

LINUX Administrator's Quick Reference Card

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User Management

Files

/etc/group /etc/passwd /etc/shadow	User account information.
/etc/bashrc /etc/profile \$HOME/.bashrc \$HOME/.bash_profile	BASH system wide and per user init files.
/etc/csh.cshrc /etc/csh.login \$HOME/.cshrc \$HOME/.tcshrc \$HOME/.login	TCSH system wide and per user init files.
/etc/skel	template files for new users.
/etc/default	default for certain commands.
/etc/redhat-release /etc/slackware-version	Redhat and Slackware version info (Linux kernel version with "uname -a")

Commands

adduser	script to create a new user interactively (slackware) or link to useradd (Redhat).
useradd, userdel, usermod	create, delete, modify a new user or update default new user information..
newusers	update and create new users (batch mode).
groupadd, groupdel, groupmod	add, delete or modify group.
chage, chfn, chsh	modify account policy (password length, expire data etc.) or finger information (full name, phone number etc.) change default login shell.
linux init=/bin/sh rw	gain root access during boot prompt without password, can be used to fix some problems.
mount -w -n -o remount /	
makebootdisk	make a bootable floppy disk

Network Configuration

Files

/etc/rc.d/rc.inet1 (Slackware) /etc/sysconfig/network-scripts/ifcfg-eth0 (Redhat)	IP address, Network mask, Default gateway are in these files. May edit manually to modify network parameters.
--	---

/etc/HOSTNAME
/etc/NETWORKING (Slackware)

hostname is set by "/bin/hostname" during boot and the name is read from these files. May change manually.

/etc/sysconfig/network (Redhat)

specify name server, DNS domain and search order. For Example:
search la.asu.edu
nameserver 129.219.17.200

etc/resolv.conf

host name to IP mapping file.

/etc/hosts

host name information look up order. Example:

order hosts, bind
multi on

/etc/host.conf

new way to specify information source.

/etc/nsswitch.conf

/etc/networks
/etc/protocols
/etc/services

TCP/IP services and ports mapping.

/etc/rpc

RPC service name to their program numbers mapping.

Commands

netconfig	menu driven Ethernet setup program.
pppsetup	setup PPP connection (Slackware). setup Ethernet during boot, for example /sbin/ifconfig eth0 \${IPADDR} broadcast \${BROADCAST} netmask \${NETMASK}
ifconfig	/sbin/route add -net \${NETWORK} netmask \${NETMASK} eth0
host	lookup host name or IP (similar to nslookup).
dnsdomainname	show DNS domain name.
arping; arp	find out Ethernet address by first arping then arp.
ipchains	firewall and NAT (/etc/sysconfig/ipchains on Redhat)
iptables	firewall and NAT (/etc/sysconfig/iptables on Redhat)
ntsysv	menu driven SYSV service configuration (Redhat)
chkconfig	command line SYSV service configuration (Redhat)

Redhat files in /etc/sysconfig

Configuration Files

keyboard	keyboard map, e.g., KEYBOARD="/usr/lib/kdb/keytables/us.map"
mouse	Mouse type, e.g., MOUSETYPE=Microsoft XEMU3=yes
network	network settings, contains NETWORKING=yes

HOSTNAME=hostname.domain.com

NFS File Sharing

Files

/etc/fstab	file systems mounted during boot.
/etc/exports	NFS server export list.
/etc/auto.master	auto mount master file.

Commands

mount	mount a file system or all entries in fstab.
exports	export file system listed in exports
showmount -e hostname	show file systems exported

Printer Configuration

Files

/etc/printcap /etc/printcap.local	Printer capabilities data base.
/etc/lpd.conf	LPRng configuration file.
/etc/lpd.perms	permissions control file for the LPRng line printer spooler
/etc/hosts.lpd	Access control (BSD lpd).
/etc/hosts.equiv	trusted hosts.
PRINTER	Environment variable of default printer.
/dev/lp0	parallel port.

Commands

lpc, lpq, lprm	line printer control program, print queue maintain
-----------------------	--

Sendmail

Files

sendmail.cf sendmail.mc	"sendmail.cf" is the configuration file. "sendmail.mc" is a macro file which can be used to generate "sendmail.cf" by: m4 sendmail.mc > sendmail.cf
aliases	mail aliases, must run "newaliases" after change. use :include: to include external list in a file.
.forward	per user aliases, use \yourname to prevent further expand and keeps a copy in mailbox.
access	mail access control, FEATURE(access_db) should be set in sendmail.mc. For example, in /etc/mail/access cyberpromo.com REJECT mydomain.com RELAY spam@somewhere.com DISCARD
/etc/mail/relay-domains	makemap hash /etc/mail/access < /etc/mail/access list all host/domain accepted for relaying.

Commands

newaliases rebuild the data base for the mail aliases file.
makemap build access database, e.g.,
makemap hash access.db<access

Useful Configuration Files

Files

httpd.conf Apache web server configuration file.
lilo.conf LILO boot loader configuration file.
syslog.conf System log daemon (syslogd) configuration.
ssh_config SSH client and server configuration files.
sshd_config
ld.so.conf default dynamic library search path (run ldconfig).
mtools.conf mtool configuration file (access DOS file).
named.conf DNS name server (BIND).
sysctl.conf kernel parameters by sysctl (Redhat).
ntp.conf net time server.
inetd.conf Internet super server.
Xinetd.conf, Xinetd directory Extended inetd configuration.
proftpd.conf proftpd FTP server.
amanda.conf network backup server.
/etc/pine.conf PINE mail client system wide settings.
/etc/pine.conf.fixed

Rebuild Kernel

Configure Kernel Parameters

Unpack the tarball in /usr/src directory
`bzip2 -dc linux-2.4.0.tar.bz2 | tar xvf -`
make config
make menuconfig Configuring the kernel with interactive, menu or X window interface.
make xconfig

Compile Kernel Source

Building and installing a new kernel.

`cp arch/i386/boot/bzImage /boot/bzImage-KERNEL_VERSION`
make dep
make zImage
make zdisk
make zliilo
make bzImage

`cp System.map /boot/System.map-KERNEL_VERSION`

`ln -s /boot/System.map-KERNEL_VERSION /boot/System.map`

Compile Modules

make modules
make modules_install Building and installing modules.

Manage Modules

insmod, lsmod, modinfo, modprobe, rmmod, depmod Manage loadable modules.

Miscellaneous

Files

/etc/shells allowed login shells
/etc/ftpusers user names NOT allowed to use ftp.
/etc/hosts.allow TCP wrapper access control files.
/etc/hosts.deny
/etc/sysconfig (redhat) contains system configuration files.
/dev/fd0 floppy drive A
/etc/inittab system run level control file.
/etc/init.d

Commands

fromdos, todos (Slackware) convert text file from/to linux format.
dos2unix, unix2dos (Redhat)
pwck, grpck verify integrity of password and group files.
pwconv, pwunconv, grpconv, grpuncov convert to and from shadow passwords and groups.
shadowconfig toggle shadow passwords on and off.
quota, edquota, quotacheck, quotaon, quotaoff, repquota, Manage disk quota.
lilo -D dos set LILO default OS (default=dos in lilo.conf)
ldd find out shared library dependencies.
lsuf list opened files.
fuser filename show processes that using the file.
ifdown ifup bring up/down a network interface (Redhat)
sysctl configure kernel parameters (Redhat).
socklist list opened socked.
shutdown [-r|h] now reboot / halt computer
nmap scan a host for opened ports.
crontab show or edit cron jobs.
sys-unconfig unconfigure system
chkconfig --list list services started at different run level.

unset TMOUT disable BASH auto-logout feature
unset autologout disable TCSH auto-logout feature
kudzu probe for new hardware (Redhat).

rpm -i INSTALL a package
rpm -e UNINSTALL a package
rpm -q QUERY a package
rpm -U UPDATE a package

Rpm

man cmd | col -b >cmd.txt save a man page as a text file and remove control characters.

Ntop -w 3000 Run ntop and listen on web port 3000. View traffic with browser to http://hostname:3000

Configure Apache 2.0 with SSL

mod_ssl

- when compile apache, specify `--enable-ssl` for configure script. By default, ssl is not enabled. After compiling, use `httpd -l` to list the modules. "mod_ssl" should be in them.
- generate private key with command:
`openssl genrsa -out server.key 1024`
- generate certificate request
`openssl req -new -key server.key -out server.csr`
- generate self-signed certificate
`openssl x509 -req -days 60 -in server.csr -signkey server.key -out server.crt`
- modify "ssl.conf" which is included in "httpd.conf". To start web server with SSL support, use "httpd -DSSL" or "apachectl startssl", otherwise, commented out `<IfDefine SSL>` in ssl.conf.

(*) Trouble shoot SSI connection with command
`openssl s_client -connect yourhost.yourdomain.com:443`

Syslog.conf

Each line consists of a selector and an action. A selector has two parts: facilities and priorities, separated by a period (.). You may precede every priority with an equation sign ("=") to specify only this single priority and not any of the above. You may also (both is valid, too) precede the priority with an exclamation mark ("!") to ignore all that priorities, either exact this one or this and any higher priority.

Example:

```
mail.notice /var/log/mail # log to a file
*.emerg @myhost.mydomain.org # log to remote host
```

Note: separator between first column and second column (log file name) must be TAB, not spaces.

facilities auth, auth-priv, cron, daemon, kern, lpr, mail, mark, news, syslog, user, uucp, local0 - local7.
priorities debug, info, notice, warning, err, crit, alert, emerg.

action

Regular File:

File with full pathname beginning with “/”.

Terminal and Console:

Specify a tty, same with /dev/console.

Remote Machine:

@myhost.mydomain.org

Printing with CUPS

Introduction

Common Unix Printing System (CUPS) is the default printing system on most Linux distributions.

If your system does not have CUPS preinstalled or you want the latest version, you may download it from <http://www.cups.org>. You have to download CUPS package, and optionally ESP Ghostscript package if you don't have a Postscript printer.

You compile and install both packages with *configure*; (see *configure --help*)
make;
make install

The printing daemon “/usr/sbin/cupsd” is controlled by a configuration file “/etc/cups/cupsd.conf”. The syntax of this file is similar to Apache's httpd.conf. Normally, you don't need to modify this file.

You can start “cupsd” directly or use a system starting script (e.g., rc.cups start).

You can manage printers with a GUI program from KDE/GNOME, web interface or command lines.

lpadmin -p myprint -E -v parallel:/dev/lp0 -m laserjet.ppd
lpadmin -p myprint -E -v socket://11.22.33.44 -m myprint.ppd
lpadmin -p myprint -E -v lpd://11.22.33.44/ -m myprint.ppd

The about commands add a printer connected to (1) local parallel port, (2) JetDirect printer, and (3) LPD printer. -m option specifying a Postscript Printing Definition (PPD) files. CUPS has a few PPD files preinstalled. In order to use full features of your printer, you may need to find a proper PPD file and put it in “/usr/share/cups/model” directory.

kcmshell printmgr KDE printer manager
http://localhost:631 CUPS web administration interface
lpadm -d myprint -d option set a printer as default
lpadm -x myprint -x option delete a installed printer.
enable/disable Control printing queue
accept/reject
lpadmin -p myprint -P another.PPD Change PPD file
lpoptions -p myprint -l Display associate PPD
lpinfo -v List supported printing protocols
/etc/cups/printers.conf
/etc/cups/classes.conf CUPS related configuration files
/etc/cups/cupsd.conf

/etc/cups
/usr/lib/cups
/usr/share/cups

CUPS related directories

Samba File and Printer Sharing

Introduction

Samba provides file and printer sharing with MS Windows computers. It makes UNIX speaks SMB/ICFS file and printer sharing protocol. The latest version of samba can be downloaded from

<http://www.samba.org>.

Samba is controlled by a configuration file “smb.conf”. On Redhat Linux, one can use “**redhat-config-samba**” to modify the configuration file. On other systems, SWAT is a web based GUI interface. SWAT is run from “inetd” and listen to port 901. You just need point your browser to <http://localhost:901> after starting swat.

Commands

To test if the syntax of “smb.conf” is correct, use

testparm smb.conf

List shares on a Samba or Windows server

smbclient -L machinename -U username

Connect to a Samba or Windows server and get/put files using FTP like commands:

smbclient //machinename/sharename -U username

Security Mode in “smb.conf”

security = user

In this (default) security mode, samba maintain its own user login database which is usually in /etc/samba/smbpasswd. This file is created with command /usr/sbin/smbpasswd. Note, the user login file and command have the same name but in different directories. Following settings are used:

encrypt passwords = yes

smb passwd file = /etc/samba/smbpasswd

security = domain

In this security mode, samba server must join to an NT domain (using net command) and authenticate users by a domain controller. A user must have both valid UNIX and NT account in order to access files.

security = server

Use another computer (NT or W2k) to authenticate users. No need to join a domain. Need to specify a login server:
password server = **mywin.domain.com**

security = share

Give each share a password, no user name needed.

IPtables (Netfilter)

Command Syntax

iptables [-t <table >] <command> <chain > <parameters>

Save and Restore rules

/sbin/iptables-save > /etc/sysconfig/iptables

/sbin/iptables-restore < /etc/sysconfig/iptables

Firewall script sample

http://tiger.la.asu.edu/iptables_examples.htm

Build-in Table

filter

This is the default table for handling network packets. Build-in chains are:

1. **INPUT** — This chain applies to packets received via a network interface.
2. **OUTPUT** — This chain applies to packets sent out via the same network interface which received the packets.
3. **FORWARD** — This chain applies to packets received on one network interface and sent out on another.

nat

This table used to alter packets that create a new connection. Build-in chains:

1. **PREROUTING** — This chain alters packets received via a network interface when they arrive.
2. **OUTPUT** — This chain alters locally-generated packets before they are routed via a network interface.
3. **POSTROUTING** — This chain alters packets before they are sent out via a network interface.

Masquerade everything out ppp0.

iptables -t nat -A POSTROUTING -o ppp0 -j MASQUERADE

MASQUERADE

Change source addresses to 1.2.3.4.

iptables -t nat -A POSTROUTING -o eth0 -j SNAT --to 1.2.3.4

mangle

This table is used for specific types of packet alteration. Build-in chains:

1. **PREROUTING** — This chain alters packets received via a network interface before they are routed.
2. **OUTPUT** — This chain alters locally-generated packets before they are routed via a network interface.

Commands

--flush | -F Flush (delete) rules in the selected chain.
--policy | -P Set default policy for a particular chain.
--list | -L List all rules in filter table, use [-t tablename] to specify other tables.
--append | -A A appends a rule to the end of the specified chain.
-insert | -I Inserts a rule in a chain at a particular point.

Other commands:

(1) --new | -N **(2) --delete | -D** **(3) --replace | -D** **(4) --zero | -Z**
(5) --check | -C **(6) delete-chain | -X** **(7) rename-chain | -E**

Parameters

--proto -p [!] <i>name</i>	protocol: by number or name, including tcp , udp , icmp or all .
--source -s [!] <i>addr/mask</i>	source IP address.
--destination -d <i>addr/mask</i>	destination IP address.
--in-interface -i	incoming interface name, e.g. eth0 or ppp0.
--out-interface -o	outgoing interface name.
--jump -j	jump to a particular target when matching a rule. Standard options: ACCEPT , DROP , QUEUE , RETURN , REJECT . May jump to a user defined chain.
--fragment -f	match second or further fragments only.

Options for TCP and UDP protocol

--sport --source-port	source and/or destination port. Can specify a
--dport destination-port	range like 0:65535, use exclamation character (!) to NOT match ports.

Options for TCP only

--syn	Match SYN packets.
--tcp-flags	Match TCP packets with specific bits set. For example, <code>-p tcp --tcp-flags ACK,FIN,SYN</code> SYN will only match TCP packets that have the SYN flag set and the ACK and FIN flags unset.

Options for ICMP only

--icmp-type [!] <i>type</i>	Match specified ICMP type. Valid ICMP type can be list by <code>iptables -p icmp -h</code>
------------------------------------	--

Option for state module (-m state --state)

ESTABLISHED	The matching packet is associated with other packets in an established connection.
RELATED	The matching packet is starting a new connection related in some way to an existing connection.
NEW	The matching packet is either creating a new connection or is part of a two-way connection not previously seen.
INVALID	The matching packet cannot be tied to a known connection.

X Window (XFree86)

Files

To set screen resolution, in “Screen” section and Subsection “Display”, specify a mode. For example: Modes “1024x768”

To specify screen refresh rate, in “Monitor” section, specify vertical rate. For example: VertRefresh 70-120

\$HOME/.xinitrc
/etc/X11/xinit/xinitrc
/etc/X11/xinit/xinitrc.d scripts run after X server started
\$HOME/.Xclients
/etc/X11/xinit/Xclients

/etc/sysconfig/desktop decide which desktop (GNORM, KDE) to start (Redhat). (by /etc/X11/prefdm)

/etc/X11/fs/config configuration of X11 font path (font server).

Commands

startx	start X window system.
Xconfigurator (Redhat) xfree86setup (Slackware) xf86config	setup X server and generate XF86config.
XFree86 -configure	XFree86 auto configuration (Plug-n-Play), generate a template named “XF86Config.new”
Ctrl+Alt+Del	stop X server (on some system Ctrl+Alt+ESC).
Ctrl+Alt+F1 Ctrl+Alt+F7	F1 temporary switch to text mode, F7 switch back to graphic mode.
SuperProbe	detect graphic hardware.
xvidtune	adjust X server origin and size.
xmodmap	modifying key map and mouse button map.
xhost	server access control program for X.
xsetroot	root window parameter setting utility for X.
xlsfonts	server font list displayer for X.
xset	ser preference utility for X.

XF86Config

XFree86 uses a configuration file called **XF86Config** for its initial setup. This file is normally located in “/etc/X11” or “/etc” directory. The XF86Config file is composed of a number of sections which may be present in any order. Each section has the form:

```
Section "SectionName"  
SectionEntry  
...  
EndSection
```

The graphics boards are described in the **Device** sections, and the monitors are described in the **Monitor** sections. They are bound together by a **Screen** section. Keyboard and Mouse are described in **InputDevice** sections, although *Keyboard* and *Pointer* are still recognized. **ServerLayout** section is at the highest level and bind together the InputDevice and Screen sections.

A special keyword called **Option** may be used to provide free-form data to various components of the server. The Option keyword takes either one or two string arguments. The first is the option name, and the optional second argument is the option value. All Option values must be enclosed in quotes.

File Section

FontPath "path"

Font path elements may be either absolute directory paths, or a font server identifier

RGBPath "path"

Sets the path name for the RGB color database.

ModulePath "path"

Allows you to set up multiple directories to use for storing modules loaded by the XFree86 server.

EXAMPLE

```
Section "Files"  
  RgbPath "/usr/X11R6/lib/X11/rgb"  
  FontPath "unix/:7100"  
EndSection
```

Serverflags Section

Option "DontZap" "boolean"

Disable use **Ctrl+Alt+Backspace** to terminate X server.

Option "DontZoom" "boolean"

Disable use **Ctrl+Alt+Keypad +** and **Ctrl+Alt+Keypad -** to switch video mode.

Option "BlankTime" "time"

Sets the inactivity timeout for the blanking phase of the screensaver in minutes. Default 10 min.

Option "StandbyTime" "time"

Sets the inactivity timeout for the "standby" phase of DPMS mode in minutes. Default 20 min.

Option "SuspendTime" "time"

Sets the inactivity timeout for the "suspend" phase of DPMS mode, default 30 min.

Option "OffTime" "time"

Sets the inactivity timeout for the "off" phase of DPMS mode, default 40 min.

Option "DefaultServerLayout" "layout_id"

Specify the default ServerLayout section to use. Default is the first ServerLayout section.

EXAMPLE

```
Section "ServerFlags"  
  Option "BlankTime" "99999"  
  Option "StandbyTime" "99999"  
  Option "SuspendTime" "99999"  
  Option "OffTime" "99999"  
EndSection
```

Module Section

Load "modulename"

Load a module. The module name given should be the module's standard name, not the module file name.

EXAMPLE

```
Section "Module"  
  Load "extmod"  
  Load "type1"  
EndSection
```

InputDevice Section

There are normally at least two InputDevice sections, one for Keyboard and one for Mouse.

Identifier

Specify an unique name for this input device.

Driver

Specify the name of the driver to use for this input device..

Option "CorePointer"

This input device is installed as the primary pointer device.

Option "CoreKeyboard"

This input device is the primary Keyboard.

EXAMPLE

```
Section "InputDevice"
    Identifier "Generic Keyboard"
    Driver "keyboard"
    Option "AutoRepeat" "500 30"
    Option "CoreKeyboard"
EndSection

Section "InputDevice"
    Identifier "PS2 Mouse"
    Driver "mouse"
    Option "CorePointer"
    Option "Device" "/dev/mouse"
    Option "Protocol" "PS/2"
    Option "Emulate3Buttons" "true"
EndSection
```

Device Section

Specifies information about the video card used by the system. You must have at least one Device section in your configuration file. The active device is in ServerLayout->Screen.

Identifier

Specify an unique name for this graphics card.

Driver

Specify the name of the driver to use for this graphics card.

EXAMPLE

```
Section "Device"
    Identifier "ATI Mach64"
    VendorName "ATI MACH64"
    VideoRam 2048
EndSection
```

Monitor Section

Monitor section describes a monitor. There must be at least one monitor section and the active one is used in ServerLayout->Screen.

Identifier

Specify an unique name for this monitor.

HorizSync horizsync-range

Gives the range(s) of horizontal sync frequencies of this monitor in kHz.

VertRefresh vertrefresh-range

Gives the range(s) of vertical sync frequencies of this monitor in Hz.

EXAMPLE

```
Section "Monitor"
    Identifier "Generic Monitor "
    VendorName "Monitor Vendor"
    ModelName "Monitor Model"
    HorizSync 31.5-56.6
    VertRefresh 40-70
EndSection
```

Screen Section

Screen section binds Device and Monitor sections. There must be at least one Screen Section. The active one is in ServerLayout section.

Identifier

Specify an unique name for this Screen Section.

Device "device-id"

This specifies the Identifier of **Device section** to be used for this screen.

Monitor "monitor-id"

This specifies the Identifier of **Monitor section** to be used for this screen.

DefaultDepth depth

Default color depth, like 8, 16 or 24.

Option "Accel"

Enables XAA (X Acceleration Architecture), default is ON.

DISPLAY SUBSECTION

Each Screen section must have at least one Display Subsection which matches the depth values in DefaultDepth.

Depth depth

This entry specifies what color depth of this Display Subsection.

Virtual xdim ydim

Specifies the virtual screen resolution to be used.

ViewPort x0 y0

Sets the upper left corner of the initial display.

Modes "mode-name" ...

Specifies the list of video modes to use. Each mode-name specified must be in double quotes. They must correspond to those specified in the appropriate Monitor section (including implicitly referenced built-in ESA standard modes). mode can be switched with Ctrl+Alt+Keypad-Plus or Ctrl+Alt+Keypad-Minus.

EXAMPLE

```
Section "Screen"
    Identifier "My Screen"
    Device "ATI Mach64"
    Monitor "Generic Monitor"
    DefaultDepth 16
    SubSection "Display"
        Depth 16
        Modes "1024x768" "800x600" "640x480"
    EndSubSection
    SubSection "Display"
        Depth 24
        Modes "1024x768" "800x600" "640x480"
    EndSubSection
EndSection
```

ServerLayout Section

ServerLayout section binds a Screen section and one or more InputSection to form a complete configuration. The active ServerLayout section is specified in ServerFlags. If not, the first ServerLayout section is active. If no ServerLayout sections are present, the single active screen and two active (core) input devices are selected as described in the relevant sections.

Identifier

An unique name for this ServerLayout Section.

Screen screen-num "screen-id" position-information

The screen-id field is mandatory, and specifies the Screen section being referenced.

InputDevice "idev-id" "option" ...

Normally at least two are required, one for the core pointer and the other for the primary keyboard devices.

EXAMPLE

```
Section "ServerLayout"
    Identifier "Default Layout"
    Screen "My Screen"
    InputDevice "Generic Keyboard"
    InputDevice "PS/2 Mouse"
EndSection
```

Boot Sequences

Redhat

Usually the Linux kernel file is **/boot/vmlinuz** and is loaded by a boot loader (e.g., LILO). The first process created by the kernel is **/sbin/init**. It uses a configuration file **/etc/inittab**. **init** process runs **/etc/rc.d/rc.sysinit** script first, then runs all scripts in **/etc/rc.d/rc.N.d**, where **N** is the default run level defined in **inittab**. The actual scripts are stored in **/etc/rc.d/init.d** and proper links are created in run level directoris to point to corresponding scripts in **init.d** directory. The last script to run is **/etc/rc.d/rc.local**.

Run level 1: Single user mode

Run level 3: Multiuser mode

Run level 5: Multiuser model with X11

Slackware

In Slackware, Linux kernel is **/boot/vmlinuz** and the first process started by the kernel is **/sbin/init**. Its configuration file is **/etc/inittab**. **init** first runs script **/etc/rc.d/rc.S**, then runs **/etc/rc.K** for single user mode or **/etc/rc.M** for multiuser mode. The last script to run is **/etc/rc.d/rc.local**.

rc.S calls scripts (**rc.modules**, **rc.pcmcia**, **rc.serial** and **rc.sysvinit**).

rc.M calls scripts (**rc.inet1**, **rc.inet2**, **rc.httpd**, **rc.samba**) and start some network server (lpd, httpd etc.)

rc.inet1 sets IP address, Mask, and default Gateway.

Run level 1: Single user mode

Run level 3: Multiuser mode

Run level 4: Multiuser model with X11

GRUB boot loader

Introduction

More Linux distributions use GRUB as their boot loader instead of LILO. If your system does not have GRUB preinstalled, it can be downloaded from <http://www.gnu.org/software/grub/>

The newer version of GRUB (called GRUB2) is totally rewritten and uses somewhat different syntax than Ver 0.xxx (called GRUB Legacy). After unpacking GRUN, compile and install it with following commands:

```
./configure  
make  
make install
```

First test GRUB by creating a bootable floppy disk with command

```
grub-install /dev/fd0
```

Suppose you have Windows installed on the first hard disk and Linux on the second disk, boot with just created floppy and type following commands

```
=== Boot Linux ===  
grub> root (hd1,0)  
grub> kernel /boot/vmlinuz  
(or linux /boot/vmlinuz if using GRUB2)  
grub> boot
```

```
=== Boot Windows ===  
grub>rootnoverify(hd0, 0)  
chainloader +1  
boot
```

Other Useful GRUB commands

ls	Display disks and partitions
configfile (hd1,0)/boot/grub.conf	Display boot menu
cat (hd1, 0)/etc/fstab	Display a file content, can figure out which partition was used as root partition in an unbootable system, then pass root parameter in “kernel” command
help	List available commands

Sample GRUB configuration file

```
#=====  
# GRUB ver 0.xxx  
#=====  
default=0  
timeout=10  
splashimage=(hd1,2)/grub/splash.xpm.gz  
title Linux  
    root (hd1,0)  
    kernel /boot/vmlinuz  
  
title Windows XP  
    rootnoverify (hd0,0)
```

```
chainloader +1  
  
#=====  
# GRUB2  
#=====  
set timeout=10  
set default=0  
  
# Entry 0 - Load Linux kernel  
menuentry "Linux" {  
    set root=(hd1, 0)  
    linux /boot/vmlinuz root=/dev/hda2  
    initrd /initrd  
}  
  
# Entry 1 - Chainload another bootloader  
menuentry "Windows" {  
    set root=(hd0, 0)  
    chainloader +1  
}
```