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?

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Thursday, February 15, 2007
Session 9224/9225
About me

- Mark Post (mpost@novell.com)
- Technology Specialist for Linux Impact Team (for 1 week).
- 28.75 years with EDS.
- Worked with IBM mainframes since entering college in 1973.
- Supported VM, MVS, Linux and Linux/390 for GM and EDS.
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 -zxj 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 ld1.
• 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

- New disks detected automatically
- `/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
cchccwdev --e 0.0.0601
Formatting DASD - 2.4.x, 2.6.x

- \texttt{dasdfmt -b 4096 [ -l volser ] [ -d layout ]} \\
  \texttt{-f /dev/dasd?} \\
  \texttt{-n 0d18} \quad \text{(only if devfs is in use)}

- \texttt{dasdfmt -b 4096 -d cdl -f /dev/dasda}
- \texttt{dasdfmt -b 4096 -d ldl -n 0cf3}
- \texttt{dasdfmt -b 4096 -d cdl -n 0d2f}

- \texttt{fdasd /dev/dasd?}
  \textbullet \textbf{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

/ (root)
/bin
/boot *
/dev
/etc
/home
/lib, /lib64
/mnt
/opt
/proc
/root (not to be confused with / root)
/sbin
/sys
/tmp
/usr
/var
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.
Software & maintenance management (3)

- 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).
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.
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 its parameters?

- Provided on `insmod` command
- Read from `/etc/modules.conf` by `modprobe` and the kernel.
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.
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
* 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>
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<tr>
<td>MOVE</td>
<td>MOVE</td>
<td>mv</td>
<td>move</td>
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<tr>
<td>RENAME</td>
<td>RENAME</td>
<td>mv</td>
<td>ren</td>
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<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>
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</table>

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## 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>• umount</td>
</tr>
<tr>
<td>• D TS</td>
<td>• Q N</td>
<td>• uptime</td>
</tr>
<tr>
<td>• D TS,L</td>
<td>• Q N</td>
<td>• users / w</td>
</tr>
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<td>• D A,L</td>
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<td>• ps -ax</td>
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### Command comparison (3)

<table>
<thead>
<tr>
<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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<tr>
<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>
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<td>traceroute</td>
<td>tracert</td>
<td>set</td>
<td>set</td>
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<tr>
<td></td>
<td></td>
<td>export</td>
<td>set</td>
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