images
- Questions?
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- Additional Information Resources
  - Web sites, Redbooks/pieces/tips, Usenet (news), O’Reilly Books
- Command Comparisons
Cultural Differences & Similarities

- Open Source Community
  - Think of how many people you know from IBMMAIN or IBMVM
- Open Source software
- Software quality
- Where and how you get support
- Expectations of self-reliance
- 3270 terminals vs. VTxxx.
- Is rebooting unnecessarily a sin?
- Install Linux on a PC and use it.
Terminology

- IPL
- nucleus
- PLPA / LINKLIST
- TSO / CMS
- OSA
- PTF / APAR
- IEBUPDTE
- IEBUPDTE input
- SuperC / COMPARE
- xedit update mode
- boot
- kernel
- kernel modules
- shell
- NIC
- patch
- patch
- diff
- diff
- diff
Terminology (2)

- paging space
- multi-processor
- systems programmer
- GUI
- pattern matching
- help files
- STC / SVM
- address space
- task (tcb)

- swap partition/volume/file
- SMP
- system administrator
- X / X-Window
- regular expression
- man pages
- daemon
- process
- thread
Terminology (3)

- runlevel
- device driver
- tarball (tar - tape archive)
  - `tar -cf backup.tar file1 file2 file3 file4`
  - **tar -xf backup.tar**
  - `tar -zcf backup.tar.gz file1 file2 file3 file4`
    - Equivalent to tar command followed by gzip command
  - `tar -zcf backup.tgz file1 file2 file3 file4`
  - **tar -zxf backup.tgz**
  - `tar -jcf backup.tar.bz2 file1 file2 file3 file4`
    - Uses bzip2 instead of gzip for compression
  - **tar –jxf backup.tar.bz2**
How Does Linux/390 Compare to...

• Unix System Services
  • Linux/390 is “real” UNIX “under the covers.” Things that run on most other Unix systems can be run on Linux/390, usually without change (assuming source is available).
  • There is no such thing as SMP/E or SES in UNIX / Linux.
  • Option “switches” on various commands are different, due to different shells, or compliance to different standards.
  • The Linux man pages work without extra effort on OS/390 side.
  • There’s no confusion about which TCP/IP parameters are put where.
  • Things that you learn about other UNIX systems are generally easier to apply to Linux than USS.
  • There’s no “other side” (OS/390) to help bail you out when things get messed up.
  • Native ASCII. No EBCDIC <-> ASCII conversions.
How Does Linux/390 Compare to...

- Unix System Services (cont.)
  - Source code is typically available on Linux.
  - Default shell is more often bash than (t)csh.
  - No 3270 interface/limitations to work around. Which also means no real ISPF. (You can buy a clone of it, though.)
  - PL/1, CLISTs are not available.
  - REXX is available, but called Regina.
  - OREXX is available, now in Open Source form.
  - HLASM is now available from Tachyon Software.

- Other Linux Platforms
  - Very similar, but it lacks a lot of common PC-type hardware
  - 3270 support included for consoles in LPAR mode
  - S/390 specific hardware
What are Distributions?

- VARs
- Packagers
- System Integrators
- Maintainers
- Developers
- Support
- Why doesn’t IBM have one?
Linux/390 Hardware Support

- Any processor that supports the “Halfword Immediate and Relative Branch Feature” instructions added with the G2.
- For decent performance, IEEE FPU is needed. (G5 and up, MP3000.)
- ECKD DASD
- FBA DASD
- 3480/3490/3590/3592 Tapes
  - Including 3592 hardware encryption
- SCSI over FCP, including tape drives
- Crypto cards and Secure Key Entry
Linux/390 Network Connections

- 3172
- OSA-2 (Token-Ring, Ethernet, Fast Ethernet)
- OSA-Express (Ethernet, Fast Ethernet)
- 2216 (Token Ring, Ethernet)
- QDIO OSA-Express (and -2 -3) (1 & 10Gb Ethernet, Fast Ethernet)
- ESCON / CTC (native and under VM)
- IUCV (only under VM)
- HiperSockets (native and under VM)
- Guest LANs (only under VM) – NOT the same as VLANs
- VSwitch (only under VM, requires an OSA)
- Cisco CLAW (CIP) - original driver by UTS Global, redone by IBM
Where's SYS1.PARMLIB Kept?

- Just about everything you need is kept under /etc (at some level of hierarchy).
- Individual text files (or groups of them), since no concept of a PDS in Linux.
- Some really important ones:
  - /etc/passwd
  - /etc/shadow
  - /etc/group
  - /etc/inittab
  - /etc/inetd.com
  - /etc/modules.conf
  - /etc/fstab
  - /etc/hosts
  - /etc/resolv.conf
  - /etc/rc.d/...
  - /etc/httpd/...
  - /etc/sysconfig/...
  - /etc/samba/...
  - /etc/pam.d/...
  - /etc/ssh/...
Do I *Really* Have to Know All This Stuff?

- No, but shouldn’t you?
  - Would you let a junior systems programmer or system operator loose on SYS1.PARMLIB or SYSTEM CONFIG via a GUI?

- If you really don’t want to know what’s going on or have a large virtual farm:
  - YaST (SUSE)
  - Nautilus (Red Hat)
  - GNOME Control Center (SUSE and Red Hat)
  - Webmin (completely Perl-based)
  - Others
Quick Overview:

- Adding and removing DASD
- Preparing DASD for use
  - Formatting
    - 2 kinds of DASD layouts
  - Partitioning (2.4.x & 2.6.x kernels only)
  - Creating file systems and Swap
  - File systems vs. directories
- Backing up your DASD
Adding & Removing DASD

- For 2.4.x kernels, can be non-disruptive, but manual:
  - Adding a device
  - echo "add device range=devno-range " > /proc/dasd/devices
  - Disabling a device
  - echo "set device range=devno-range off " > /proc/dasd/devices
  - Enabling a device
  - echo "set device range=devno-range on " > /proc/dasd/devices
  - Still want to update /boot/parmfile or /etc/zipl.conf and re-run “zipl” to make the change permanent. (mkinitrd may also be required.)

- The 2.2.x kernels, required updating /boot/parmfile, re-running “silo,” and rebooting.
Adding and Removing DASD in 2.6.x

- New disks detected automatically
- `/sys/bus/ccw/devices/0.0.0b01@
- `/sys/bus/ccw/drivers/dasd-eckd/0.0.0b01@
- `/sys/bus/css/devices/0.0.0016@
- `/sys/bus/css/drivers/io_subchannel/0.0.0016@
- `/sys/devices/css0/0.0.0016/
  - 0.0.0b01/
    - bus@
    - chpids
    - driver@
    - pimpampom

- `/sys/devices/css0/0.0.0016/0.0.0b01/
  - Availability
  - bus@
  - cmb_enable
  - cutype
  - devtype
  - discipline
  - driver@
  - online
  - readonly
  - use_diag

Use `/sbin/chccwdev` instead

- `chccwdev --online 0.0.0b01`
- `chccwdev -e 0.0.0b01`
- `chccwdev -d 0.0.0b01`
Formatting DASD - 2.4.x, 2.6.x

- `dasdfmt -b 4096 [ -l volser ] [ -d layout ] -f /dev/dasd?`
  - `dasdfmt -b 4096 -d cdl -f /dev/dasda`
  - `dasdfmt -b 4096 -f /dev/dasda`
  - `dasdfmt -b 4096 -d ldl -f /dev/dasda`

- `fdasd /dev/dasd?`
  - **Must** create one, two, or three partitions for CDL-formatted volumes
  - Similar to the fdisk command
    - fdisk is still used for SCSI disks!
Creating File Systems and Swap

2.4.x, 2.6.x Kernels

- mke2fs -b 4096 /dev/dasd?1,2,3
  - mke2fs -b 4096 /dev/dasda1
  - mke2fs -b 4096 /dev/dasda2
  - mke2fs -b 4096 /dev/dasda3
  - mke2fs -b 4096 /dev/dasdb1
  - mke2fs -b 4096 /dev/dasdc1

- Other file system types possible (Red Hat only supports EXT2 & EXT3)
  - mkfs.reiserfs
  - mkfs.ext3
  - mkfs.xfs
  - mkfs.jfs (deprecated in SLES10)

- mkswap /dev/dasd?1,2,3 (mkswap /dev/dasda1)
File Systems and Directories

- / (root)
- /bin
- /boot *
- /dev
- /etc
- /home
- /lib, /lib64
- /mnt
- /opt
- /proc
- /root (not to be confused with / root)
- /sbin
- /srv
- /sys
- /tmp
- /usr
- /var
### File Systems and Directories

- `# df -h`

<table>
<thead>
<tr>
<th>Filesystem</th>
<th>Size</th>
<th>Used</th>
<th>Avail</th>
<th>Use%</th>
<th>Mounted on</th>
</tr>
</thead>
<tbody>
<tr>
<td>/dev/dasda1</td>
<td>388M</td>
<td>119M</td>
<td>250M</td>
<td>33%</td>
<td>/</td>
</tr>
<tr>
<td>/dev/dasda2</td>
<td>97M</td>
<td>4.2M</td>
<td>88M</td>
<td>5%</td>
<td>/home</td>
</tr>
<tr>
<td>/dev/dasda3</td>
<td>74M</td>
<td>21M</td>
<td>50M</td>
<td>30%</td>
<td>/opt</td>
</tr>
<tr>
<td>/dev/dasdc1</td>
<td>1.2G</td>
<td>1.1G</td>
<td>100M</td>
<td>92%</td>
<td>/srv</td>
</tr>
<tr>
<td>/dev/dasdb1</td>
<td>291M</td>
<td>17M</td>
<td>260M</td>
<td>6%</td>
<td>/tmp</td>
</tr>
<tr>
<td>/dev/dasdb2</td>
<td>1.2G</td>
<td>915M</td>
<td>183M</td>
<td>84%</td>
<td>/usr</td>
</tr>
<tr>
<td>/dev/dasdb3</td>
<td>245M</td>
<td>69M</td>
<td>164M</td>
<td>30%</td>
<td>/var</td>
</tr>
</tbody>
</table>
Backup and Restore

- Native Linux facilities
  - afio/cpio/tar

- Software packages (Open Source and proprietary)
  - Bacula, Amanda
  - DFSMSdss / DDR
  - Tivoli TSM/ADSM
  - Innovation FDRINSTANT/UPSTREAM
  - CA BrightStor
  - SecureAgent SecureBackup
  - UTS Global TSS-BAR
  - Veritas NetBackup

- Note that unless you have the backup server on the local system and tape drives available, backup data will be sent over the network.
Software & Maintenance Management

- Since there is no such thing as SMP/E or SES, you have to learn a new mindset.
- There are “binary” packages for several platforms, primarily Intel. Different distributions use different methods to manage those packages: RPM, dpkg.
- Source packages (RPM, tar.gz, etc.) are always available for Open Source software. This is not an invitation to compile from source and install without using the same packaging tool as your distribution provider uses.
• In a number of cases, there is no binary available for Linux/390. Compiling from source is the only option. This can be very easy or very difficult, depending on the package.
• You will become very familiar with the ‘tar,’ ‘gzip,’ and ‘make’ commands. Most likely ‘patch’ and ‘diff’ as well.
• Once you start down that road, you are no longer a Linux user, but a Linux developer, with all the pain that can entail.
Keeping track of security patches is very important, and people-intensive.

Getting email notifications from trusted security industry sources (CERT, etc.) is recommended.

If you have to compile a package from source, it probably won’t be too difficult.

- tar -zxf package.name.tar.gz
- cd package-directory
- ./configure
- make, and then make install
Using RPM

• VERY high-level!
  • `rpm -i package.name.rpm` (install)
  • `rpm -e package.name` (remove)
  • `rpm -q package.name` (query)
  • `rpm -ql package.name`
  • `rpm -qlp package.name.rpm`
  • `rpm -qa`
  • `rpm -qf /path/to/file/name`

• dpkg on Debian-based systems
• pkgtools on Slack/390 systems
Data Sharing With Linux and Other OSes

- No direct, hard-wired sharing
- z/OS doesn’t “know” ext2
  - z/VM does, but only usable when the Linux system is down
- Linux does “know” VTOCS, etc.
  - But, no security! (your audit compliance folks won’t like you)
- Various network-based methods and clustering file systems
  - NFS
  - AFS
  - Samba (SMB / CIFS / MS Networking)
  - GFS, OCFS2 (OCFS2 is not quite ready for production use)
- Under VM - sharing minidisks read-only between guests.
Job Scheduling

- Linux native facilities
  - cron
  - at

- Open Source:
  - DQS
  - queue
  - OpenPBS
  - generic NQS

- Proprietary
  - Avatar
  - Computer Associates
  - ESP
  - Jobtrac
  - PBSPro
  - UC4:global
  - Xi-Batch
Security and User Management

• Security in an ongoing process, not a status. It must be constantly attended to for you to have any chance at all.
• Most successful security breaches come from employees of a company, not outsiders.
• In contrast to typical mainframe security, Linux security is more network oriented.
• If possible, have a UNIX security person handle your Linux security needs.
Security and User Management (2)

- Turn off *ALL* unnecessary services: telnet, ftp, smtp, time, finger, http, pop3, imap, login, shell, printer, nfs, etc., etc.
- Use OpenSSH instead of telnet, ftp, rlogin, rsh, rexec, rlogin, etc..
- Use TCP Wrappers (/etc/hosts.allow, etc.) if you have to use an insecure protocol.
- Review your system logs regularly.
- Monitor security alerts from your suppliers, and from various security organizations.
Don’t lump all your users into one group (typically “users” - SUSE default).

Don’t create a separate group for each user (Red Hat’s approach).

Try to have reasonable groups defined so that people can share data appropriately, and put the proper users into them.

Don’t give anyone a UID of zero unless it’s absolutely necessary (and even then think about other ways to avoid it).
Various tools are available for adding, deleting and changing user and group definitions. All information about users and groups are in plain text files.

- SUSE has YaST
- Red Hat has Nautilus and redhat-config-* tools
- Webmin is popular
- `useradd`, `userdel`, `usermod`, `groupadd`, `groupdel`, `groupmod` are the common command-line tools
Security and User Management (5)

- Protect the password of “root” very carefully.
- Login as “yourself” and su to root only when really needed.
- Consider using /etc/sudoers to grant some selected command authority to designated people.
- If you’re running a Linux that doesn’t use PAM (pluggable authentication modules), consider using /etc/suauth to allow designated people to “su” using their own password.
Diagnostic Information

- strace
- ulimit (to enable core dumps)
- gdb
- uptime
- top
- ksymoops
- vmstat
- supportconfig/siga (SUSE)
- iostat
- sar
- netstat
- ping
- traceroute
- system logs
- dmesg
- standalone dump
- sysreport (Red Hat)
Editors (Holy War fodder)

- vi / vim / elvis
- emacs / xemacs
- joe
- jed
- jove
- ed (sed)

- nano
- pico
- ne
- ned (3270 enabled)
- Nedit
- THE (The Hessling Editor)

No native free (no cost) ISPF/PDF clones. (2 proprietary ones)
Basic vi Concepts

- Cursor keys work as expected (or h-j-k-l), as do Page up and Page Down, Delete and Backspace (when ssh client is properly configured).
- Two important modes: command, insert.
- I’m pretty unfamiliar with vi, so I basically use insert mode and command mode.
- Insert button = insert mode (twice = replace)
- ESC = exit insert/command mode.
Basic vi Concepts (2)

- `:set smd` or `:set showmode`
  - Gives visual indicator of what mode you’re in
- `:d` = delete a line
- `:w` = write updated file to disk
- `:x` = write updated file to disk and exit
- `:q` = quit if no updates have been made since the last save (`:w`)
- `:q!` = quit regardless
- `:help` = help me!
Scripting Languages (Holy War Cont.)

• Perl
• ash / bash / csh / tcsh / ksh / ksh93 / zsh
• Regina (REXX)
• OREXX
• Python (can also be compiled)
• Ruby
• Tcl
• The list goes on...
System Logs

- Most of what you want will be in `/var/log/`, or in a subdirectory of it.
- Names and contents vary by distribution
  - Look at `/etc/syslog.conf` if you're interested
- Reviewing them *frequently* is important
- Samples:
  - `/var/log/messages`
  - `/var/log/syslog`
  - `/var/log/debug`
  - `/var/log/boot.log`
  - `/var/log/dmesg`
  - `/var/log/proftpd.log`
  - `/var/log/maillog`
  - `/var/log/warn`
  - `/var/log/httpd/...`
  - `/var/log/samba/...`
Basic Commands

- `rm -rf /`
- `cd`
- `cp`
- `mv`
- `rm`
- `ls`
- `find`

- `grep`
- `cat`
- `less / more`
- `man`
- `info`
- `mount`
- `umount`

- `mkdir`
- `rmdir`
- `ps`
- `pushd`
- `popd`
- `which`
- `zipl`
Advanced Commands

• ifconfig
• route
• host / nslookup
• su
• sudo
• gzip / bzip2
• last

• chmod
• chown
• dmesg
• du
• df
• locate
• top

• sed
• head
• tail
• wget
• export
• file
• telinit
Kernel Modules

• The kernel, along with kernel modules, contains all the code necessary to run as an operating system. This includes device drivers, file system drivers, networking code, etc.

• Kernel modules are parts of the kernel that don’t have to be compiled into the kernel itself (but can be if you want to).

• This can allow you to update these components on the fly, without rebooting.
Loading Kernel Modules

• Since modules are *not* in the kernel, how do they get loaded into kernel storage?
  • insmod
  • modprobe
  • dynamically by the kernel if /etc/modules.conf or /etc/modprobe.conf has the right data in it.

• How does the module get it’s parameters?
  • provided on insmod command
  • read from /etc/modules.conf or /etc/modprobe.conf by modprobe and the kernel.
Loading Kernel Modules

• How does the kernel find the module?
  • Usually in /lib/modules/kernelver/...
    • /lib/modules/2.6.16.27-0.9-smp/
  • depmod -a command creates a cross reference of the modules and where they are located, and writes it into /lib/modules/kernelver/modules.??? files.
  • modprobe figures out the dependencies and loads the modules in the right order. insmod does not do this.
Unloading Kernel Modules

• The `rmmod` command is used to do the unloading

• Kernel modules must be unused to be unloaded
  • The jbd module is in use by the ext3 module and cannot be unloaded
    # lsmod
    jbd       62880  1 ext3

• There is a `-f` (force) parameter to `rmmod`, but under normal circumstances it would be unwise to use it.
  • `CONFIG_MODULE_FORCE_UNLOAD=Y` must have been specified in the kernel config for it to work.
System Startup and Shutdown

- From the HMC, just like any other OS, except no loadparms are needed/used.
- From VM, there are usually some CMS/CP commands issued in PROFILE EXEC, followed by a ‘CP IPL devno CLEAR’
- From VM, you can still IPL from the reader, if desired.
- snIPL (simple network IPL)
- How the rest of the system is brought up by init is a very complex process, beyond the scope of this talk.
System Startup and Shutdown (2)

- When shutting down, it is important to do it *properly*. File system corruption and data loss can result otherwise.
- Use the halt, reboot or shutdown command.
- You can use shutdown to warn any logged on users, and/or set the shutdown to some time in the future.
- The shutdown command has options to reboot, halt, or cancel a previous shutdown command.
- The `ctrlaltdel` entry in `/etc/inittab` can be used to automate this by listening for LPAR or z/VM shutdown signals:
  `ca::ctrlaltdel:/sbin/shutdown -h -t 4 now`
Performance Management

• Some “standalone” native Linux tools:
  • top, ntop, httperf, sar, iostat, gkrellm, pload, statnet, Big Brother, Hobbit, iptraf
  • Understand that in a shared environment, such as z/VM (or even LPAR), these will all be lying to you in certain ways. SLES10 and RHEL5 are the first versions that use a kernel that has the code necessary to correct this.

• Proprietary products
  • Velocity Software ESALPS
  • BMC MAINVIEW
  • IBM Performance Tookit
  • OMEGAMON XE
Creating Additional Images

- Some commercial tools, none of them cheap
- Can be done with home grown tools
- IBM Redbook “Linux on IBM zSeries and S/390: ISP/ASP Solutions,” SG24-6299
- z/VM and Linux on IBM System z: The Virtualization Cookbook for SLES10
- z/VM and Linux on IBM System z: The Virtualization Cookbook for RHEL5
Questions?
Additional Information - Web Sites

- http://linuxvm.org/
  (Linux/390 mailing list subscription and archives)
- http://www.slack390.org/
- http://www.kernel.org/
- http://www.linux.org/
- http://www.tldp.org/
  (The Linux Documentation Project)
Additional Information - Redbooks

- Linux for S/390, SG24-4987
- Linux for zSeries and S/390: Distributions, SG24-6264
- Linux on zSeries and S/390: ISP/ASP Solutions, SG24-6299
- Linux on zSeries and S/390: Application Development, SG24-6807
- Linux on zSeries and S/390: System Management, SG24-6820
Additional Information - Redbooks (2)

- Linux on zSeries and S/390: Large Scale Linux Deployment, SG24-6824
- Linux on zSeries and S/390: Performance Measurement and Tuning, SG24-6926
- Linux with zSeries and ESS: Essentials, SG24-7025
- Experiences with Oracle for Linux on zSeries, SG24-6552
- SAP on DB2 UDB for OS/390 and z/OS: Implementing Application Servers on Linux for zSeries, SG24-6847
Additional Information - Redbooks (3)

- e-Business Intelligence: Leveraging DB2 for Linux on S/390, SG24-5687
- e-Business Intelligence: Data Mart Solutions with DB2 for Linux on zSeries, SG24-6294
Additional Information - Redpieces

- Implementing Linux in your Network using Samba, redp0023
- Building Linux Systems Under IBM VM, redp0120
- Linux on zSeries and S/390: High Availability for z/VM and Linux, redp0220
- Linux on zSeries and S/390: Securing Linux for zSeries with a Central z/OS LDAP Server (RACF), redp0221
- Linux on zSeries and S/390: Server Consolidation with Linux for zSeries, redp0222
- Linux on zSeries and S/390: Cloning Linux Images in z/VM, redp0301
• Linux on zSeries and S/390: TCP/IP Broadcast on z/VM Guest LAN, redp3596
• Linux on zSeries and S/390: Managing a Samba Server from z/VM, redp3604
• Linux on zSeries and S/390: Porting LEAF to Linux on zSeries, redp3627
• Linux on zSeries and S/390: Virtual Router Redundancy Protocol on VM Guest LANs, redp3657
• Linux on zSeries and S/390: z/VM Configuration for WebSphere Deployments, redp3661
Additional Information - Redpieces (3)

- Linux on zSeries and S/390: Building SuSE SLES8 Systems under z/VM, redp3687
- Linux on zSeries and S/390: VSWITCH and VLAN Features of z/VM 4.4, redp3719
- e-commerce Patterns for Linux on zSeries Using WebSphere Commerce Suite V5.1 Patterns for e-business series, redp0411
- Getting Started with zSeries Fibre Channel Protocol, redp0205
- WebSphere Portal Installation on Linux for zSeries, redp3699
- Open Your Windows with Samba on Linux, redp3780
Additional Information - Hints & Tips

- Linux on zSeries: Configuring gcc as a cross-compiler, tips0005
- Dynamic management of DASD devices in Linux running on zSeries, tips0023
- Formatting and Labeling a DASD Volume for Linux Guests Running Under z/VM, tips0275
- Partitioning DASD for Linux Guests Running under z/VM, tips0277
Addition Information – O'Reilly Books

  Apache Pocket Reference
* Building Internet Firewalls, 2nd Ed
* DNS and BIND, 5th Edition
* Learning Perl, 5th Edition
* Learning the bash Shell, 3rd Edition
* Learning the vi and Vim Editors, 7th Edition
  Learning MySQL
Addition Information – O'Reilly Books

* Perl Cookbook, 2nd Edition
Perl for System Administration
Perl for Web Site Management
Perl in a Nutshell, 2nd Edition
* Practical UNIX & Internet Security, 3rd Edition
* Programming Perl, 3rd Edition
* Running Linux, 5th Edition
  Samba Pocket Reference, 2nd Edition
Addition Information – O'Reilly Books

- sed & awk Pocket Reference, 2nd Edition
- * sed & awk, 2nd Edition
- * sendmail, 4th Edition
  - sendmail Desktop Reference
- * TCP/IP Network Administration, 3rd Edition
- * Using Samba, 3rd Edition
- vi Editor Pocket Reference
# Command Comparison

<table>
<thead>
<tr>
<th>MVS</th>
<th>VM</th>
<th>Linux</th>
<th>DOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>LISTC</td>
<td>ls / locate</td>
<td>L</td>
<td>dir</td>
</tr>
<tr>
<td>LISTD</td>
<td>file</td>
<td>L (L</td>
<td>attrib</td>
</tr>
<tr>
<td>LIST</td>
<td>cat</td>
<td>TYPE</td>
<td>type</td>
</tr>
<tr>
<td>COPY</td>
<td>cp</td>
<td>COPY</td>
<td>copy</td>
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<tr>
<td>MOVE</td>
<td>mv</td>
<td>MOVE</td>
<td>move</td>
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<tr>
<td>RENAME</td>
<td>mv</td>
<td>RENAME</td>
<td>ren</td>
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<tr>
<td>DELETE</td>
<td>rm</td>
<td>ERASE</td>
<td>del</td>
</tr>
<tr>
<td>HELP</td>
<td>man / info</td>
<td>HELP</td>
<td>help</td>
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<tr>
<td>ICKDSF</td>
<td>dasdfmt / mke2fs</td>
<td>FORMAT</td>
<td>format</td>
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# Command Comparison (2)

<table>
<thead>
<tr>
<th>MVS</th>
<th>VM</th>
<th>Linux</th>
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<tbody>
<tr>
<td>SEND</td>
<td>TELL / MSG / NOTE</td>
<td>write / talk / wall</td>
</tr>
<tr>
<td>LISTB</td>
<td>LOGOFF</td>
<td>/etc/motd</td>
</tr>
<tr>
<td>LOGOFF</td>
<td>PRINT</td>
<td>exit</td>
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<td>PRINTDS</td>
<td>ATTACH</td>
<td>lpr</td>
</tr>
<tr>
<td>V ONLINE</td>
<td>DETACH</td>
<td>mount</td>
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<td>V OFFLINE</td>
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<td>umount</td>
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<td>D TS</td>
<td>Q U</td>
<td>uptime</td>
</tr>
<tr>
<td>D TS,L</td>
<td>Q N</td>
<td>users / w</td>
</tr>
<tr>
<td>D A,L</td>
<td>Q N</td>
<td>ps -ax</td>
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## Command Comparison (3)

<table>
<thead>
<tr>
<th>Linux</th>
<th>DOS</th>
<th>Linux</th>
<th>DOS</th>
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<tbody>
<tr>
<td>cd</td>
<td>cd</td>
<td>host</td>
<td>nslookup</td>
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<tr>
<td>mkdir</td>
<td>mkdir</td>
<td>nslookup</td>
<td>nslookup</td>
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<td>rmdir</td>
<td>rmdir</td>
<td>netstat</td>
<td>netstat</td>
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<td>less / more</td>
<td>more</td>
<td>route</td>
<td>route print</td>
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<td>ping</td>
<td>ping</td>
<td>find</td>
<td>find</td>
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<td>tracert</td>
<td>set</td>
<td>set</td>
</tr>
<tr>
<td></td>
<td></td>
<td>export</td>
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