Linux/390 System Management for the Mainframe System Programmer

I know how to do “abc” with my usual OS. How do I do that with Linux/390?

Mark Post
Thursday, August 17, 2006
Session 9224/9225
About me

- Mark Post (mark.post@eds.com)
- Senior Infrastructure Specialist (Systems Programmer, “plus”)
- EDS, Auburn Hills, Michigan
- Worked with IBM mainframes since entering college in 1973.
- Supported MVS and VM for GM and EDS
- Linux and Linux/390 Technical Lead since 01/2003
My Linux background

- First installed Slackware Linux on a PC at home in 1998.
- Involved with Linux/390 since May of 2000.
- Co-author of IBM Redbook: “Linux for zSeries and S/390: Distributions,” SG24-6264
- Active in the Linux-390 mailing list hosted by Marist College.
- Webmaster for the linuxvm.org web site.
- Ported Slackware® Linux to the mainframe, released as Slack/390 in July of 2004.
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?
Agenda (2)

- What networking connections does Linux/390 support?
- Where’s SYS1.PARMLIB kept?
- Do I really have to know all this stuff?
- Linux/390 DASD management
- Backup and restore
- Software and maintenance management
- Data sharing with Linux/390 and other OS
Agenda (3)

- Job scheduling
- Security and user management
- Diagnostic information available (or not)
- Editors
- Basic vi concepts
- Scripting languages
- System logs
- Basic commands
Agenda (4)

- Advanced commands
- Kernel modules, insmod and modprobe
- System startup and shutdown
- Performance management
- Creating additional images
- Additional information resources
  - Web sites, Redbooks/pieces/tips, Usenet (news), O’Reilly Books
- Command comparisons
Cultural differences

- Open Source Community
- Expectations of self-reliance
- Open Source software
- Software quality
- Where and how you get support
- 3270 terminals vs. VTxxx.
- Install Linux on a PC and use it.
- Is rebooting unnecessarily a sin?
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. (Not that USS really uses it either, per se.)
  - Option “switches” on various commands are different, due to different shells, or compliance to different standards.
How does Linux/390 compare to...

- Unix System Services (cont.)
  - 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 available.
  - 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
- System Integrators
- Packagers
- 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 Tapes
- SCSI over FCP now available
Linux/390 networking connections

- 3172
- OSA-2 (Token-Ring, Ethernet, Fast Ethernet)
- OSA-Express (Ethernet, Fast Ethernet)
- 2216 (Token Ring, Ethernet)
- QDIO OSA-Express (Gb Ethernet, Fast Ethernet)
- ESCON / CTC (native and under VM)
- IUCV (only under VM)
- HiperSockets (native and under VM)
- Guest LANs (only under VM)
- VSwitch (only under VM, requires an OSA)
- Cisco CLAW (CIP) - driver by UTS Global
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/gshadow
  • /etc/inittab
  • /etc/inetd.conf
  • /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?

• If you really don’t want to know what’s going on or have a large virtual farm:
  • YaST (SuSE)
  • Nautilus (Red Hat)
  • Webmin (completely perl-based)
  • AdminUX (Green Light Advantage)
  • linuxconf (no longer recommended by RH)
  • Others
Linux/390 DASD management

Quick Overview:
• 2 kinds of DASD layouts, cd1 and Id1.
• Adding/removing DASD
• Preparing DASD for use
  • Formatting
  • 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 dynamic:
  • 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.)

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

• /sys/bus/ccw/devices/0.0.0601@
• /sys/bus/ccw/drivers/dasd-eckd/0.0.0601@
• /sys/bus/css/devices/0.0.0016@
• /sys/bus/css/drivers/io_subchannel/0.0.0016@
• /sys/devices/css0/0.0.0016/
  • 0.0.0601/
    bus@
    chpids
    driver@
    pimpampom

• /sys/devices/css0/0.0.0016/0.0.0601/
  • Availability
  • bus@
  • cmb_enable
  • cutype
  • devtype
  • discipline
  • driver@
  • online
  • readonly
  • use_diag

Use /sbin/chccwdev instead
chccwdev --online 0.0.0601
chccwdev --e 0.0.0601
Formatting DASD - 2.4.x, 2.6.x

- dasdfmt -b 4096 [ -l volser ] [ -d layout ]
  -f /dev/dasd?
  -n 0d18 (only if devfs is in use)
- dasdfmt -b 4096 -d cdl -f /dev/dasda
- dasdfmt -b 4096 -d ldl -n 0cf3
- dasdfmt -b 4096 -d cdl -n 0d2f

- fdasd /dev/dasd?
  - Must create one, two, or three partitions
Formatting DASD - 2.2.x

- dasdfmt -b 4096 [ -l volser ] -f /dev/dasd?
- dasdfmt -b 4096 [ -l volser ] -n fc23
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

• 2.2.x Kernels
  • mke2fs -b 4096 /dev/dasd?1
    • mke2fs -b 4096 /dev/dasda1
    • mke2fs -b 4096 /dev/dasdb1

• mkswap /dev/dasd?1 (2.2 kernels)
• mkswap /dev/dasd?1,2,3 (2.4, 2.6 kernels)
## File systems vs. directories

<table>
<thead>
<tr>
<th>Directory</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>/ (root)</td>
<td></td>
</tr>
<tr>
<td>/bin</td>
<td></td>
</tr>
<tr>
<td>/boot *</td>
<td></td>
</tr>
<tr>
<td>/dev</td>
<td></td>
</tr>
<tr>
<td>/etc</td>
<td></td>
</tr>
<tr>
<td>/home</td>
<td></td>
</tr>
<tr>
<td>/lib</td>
<td></td>
</tr>
<tr>
<td>/mnt</td>
<td></td>
</tr>
<tr>
<td>/opt</td>
<td></td>
</tr>
<tr>
<td>/proc</td>
<td></td>
</tr>
<tr>
<td>/root</td>
<td>(not to be confused with / root)</td>
</tr>
<tr>
<td>/sbin</td>
<td></td>
</tr>
<tr>
<td>/sys</td>
<td></td>
</tr>
<tr>
<td>/tmp</td>
<td></td>
</tr>
<tr>
<td>/usr</td>
<td></td>
</tr>
<tr>
<td>/var</td>
<td></td>
</tr>
</tbody>
</table>
Backup and restore

- Native Linux facilities
  - afio/cpio/tar

- Software packages (Open Source and proprietary)
  - Amanda / offlindr
  - DFSMSdss / DDR
  - Tivoli TSM/ADSM
  - Innovation FDRINSTANT/UPSTREAM
  - CA BrightStor
  - SecureAgent SecureBackup
  - UTS Global TSS-BAR
  - Veritas NetBackup
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.
Software & maintenance management (2)

• 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 security sources (CERT, etc.) is recommended.

If you *have* to install 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
Data sharing with Linux/390 and other OS

• No direct, hard-wired sharing
• z/OS and z/VM don’t “know” ext2
• Linux doesn’t “know” VTOCS, etc.
  • Except now it does. But, no security!
• Various network-based methods
  • NFS
  • GFS
  • AFS
  • Samba (SMB / CIFS / MS Networking)
• Under VM - sharing minidisks read-only between guests.
Job scheduling

- Linux native facilities
  - cron
  - at

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

- Proprietary
  - CA-7 Agent
  - Jobtrac
  - CA Scheduler
  - PBSPro
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 shadow password utilities.
- Use TCP Wrappers (/etc/hosts.allow, etc.)
- Review your system logs regularly.
- Monitor security alerts from your suppliers, and from various security organizations.
Security and user management (3)

- Don’t lump all your users into one group (typically “users”).
- 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).
Security and user management (4)

- 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
- linuxconf was popular, but should not be used
- useradd, userdel, usermod, groupadd, groupdel, groupmod are common
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/suauth to allow designated people to “su” using their own password.
- Consider using /etc/sudoers to grant some selected command authority to designated people.
Diagnostic information

- strace
- ulimit (to enable core dumps)
- gdb
- uptime
- top
- ksymoops

- netstat
- ping
- traceroute
- system logs
- dmesg
- standalone dump (2.4.x and 2.6.x kernels only)
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 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 to visual mode.
Basic vi concepts (2)

- `:set smd` or `:set showmode`
  - gives visual indicator 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
- Tcl
System logs

• Most of what you want will be in /var/log/, or in a subdirectory of it.
• Names and contents vary by distribution
• 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
Advanced commands

- ifconfig
- netstat
- route
- ping
- host / nslookup
- traceroute
- su
- sudo
- gzip / bzip2
- last
- chmod
- chown
- dmesg
- du
- df
- locate
- top
- sed
- head
- tail
- silo / zipl
- wget
- export
- file
- insmod
- modprobe
- lsmod
- rmmod
- telinit
Kernel modules, insmod and modprobe

• The kernel 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.
Kernel modules, insmod and modprobe (2)

- 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` has the right data in it.

- How does the module get it’s parameters?
  - provided on `insmod` command
  - read from `/etc/modules.conf` by `modprobe` and the kernel.
Kernel modules, insmod and modprobe

(3)

• How does the kernel find the module?
  • Usually in /lib/modules/kernelver/something...
  • depmod -a command creates a cross reference of the modules and where they are located, and writes it into /lib/modules/kernelver/modules.dep.
  • modprobe figures out the dependencies and loads the modules in the right order. insmod does not do this.
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.
Performance management

- Some “standalone” native Linux tools:
  - top, ntop, httperf, sar, iostat, gkrellm, pload, statnet, Big Brother, iptraf
  - Understand that in a shared environment, such as z/VM, these will all be lying to you in certain ways.

- Proprietary products
  - Velocity Software ESALPS (under z/VM)
  - BMC MAINVIEW
  - Candle OMEGAMON XE
Creating additional images

- Some commercial tools
- Can be done with home grown tools
- For large “penguin farms,” knowing what to share between images and how is key.
- IBM Redbook “Linux on IBM zSeries and S/390: ISP/ASP Solutions,” SG24-6299
Questions?
Additional information - web sites

- http://linuxvm.org/
  (Largely Linux/390 specific)
  (Linux/390 mailing list)
- 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
Additional information – Redpieces (2)

- 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
Additional information – Redpieces (4)

- 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
Additional information - Usenet ("news")

- alt.os.linux.dial-up
- alt.os.linux.redhat
- alt.os.linux.slackware
- alt.os.linux.suse
- alt.os.linux.turbolinux
- comp.os.linux.admin
- comp.os.linux.advocacy
- comp.os.linux.announce
- comp.os.linux.development.apps
- comp.os.linux.development.system
- comp.os.linux.hardware
- comp.os.linux.help
- comp.os.linux.misc
- comp.os.linux.networking
- comp.os.linux.questions
- comp.os.linux.redhat
- comp.os.linux.security
- comp.os.linux.setup
- comp.os.linux.x
- comp.protocols.smb (Samba, mainly)
- linux.debian.devel.mentors
- linux.debian.devel.qa
- linux.debian.devel.release
- linux.debian.ports.s390
- linux.debian.project
- linux.debian.project
- linux.debian.security
- linux.dev.c-programming
- linux.dev.kernel
- linux.dev.laptop
- linux.dev.newbie
- linux.help
- linux.kernel
- linux.net.masquerade
- linux.redhat.announce
- linux.redhat.devel
- linux.redhat.install
- linux.redhat.pam
- linux.redhat.rpm
- linux.samba
- linux.sources.kernel
Additional information - O’Reilly books

* Apache Pocket Reference
* Building Internet Firewalls, 2nd Ed
* DNS and BIND, 4th Edition
* Learning Perl, 3rd Edition
* Learning the bash Shell, 2nd Edition
* Learning the vi Editor, 6th Edition
* MySQL & mSQL
* Perl Cookbook
* Perl for System Administration
* Perl for Web Site Management
* Perl in a Nutshell
Additional information - O’Reilly books (2)

* Practical UNIX & Internet Security, 2nd Edition
* Programming Perl, 3rd Edition
* Running Linux, 3rd Edition
  Samba Pocket Reference
  sed & awk Pocket Reference
* sed & awk, 2nd Edition
* sendmail, 2nd Edition
  sendmail Desktop Reference
* SSH, The Secure Shell: The Definitive Guide
* TCP/IP Network Administration, 2nd Edition
* Using Samba - comes with the software
  vi Editor Pocket Reference
Additional information - O’Reilly books (3)

* Networking CD Bookshelf
  TCP/IP Network Administration, 2nd Edition
  sendmail, 2nd Edition
  sendmail Desktop Reference
  DNS and BIND, 3rd Edition
  Practical UNIX & Internet Security, 2nd Edition
  Building Internet Firewalls

* The Perl CD Bookshelf, Version 2.0
  Programming Perl, 3rd Edition
  Perl for System Administration
  Perl in a Nutshell
  Perl Cookbook
  Advanced Perl Programming
* The Linux Web Server CD Bookshelf

Running Linux, 3rd Edition

Linux in a Nutshell, 3rd Edition


MySQL & mSQL

Programming the Perl DBI

CGI Programming with Perl, 2nd Edition
# 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>L</td>
<td>ls / locate</td>
<td>dir</td>
</tr>
<tr>
<td>LISTD</td>
<td>L (L</td>
<td>file</td>
<td>attrib</td>
</tr>
<tr>
<td>LIST</td>
<td>TYPE</td>
<td>cat</td>
<td>type</td>
</tr>
<tr>
<td>COPY</td>
<td>COPY</td>
<td>cp</td>
<td>copy</td>
</tr>
<tr>
<td>MOVE</td>
<td>MOVE</td>
<td>mv</td>
<td>move</td>
</tr>
<tr>
<td>RENAME</td>
<td>RENAME</td>
<td>mv</td>
<td>ren</td>
</tr>
<tr>
<td>DELETE</td>
<td>ERASE</td>
<td>rm</td>
<td>del</td>
</tr>
<tr>
<td>HELP</td>
<td>HELP</td>
<td>man / info</td>
<td>help</td>
</tr>
<tr>
<td>ICKDSF</td>
<td>FORMAT</td>
<td>dasdfmt / mke2fs</td>
<td>format</td>
</tr>
</tbody>
</table>

Copyright 2002-2006 by Mark Post
# Command Comparison (2)

<table>
<thead>
<tr>
<th>MVS</th>
<th>VM</th>
<th>Linux</th>
</tr>
</thead>
<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>
</tr>
<tr>
<td>PRINTDS</td>
<td>ATTACH</td>
<td>lpr</td>
</tr>
<tr>
<td>V ONLINE</td>
<td>DETACH</td>
<td>mount</td>
</tr>
<tr>
<td>V OFFLINE</td>
<td>Q U</td>
<td>uptime</td>
</tr>
<tr>
<td>D TS</td>
<td>Q N</td>
<td>users / w</td>
</tr>
<tr>
<td>D TS,L</td>
<td>Q N</td>
<td>ps -ax</td>
</tr>
<tr>
<td>D A,L</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Copyright 2002-2006 by Mark Post*
## Command comparison (3)

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