Linux Professional Institute
Exam LPIC 101
Preparation Guide

Version 3a

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About this document

Version 3 by Alan McKinnon

I needed an exam preparation guide for my students once they had completed their Linux training and wanted to prepare to write the LPI level 1 exams. I found version 2 of this guide by Michel Bisson on the LPI website (http://www.lpi.org) and it suited my needs.

The content of this guide is essentially still the same as Michel wrote it. I have merely reformatted it, changed the order of some sections and fixed some typos and grammar errors.

Any queries about this guide should be directed to me:

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This guide is re-released under the same terms as the original – see below.

Version 2 by Michel Bisson

This document was produced to help candidates pass the LPI 101 exam. I have created it essentially as a reference document and not as a tutorial. That's why in general, it doesn't have many explanations for the subjects treated. I usually use it in my courses as exam preparation. To my knowledge it covers the most important aspects of the topics asked in the exam, but it's layout and content organization is not perfect. Helped by this document and with enough practice, most of my students passed the exam. In some topics I have added more information than is needed for the LPI 101 exam. When in doubt, refer to the description of the requirements located at the beginning of each topic.

This is a free document. You may distribute, modify, or improve it for personal or commercial use as you wish.. I take no responsibility of any kind for the accuracy of the information in this document, nor for the success or failure of any participants in passing the exam.

I would appreciate it that if you make modifications to this document, you send me a copy of the new version.

Please let me know of any errors or inaccuracies in the information in this document, that would help me improve it. Feedback of any kind is welcome. If anybody wants to contribute to this document, you're very welcome, please contact me at

michel@linuxint.com

I hope it will help you to prepare for the LPI 101 exam and remember, that practice, practice, and more practice is the key.

Regarding the LPI 101 Exam

This is a required exam for LPI certification Level 1. It covers basic system administration skills that are common across all distributions of Linux.

Each objective is assigned a weighting value. The weights range roughly from 1 to 10, and indicate the relative importance of each objective. Objectives with higher weights will be covered in the exam with more questions.

Approximate number of questions per topic

Weight per topic

Tips on writing the exam

Most questions that require you to fill-in the blanks, don't require any options. eg. cat or ls or cp (without options)

Use your experience and common sense to deciding what is important and what is not when studying. When in doubt, just read the description of the requirements located at the beginning of each topic again.

I recommend you create a checklist of topics for yourself and to review it once in a while. This can help avoid spending too much time in one subject at the expense of other important subjects.

Note the weight of each topic and spend the equivalent amount of time on it.

When doing the exam, I recommend you first answer the questions that you are sure of and then go back to the other ones afterwards.

Read the questions thoroughly and make sure you understand them well. Then read ALL the answers carefully before answering. I almost got caught a few times, answering something I was sure couldn't be anything else, but when I read the other answers I saw which one was really the correct answer.

The exam is difficult and needs concentration and a good memory. It is not recommended to eat a heavy meal before the exam.

There is no need to rush through the exam and risk overlooking something. There is more than enough time to answer all the questions. When you're finished and there is still time left, review your answers once.

Topic 101: Hardware & Architecture

Summary

General hardware

Processor, BIOS, RAM , Address Bus system, Data Bus system

Address and IRQ conflicts

    IRQ Table

Used by system: 1,2,6,8,14,15

Mostly free: 5,9,10,11,13

May be freeable: 3,4,7,12

IRQ Sharing

    PCI Mostly OK, ISA – Not sharable

DMA

    8 DMA Channels.

    DMA 4 is always busy.

    Normal use: DMA 1,2 or 3.

Setting Hardware ADDR, IRQ, DMA

    Peripherals Integrated in Motherboard: via BIOS

    Old ISA expansion boards: Jumpers and DIP Switches on boards

    Newer ISA expansions boards: Jumpers(ADDR)and software (IRQ)

    ISA Plug-And-Play expansion boards: BIOS or OS PNP feature

    PCI expansion cards: Via BIOS and OS using PCI bus

    Memory Base of certain PCI cards for RAM or BIOS:

                                               Direct on the cards

Setting and reading the hardware and system time

`date`   Show current system date and time

`date -s "15:34"`   Set the System time

`hwclock`   Show the hardware clock time setting

```
hwclock –localtime        Hardware clock stores local time
```

```
hwclock –utc              Hardware clock stores utc time
```

```
hwclock --set --date="9/22/2002 16:45:05"
```
Set the hardware clock and time

```
hwclock –hctosys          Sets the system time to current hardware clock
```

```
hwclock –systohc          Sets the hardware clock to current system time
```

```
setclock 09/18/2003 21:13:00
```
Sets the hardware and system clock in one command to
Thu Sep 18 21:13:00 2003

Time Variables in `/etc/sysconfig` (SuSE only)

```
HWCLOCK="–localtime"      for localtime mode
HWCLOCK="-u"              for utc time mode
```

When SuSE boots-up it sets the time from the script `/etc/init.d/boot`

Files that have some relation to time are:

```
/usr/lib/zoneinfo/localtime --> /etc/localtime  (binary file)
/etc/adjtime                          Temporary file used to adjust the time regularly
```

Hardware-related commands

```
ksysctrl     Is good for displaying the found system devices a-la-Windows.
```

```
hwinfo       Shows a lot of info about automatically found hardware. (SuSE)
```

```
lsdev        Shows a list of recognized devices and their I/O Addr, IRQ and DMA
```

```
procinfo     Shows a list of recognized devices and their I/O Addr and IRQ
```

```
MAKEDEV      Command to create devices
```

```
losetup      Set up and control loop devices
```

KERNEL MODULES (general)

```
lsmod                     To list all the Kernel modules already loaded:
```

```
cat /proc/modules         (same as above)
```

Note: The word *modulename* below means the name of the module
and not the module file name(`xxxx.o`)

```
modinfo modulename        To get more info about a module
```

```
modprobe modulename       Load a kernel module(checks for dependencies)
```

```
insmod modulename         Load a kernel module(DOESN'T check for dependencies)
```

```
modprobe -r modulename    Removes a kernel module
```

`rmmod modulename`	Removes a kernel module
`depmod`	To list all loadable kernel modules that wouldn't load properly because of missing symbols (unfulfilled dependencies) see `man depmod` for more info on module dependencies

Configuration files for hardware modules:

`/etc/modules.conf`	Older configuration used by `modprobe` to change the way a module is loaded or unloaded. Although this file is an older format it provides a lot of functions.
`/etc/modprobe.conf`	Newer configuration file for `modprobe` command which is used for the same purpose as `/etc/modules.conf`.

Note: I have not determined what the results will be if both the above configuration files are present on the system.

`modprobe -c`	Provides a listing of options used for loaded modules from `/etc/modprobe.conf`

Getting information on hardware

USB

`lsusb`	Lists all connected USB devices
`/sbin/hotplug`	Script; handles hot-pluggable PCI & USB devices.
`rchotplug [start|stop]`	Starts/Stops USB and PCI configurator.(till SuSE 9.2)
`rchal [start|stop]`	Starts/Stops USB and PCI configurator.(from SuSE 9.3)
`usbmodules --device /proc/bus/usb/<NNN>/<nnn>`	Lists kernel modules corresponding to USB devices currently plugged into the computer. Example: `usbmodules --device /proc/bus/usb/001/009`

PCI

`Lspci`	List all PCI devices
`cat /proc/pci`	List all PCI devices
`setpci`	Configure PCI devices
`pcitweak`	Read/write/list PCI config space
`scanpci`	Scan/probe PCI buses
`/sbin/hotplug`	SuSE cript to handle hot-pluggable PCI and USB devices
`rchotplug [start|stop]`	Starts/Stops USB and PCI configurator

Topic 101: Hardware & Architecture

PCMCIA

`cardinfo`	X-Program to list and control PCMCIA cards
`cardctl`	ASCII program to control the PCMCIA cards
`dump_cis`	ASCII program to list PCMCIA cards and their `parameters`
`cardmgr`	Daemon that loads and unloads PCMCIA kernel modules for inserted cards.
`/etc/init.d/pcmcia`	Script to load PCMCIA cardmgr as daemon

PNP

`lspnp`	To list Plug and Play BIOS device nodes and resources.
`/etc/isapnp.conf`	File used by `isapnp`. See also `man setpnp` for info on controlling PnP device resources.
`isapnp /etc/isapnp.conf`	Set the PNP devices according to `/etc/isapnp.conf`

SCSI

`sg_map`	Displays mapping between `sg` and other SCSI devices.
`cat /proc/scsi/scsi`	Displays information about all possible SCSI devices like: `hdx, srx, sgx, scdx`
`scsiinfo -l`	List of active SCSI device in system. `eg. /dev/sda /dev/scd0 etc.`
`sg_reset`	Exercises SCSI device/bus/host reset capability
`scsi_info`	SCSI device description tool
`sg_test_rwbuf`	Tests the SCSI host adapter by issuing write and read operations on a device's buffer and calculating checksums.
`Lsscsi`	list all SCSI devices (or hosts) currently on system
`mover`	utility to control SCSI media changers
`sg_scan`	does a SCSI bus scan and prints the results to STDOUT
`sg_senddiag`	performs a SCSI SEND DIAGNOSTIC command
`sg_logs`	reads SCSI LOG SENSE pages
`scsidev`	populate `/dev/scsi` with device names that are persistent against SCSI configuration changes.
`sg_start`	starts (spins-up) or stops (spins down) SCSI devices
`sg_map`	displays mapping between sg and other SCSI devices
`scsiinfo`	query information from a SCSI device
`sg_readcap`	calls a READ CAPACITY command on a SCSI device

`sg_rbuf`	reads data using SCSI READ BUFFER command
`sg_inq`	outputs data retrieved from the SCSI INQUIRY `command`
`sginfo`	outputs mode sense information for a SCSI generic device
`sg_modes`	reads SCSI MODE SENSE pages
`xmover`	X11 frontend for SCSI media changers
`scsi_devfs_scan`	Scan SCSI devices within a devfs tree
`sane-find-scanner`	find SCSI and USB scanners and their device files
`scsiformat`	low level format a SCSI disk device

SERIAL

`cat /proc/tty/drivers`
                    Display detected serial ports.

CDROMS

`cat /proc/sys/dev/cdrom/info`

The CD-ROM device names and their capabilities. Note: SCSI CDROMs can be `scdx`

I/O ADDRESSES

`cat /proc/ioports` I/O Addresses used by which device.

I/O MEMORY

`cat /proc/iomem`   Memory Address usage.

INTERRUPTS

`cat /proc/interrupts`
                    Interrupt usage

DMA

`cat /proc/dma`   DMA channels in use.

CPU

`cat /proc/cpuinfo` CPU hardware information

DEVICES

`cat /proc/devices` Character & Block devices used and their Ids.
`lsdev`   Displays recognized devices IRQ, DMA and IO.

KERNEL OPTIONS

`cat /proc/cmdline` Kernel options given at boot time

FILESYSTEMS

`cat /proc/filesystems`
>   Filesystem types recognized by Linux.
>   `'nodev'` = it doesn't have any physical device.

SYSTEM MEMORY

`cat /proc/meminfo`   System Memory management information

The /proc file system.

Displays the kernel's internal workings. Mostly ReadOnly.

Each process get a directory in `/proc` (named after the PID). Content is:

`cmdline`	What started the process
`cwd`	Symlink to dir where user was when he started the command.
`environ`	Environment of process.
`exe`	Symlink to the running program (full path)
`root`	root dir for the process. (may be changed using command chroot)
`fd`	file descriptors (eg. 0,1,2,255. used in `prgm 1>&2` etc.)

Hardware Parameters

`interrupts`	IRQ used by peripherals
`ioports`	IO Address used by peripherals
`dma`	DMA used by peripherals
`iomem`	Video RAM/ROM, System RAM/ROM, PCI system memory, VESA Frame buffer, reserved areas.

Other hardware information

`cpuinfo`	Processor type/model, speed, internal cache size, etc.
`partitions`	List of known local PC partitions with major and minor numbers.
`pci`	Scan of peripherals on PCI bus and AGP slot.

Kernel and software information

`cmdline`	Kernel start command and parameters.
`filesystems`	List of file systems know by the kernel.
`meminfo`	Info about usage of available memory
`modules`	List of loaded modules
`mounts`	List of mounted filesystems. Here are also the mounted filesystems that were mounted with the option `-n` and hidden from `/etc/mtab` and `df` command.
`version`	Present kernel version.

Other important directories in `/proc`

`bus`	Info about system buses found in systems
`ide`	Info about IDE controllers and devices
`scsi`	Info about SCSI controllers and devices
`net`	Network info like ARP Info, Routing table etc
`sys`	WRITEABLE system control table.

Plug and Play

A PNP card has an internal list of Addresses, IRQs and DMAs that it can use if requested. Linux is NOT automatically PNP compatible. It must be done manually. Two programs are available for this:

`pnpdump` Scans the ISA bus for PNP cards and displays the possible settings of each PNP card found.

`Isapnp` Reads a PNP configuration file and sets the PNP cards accordingly.

Manual Process:

1. Collect possible settings from PNP cards. Scans addresses 0x0273 to 0x03f3

    `pnpdump > /etc/isapnp.conf`

2. Edit the file and activate the desired settings of each PNP card

    `vi /etc/isapnp.conf`

3. Set the PNP cards as per `/etc/isapnp.conf`. Must be done at every boot.

    Use this command under SuSE: `isapnp /etc/isapnp.conf`
    Use this command under Debian `isapnp tools /etc/isapnp.conf`
    Use the following in step 2 while editing `/etc/isapnp.conf`:

IO ADDRESS:

   First IO base address possible: Minimum IO base address 0x0240

   Last IO base address possible: Maximum IO base address 0x03e0

   Address block size: Number of IO addresses required: 32

   Look at the already used IO addresses in system: cat /proc/ioports

   Make a list of possible IO base addresses for this card.

   (First IO base address possible +   Address block size) etc.

   eg. 240, 260, 280, 2A0, 2c0, ..., ..., 3e0

   Choose a free address, write it in the following line and uncomment the line:

   (IO 0 (BASE 0x340))

IRQ:

   Proceed the same way as above for IRQs and at the end uncomment the line:

   (INT 0 (IRQ xx (MODE +E))) (xx=chosen IRQ)

Finally activate the card by uncommenting the line:

   (ACT Y)

1.101.1 Configure Fundamental BIOS Settings

Description: Candidates should be able to configure fundamental system hardware by making the correct settings in the system BIOS. This objective includes a proper understanding of BIOS configuration issues such as the use of LBA on IDE hard disks larger than 1024 cylinders, enabling or disabling integrated peripherals, as well as configuring systems with (or without) external peripherals such as keyboards. It also includes the correct setting for IRQ, DMA and I/O addresses for all BIOS administrated ports and settings for error handling.

Weight: 1

Key files, terms, and utilities:
```
/proc/ioports
/proc/interrupts
/proc/dma
/proc/pci
```

Purpose of BIOS

The BIOS is a middleman program (in ROM) between hardware architecture (main board) and the operating system. Linux deals directly with some hardware (eg. IDE Controller) for speed and better control.

CMOS Set-up program

Triggered at boot-time by certain possible key combinations:

Examples:
    DEL (Entf on German keyboard),
    F2,
    <Ctrl-Alt-ESC> etc.

Hard disk Set-up

Although the hard disk controller is accessed directly by Linux, some HD settings in CMOS are still important.

- HD cylinders have physically less sectors at the inside of the disk than at the outside.

- LBA (Large Block Address) logically reduces the number of cylinders and increases the number of heads.

- LBA is important if number of physical cylinders is more than 1024 even if Linux doesn't use the BIOS to access the HD.

    Reasons:

    `fdisk` reads the BIOS for HD Parameters
    `lilo` and GRUB are loaded from the BIOS.

BIOS error handling

Normal:

`Halt on all errors`   booting does not continue if any type of error occurs

`Halt on all errors but keyboard.`
Linux server without keyboard:

Peripherals settings

Turn off any unused device. eg. COM ports, Mouse, IDE channels if SCSI used, etc

Reserving IRQs for older ISA cards

These settings will be applied to older cards, and will not used by the Plug and Play system.

1.101.3 Configure Modem and Sound cards

Description: Ensure devices meet compatibility requirements (particularly that the modem is NOT a win-modem), verify that both the modem and sound card are using unique and correct IRQ's, I/O, and DMA addresses, if the sound card is PnP install and run sndconfig and isapnp, configure modem for outbound dial-up, configure modem for outbound PPP | SLIP | CSLIP connection, set serial port for 115.2 Kbps

Weight: 1

Key files, terms, and utilities:
   not applicable

Modems

Check the hardware compatibility list from your distribution.

A good source of hardware info is the Hardware-HOWTO

Normal (Hayes compatible) modems are controlled with AT commands

Watch out for WinModems - they are not real hardware modems. They use Windows drivers to simulate the AT command set. This section does not apply to WinModems. More about this at www.linmodems.org

Sound Cards

LPI concentrates on OSS sound technique. (Open Sound System)
Although most current distributions are using the ALSA System
(Advanced Linux Sound Architecture)

Each sound board type needs its own kernel module.

Program for sound card installation (RedHat and others):

```
sndconfig
```

It scans possible sound cards IO ports and is menu driven.
It handles the PNP and older ISA sound cards as well.

1.101.4 Setup SCSI Devices

Description: Candidates should be able to configure SCSI devices using the SCSI BIOS as well as the necessary Linux tools. They also should be able to differentiate between the various types of SCSI. This objective includes manipulating the SCSI BIOS to detect used and available SCSI IDs and setting the correct ID number for different devices especially the boot device. It also includes managing the settings in the computer's BIOS to determine the desired boot sequence if both SCSI and IDE drives are used.

Weight: 1

Key files, terms, and utilities:
    SCSI ID
    `/proc/scsi/`
    `scsi_info`

Notes

SCSI = Small Computer System Interface

Purpose: Learning to set-up the SCSI devices with respect to BIOS, SCSI-ID, booting

Use of SCSI: Still in server industry, offers reliability, endurance, Hot-Plug features.

Tools: SCSI-ID, `/proc/scsi`, `scsi_info`

SCSI Architecture

Number of devices with SCSI, including the SCSI controller itself:

Standard: 8

Wide: 16

Properties and rules of SCSI

Cable joining the devices is 50 wires wide

No 'T' branching in the cable

Each end of the cable must be terminated by 330 Ohms to GND and 220 Ohms to +5V

Minimum 10cm of cable between SCSI devices

Maximum length of 50 strand cable: 3 Meters (>4 devices Max:1.5 Meters)

End of the cable must have a terminated device attached to it.

Types of SCSI

Standard(SCSI-1): 8 Devices 10 MHz Maximum

SCSI-2, FAST-SCSI-2, Wide-SCSI-2(68 strand cable, 16 bit bus): Faster, command set is better

SCSI-3 even faster but still in development (no meaning for LPI)

SCSI speed table

Bus width	Cable Width	Standard	Fast	Ultra	# of Devices
8-Bit	50 Strands	5 MB/sec	10 MB/sec	20 MB/sec	7+Ctrlr
Wide-16-Bit	68 Strands	10 MB/sec	20 MB/sec	40 MB/sec	15+Ctrlr

Possible names alike Ultra-Wide- or Fast-Wide, etc are possible

Addressing SCSI devices

SCSI-ID = 0 to 7 or 0 to 15

The SCSI Controller with the highest priority = highest ID: 7 or 15

If booting from SCSI then boot HD must be ID 0

Each SCSI-ID can contain LUNs (Logical Unit Number)

Each CSCI cable (Bus) also receives a number (0,1,2 etc)

Each SCSI device can then be identified as follows:
    BusNumber, SCSI-ID, LUN
    Normally 0,x,0 eg. /dev/sda is on 0,0,0

SCSI Onboard BIOS

Separate and unknown from system BIOS

Used to boot SCSI drives and change controller parameters

Cheap Controllers don't usually have On-Board BIOS. More expensive ones do.

Newer Controllers even allows software to assign SCSI-IDs to devices.

Role of the Controller:
    Assignment of SCSI-IDs to devices
    Selecting the data transfer rate of devices
    Selection of boot drive

Booting from SCSI drive

Controller must have an onboard BIOS

In SCSI onboard BIOS: Set the boot drive

In System BIOS: Set boot drive sequence to 'SCSI'

SCSI in Linux

`/proc/scsi` directory contains all SCSI devices as a sub-directory

Each sub-directory contains files named by SCSI-BUS number (0,1,2)

Theses files contain the list of devices attached to this bus.

The file `/proc/scsi/scsi` contains the list of all found SCSI devices.

Naming of SCSI devices

Hard disks are named sda, sdb … in the sequence they are found

Removable ZIP and USB Chip readers are also in the hard disk class

SCSI CD-ROMS have 2 names at the same time: srx & scdx (x=0,1,2,3,..)

Each device is also identified by SCSI-BUS,SCSI-ID,LUN

Program `scsi_info` shows info on individual device:

```
scsi_info /dev/scd0
```

1.101.5 Setup different PC expansion cards

Description: Candidates should be able to configure various cards for the various expansion slots. They should know the differences between ISA and PCI cards with respect to configuration issues. This objective includes the correct settings of IRQs, DMAs and I/O Ports of the cards, especially to avoid conflicts between devices. It also includes using isapnp if the card is an ISA PnP device.

Weight: 3

Key files, terms, and utilities:
```
/proc/dma
/proc/interrupts
/proc/ioports
/proc/pci
pnpdump(8)
isapnp(8)
lspci(8)
```

Tools

`/proc/dma`

`/proc/interrupts`

`/proc/ioports`

`/proc/pci`

Information files

`pnpdump`

`isapnp`

`lspci`

Programs

PCI

PCI devices are identified by a unique ID just like MAC address in network cards. Linux saves these PCI IDs in the following files:

> `/usr/share/pci.ids`

SuSE

> `/usr/share/hwdata/pci.ids`

RedHat & Debian

> `/usr/share/mics/pci.ids`

Old Debian distributions

> `update-pciids`

this command updates the list from Internet into /usr/share/mics/pci.ids.new or equivalent as per distribution.

Linux supports PCI (Bus ID=00) devices fully without needing manual settings.

AGP is a separate PCI bus (Bus ID=01) reserved for Graphic Cards, having only one slot. Made for undisturbed data transfer between the graphic chips and the CPU.

PCI Bus system is addressed similarly to SCSI:

`BusNr:SlotNr:FunctionNr(Device Nr.)`

`lspci` is used to list the PCI devices in the system.

`lspci` finds the manufacturers info from the file `/usr/share/pci.ids.`

`lspci -n` display vendor codes as numbers instead of lookingthem up in `pci.ids.`

Kernels after 2.1.82 have more info about devices on PCI-Bus in `/proc/pci.`

Serial ports known as `COM1, COM2` etc in DOS, are known in Linux as: `ttyS0,ttyS1` etc.

Parallel Printer ports known as `lpt1, lpt2` in DOS, are known in Linux: `lp0, lp1` etc

1.101.6 Configure Communication Devices

Description: Candidates should be able to install and configure different internal and external communication devices like modems, ISDN adapters, and DSL switches. This objective includes verification of compatibility requirements (especially important if that modem is a winmodem), necessary hardware settings for internal devices (IRQs, DMAs, I/O ports), and loading and configuring suitable device drivers. It also includes communication device and interface configuration requirements, such as the right serial port for 115.2 Kbps, and correct modem settings for outbound PPP connection(s).

Weight: 1

Key files, terms, and utilities:
```
   /proc/dma
   /proc/interrupts
   /proc/ioports
   setserial(8)
```

Tools

`/proc/dma`

`/proc/ioports`

`/proc/interrupts`

`setserial(8)`

`setserial` is from the `setserial` package for SuSE, RedHat & Debian

`minicom` is one of the modem terminal programs for linux.

`setserial /dev/ttySx`

`setserial /dev/cuax`

Shows the settings of the serial port, where `x` is the port number

`setserial /dev/ttySx <parameters>`

Sets the serial port to the supplied parameters.

Parameters are:

```
        port  <PortNr>      IO Port number
        irq  <IRQ>          IRQ number
        uart  <UART_Type>   UART(Universal Asynchronous Receiver Transmitter)
                            Possible values are: none, 8250, 16450, 16550, 16550,
                            16550A, 16650V2, 16654, 16750, 16850, 16950, 16954.
                            none=Turn device OFF
```

Most older application know only up to 38400 Baud. To allow for faster speeds even though the application asks for 38400 Baud, extra parameters to `setserial` set flags in the hardware that translates requests from applications of 38.4Kb to higher speeds in the UART.

Parameter	Speed requested by Application	Real UART speed
spd_normal	38.4Kb	38.4Kb
spd_hi	38.4Kb	57.6Kb

Parameter	Speed requested by Application	Real UART speed
`spd_vhi`	38.4Kb	115Kb
`spd_shi`	38.4Kb	230Kb
`spd_warp`	38.4Kb	460Kb

Modem AT Commands

Hayes compatible commands that controls most modems.

`AT`	Sets the baud rate between Modem and PC
`ATD <number>`	Dial the Number (Nr.)
`ATH0`	HangUp
`ATH1`	Answer the phone (Opposite of HangUp)
`ATX0`	Dial blind, CONNECT when connection OK
`ATX1`	Dial blind, CONNECT speed when connection OK
`ATX2`	Wait for DIALTONE and CONNECT speed when connection OK
`ATX3`	Dial blind, CONNECT speed when connection OK or BUZY
`ATX4`	Wait for DIALTONE and CONNECT speed when connection OK
`ATX5`	Dial blind, CONNECT speed when connection OK, BUSY, VOICE
`ATX6`	Wait for DIALTONE and CONNECT speed when connection OK, BUSY, VOICE
`ATZ`	Reset the modem.
`AT&F`	Reset the internal modem configuration to factory settings.

1.101.7 Configure USB devices

Description: Candidates should be able to activate USB support, use and configure different USB devices. This objective includes the correct selection of the USB chipset and the corresponding module. It also includes the knowledge of the basic architecture of the layer model of USB as well as the different modules used in the different layers.

Weight: 1

Key files, terms, and utilities:

```
lspci(8)
usb-uhci.o
usb-ohci.o
usbmodules
/etc/usbmgr/
/etc/hotplug
```

Summary

Main USB module is usbcore (although often already integrated in kernel)

There are 2 types of USB controllers:

OHCI   Open Host Controller Interface (Compaq)

UHCI   Universal Host Controller Interface (Intel)

All USB devices are compatible with both OHCI and UHCI.

USB chipset usage per motherboard manufacturer:

OHCI	UHCI	EHCI (USB 2.0)
Compaq	Intel	Intel
Ali	VIA	VIA
NEC		NEC
Opti Chipset		Philips

`lspci`

`less /proc/pci`

To recognize the USB controller type:

The possible USB modules are: `ohci.o` , `uhci.o` or `ehci-hcd.o`

To autoload USB at boot-time, add this entry to `/etc/modules.conf`:

`alias usb uhci`

To autoload (post-install) other submodules as well, add entries like these to `/etc/modules.conf`:

`alias usb uhci`

`post-install uhci modprobe printer`

`post-install printer modprobe joydev`

`post-install joydev modprobe hid`

USBDevFS Filesystem

This dynamic filesystem (like `/proc`) is normally mounted at `/proc/bus/usb`.

Its `/etc/fstab` entry is as follows:

```
none  /proc/bus/usb  usbdevfs  defaults  0 0
```

After the mounting, the content (2 files) of `/proc/bus/usb` looks like this:

```
-r--r--r--  1 root root 0 2003-10-18 00:02 devices
-r--r--r--  1 root root 0 2003-10-18 00:02 drivers
```

After loading the driver (`usb-ohci` or `usb-uhci`) the content of this directory grows to include 1 numbered (001,002 etc) directory for each USB device. The files in these numbered directories are in binary format.

To display the device information of all USB devices:
`cat /proc/bus/usb/devices`

Interpretation of the line starting with '`T:`'
eg: T: Bus=01 Lev=00 Prnt=00 Port=00 Cnt=00 Dev#=1 Spd=12 MxCh=2

`Bus=01`   Simply the USB bus number

`Lev=00`   Distance from the USB Tree root(Virtual hub)
            00: Virtual Bus (root)
            01: Direct connected devices
            02: Devices connected through a Hub ....

`Prnt=00`   Parent device(To which device this device is connected....well humm
                    to me it looks alwys the same number as the `Lev`)

`Cnt=00`   Device number connected to its hub.
            00: Hub itself

`Dev#=1`   Device Number of the USB Bus

`Spd=12`   Speed of the device
            12:   USB 1.1 (12 Mbits/Sec)
            480: USB 2.0 (480 Mbits/Sec)

`MxCh=2`   Maximum number of channels available in this device:
            0:          Normal Device
            >=1:   Hubs with multi channels

Architecture of USB Modules
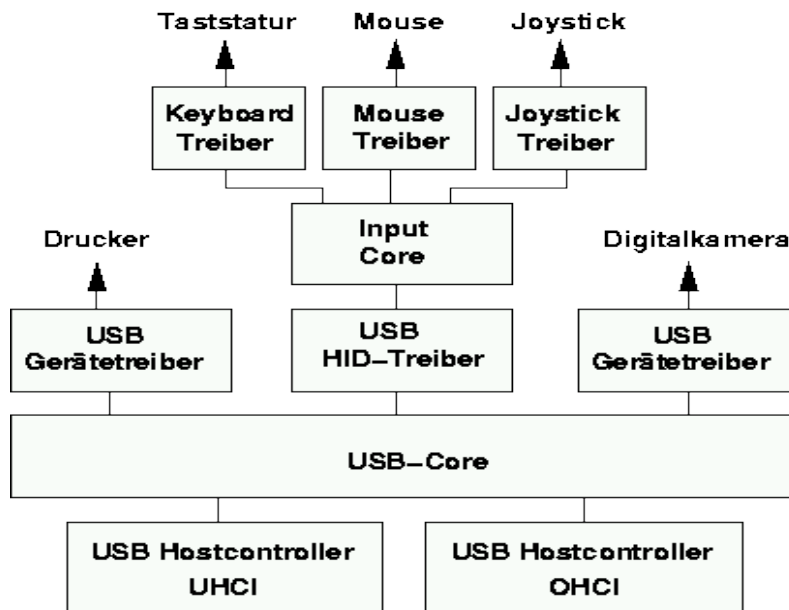
hid.o (HID = Human Interface Device) and input.o (Input Core) are only for a USB keyboard (usbkbd.o), Mouse (usbmouse.o) or Joystick otherwise they are not needed.

Other USB modules:

printers	printer.o
storage	usb-storage.o

USB devices can be listed with the lsusb command.

When printer.o is loaded it creates devices /dev/usb/lp0 ..lp1.

List of current USB modules

```
find /lib/modules/ -name "usb*" -exec basename {} \;
```

```
usb-ohci.o   usbserial.o
usb-uhci.o   usb-storage.o
usbcore.o    usb-midi.o
             usbkbd.o
             usblcd.o
             usbmouse.o
             usbnet.o
             usbvideo.o
             usbvnet5.o
             usbvnet5_2958.o
             usbvnetr.o
```

Dynamically loading USB Modules

Two dynamic systems are available to load the proper USB module when a USB device is inserted.

Hotplug   Oversees all hotpluggable devices: USB, PCMCIA, FireWire(ieee1394)

usbmgr   Oversees only USB devices.

hotplug

At boot time the hotplug daemon is started via the script `/etc/init.d/hotplug`.

When a new device is inserted, the kernel senses it, then passes an agent name as parameter to the daemon listed in the file: `/proc/sys/kernel/hotplug` (normally `/sbin/hotplug`).

The kernel then fills in the Environment Variable `DEVICES` with the info about the device, and `ACTION` indicating if the device was plugged or unplugged.

The `hotplug` daemon starts the proper agent script.

The agent script reads the content of the `DEVICES` and `ACTION` variables as well as possibly other variables provided by the kernel. It uses also the program `usbmodules` to find-out about the device inserted.

The specific 'agents' scripts are:

USB	`/etc/hotplug/usb.agent`
PCMCIA	`/etc/hotplug/pci.agent` (via a bridge)
Firewire (IEEE1394)	`/etc/hotplug/ieee1394.agent`
Network system	`/etc/hotplug/net.agent`

Files involved:

`/lib/modules/*/modules.*map`	depmod output
`/proc/sys/kernel/hotplug`	`specifies hotplug program path`
`/sbin/hotplug`	hotplug program (default path name)
`/etc/hotplug/*`	hotplug files
`/etc/hotplug/NAME.agent`	hotplug subsystem-specific agents
`/etc/hotplug/NAME*`	subsystem-specific files, for agents
`/etc/hotplug/NAME/DRIVER`	driver setup scripts, invoked by agents
`/etc/hotplug/usb/DRIVER.usermap`	depmod data for user-mode drivers
`/etc/init.d/hotplug`	hotplug system service script. Also used at boot time to load and configure hot-plug devices that are already plugged in.

USB Manager (usbmgr)

A daemon that will load the proper module according to 2 parameters given by the kernel:

USB-Vendor-ID and USB-Device-ID

It uses the following configuration files:

`/etc/usbmgr/usbmgr.conf`	List of Vendor-ID/Device-ID and module names
`/etc/usbmgr/preload.conf`	List of modules to load when usbmgr starts.
`/etc/usbmgr/host`	List of module names of the USB controller. Either `usb-ohci` or `usb-uhci`.

`usbmgr` needs the following conditions to be met:

The kernel must be USB capable (`usbcore`)

`USBDEVFS` must be supported

The needed modules must be available.

Topic 102: Linux Installation & Package Management

Summary

TODO

1.102.1 Design hard disk layout

Description: Candidates should be able to design a disk partitioning scheme for a Linux system. This objective includes allocating filesystems or swap space to separate partitions or disks, and tailoring the design to the intended use of the system. It also includes placing /boot on a partition that conforms with the BIOS' requirements for booting.

Weight: 5

Key files, terms, and utilities:
    / (root) filesystem
    `/var` filesystem
    `/home` filesystem
    swap space
    mount points
    partitions
    cylinder 1024

File Hierarchy Standard (FHS)

Lays out a standard for the filesystem structure that Linux systems are expected to adhere to.

Why multiple partitions in Linux?

Multiple hard disks can be used

Easier backups

Quotas are active per partition

Mount partitions Read-only for protection

Possible limit of Boot Manager (<1024 cylinders)

File tree structure

`/bin, / dev/, /etc, / lib, /sbin`	Mandatory. Note: A /root directory is recommended in case root must perform a rescue
`/usr`	Can be ReadOnly in it's own partition.
`/home`	Recommended as a separate partition. Reason: quotas, non-interference with the rest of the system, and fast system recovery
`/tmp`	Recommended as a separate partition. Reason: quotas, non-interference with the rest of the system.
`/var`	Highly recommended: When full, doesn't interfere with the rest of the system.
`/var/lib`	Modifiable settings
`/var/lock`	Lock files for programs and daemons
`/var/log`	Log files of system, daemons and programs

`/bin, / dev/, /etc, / lib, /sbin`	Mandatory. Note: A /root directory is recommended in case root must perform a rescue
`/var/run`	PIDs of daemons and programs (if needed)
`/var/spool`	Queues for printing, mail etc.
`/var/tmp`	Space for temporary files. Writable by anybody.

Swap Partitions

Created and managed by: `fdisk, mkswap, swapon, /etc/fstab`

Creating a swap file (64MB):

```
dd if=/dev/zero of=/path/of/swapfile bs=1024 count=64000

mkswap /path/of/swapfile 64000

swapon [-p 42] /path/of/swapfile
```

Entry in `/etc/fstab`

```
/path/of/swapfile   none   swap
```

To see all the swap files(optional for the curious)

```
cat /proc/swaps
```

1.102.2 Install a boot manager

Description: Candidate should be able to select, install, and configure a boot manager. This objective includes providing alternative boot locations and backup boot options (for example, using a boot floppy).

Weight: 1

Key files, terms, and utilities:
```
/etc/lilo.conf
/boot/grub/grub.conf
lilo
grub-install
MBR
superblock
first stage boot loader
```

MBR (<512 bytes):   Partition table and Boot sector

Stage 1	Program in MBR or Bootsector loads the bootmanager from the hard disk. (performs direct disk access)
Stage 2	Presents menu and waits
Stage 3	Starts the selected operating system

LILO

`/etc/lilo.conf`	Main and only config file.
`/boot/boot.b`	Boot Menu file
`/boot/boot-menu.b` `/boot/message` `/boot/boot-bmp.b`	Other possible menu elements
`/boot/map`	Physical Address and size of kernel files.
`/sbin/lilo`	Program that reads config file and writes the first stage bootloader to MBR. Uses BIOS functions and creates /boot/map

Note: After any change to `/etc/lilo.conf` or any location or size of any file in `/boot` directory `lilo` MUST be rerun.

`lilo -u`   Rewrites the previous boot manager in MBR (eg. windows MBR)

LILO display codes

`Nothing`	The partition booted is not Boot-activated or no bootmanager.
`L<ErrorNr>`	Second part of `LILO` cannot be loaded and `<ErrorNr>` is the reason.
`LI`	Second part of `lilo` is loaded but is probably invalid. Reason: `lilo` was probably not run after changes in `/boot` or config file.

LIL	Second part of `LILO` is loaded but the content of `/boot/map` is wrong. Reason: Media error or wrong media geometry.
LIL?	Second part of `LILO` is loaded but it is garbage. Reason: file `/boot/boot.b` has moved or changed.
LIL-	Second part of `LILO` is loaded but the `/boot/map` is garbage. Reason: file `/boot/map` has moved or changed.
LILO	All OK. `LILO` has loaded properly.

Settings in /etc/lilo.conf

General settings	
`append="reboot=warm"`	NO RAM check when rebooting.
`boot=/dev/hda`	Where the `LILO` part1 should be written. hda=MBR, hda1=Boot sector of hda1 etc.
`lba32`	HD has physically more than 1024 cylinders and LILO should be using LBA mode. Only valid if BIOS supports LBA32
`message=/boot/message`	Message loaded in MBR with part1 of `lilo.conf`
`prompt`	LILO will wait for user selection.
`timeout=300`	Boot default system when timeout occurs. 300 = 30 seconds
Individual OS sections	
`image = /boot/bzlinuz`	Location of the kernel to load.
`root = /dev/hda2`	Partition to use as root directory '/'
`initrd = /boot/initrd`	Location of ramdrive file: temporary file system.
`label = linux`	Name of menu item.
`other = /dev/hda3`	Location of a non-Linux OS. Goes to that partition and loads the boot sector it finds there. Normally used with Windows.

GRUB (GRand Unified Bootloader)

Hard disks are numbered as (`hd0`) - the first HD found in system

(`hd0,0`) is the the first partition of the first hard drive; normally `/dev/hda1`.

NO static binary menu (`/boot/boot.b`). Instead it's `/boot/grub/menu.lst`

`/boot/grub/grub.conf` can also be used as menu/config file.

Entries in GRUB menu/config file

General settings	
`default=0`	First menu item starts if no selection done before timeout.
`timeout=10`	Timeout of 10 seconds will occur if no selection is made by user.
`splashimage=(hd0,0)/` `boot/grub/splash.xpm.gz`	The menu image will be taken from `/dev/hda1` in this path.
Individual OS sections	
`title linux`	Menu item text
`root (hd0,0)`	First partition of first found Hard Drive is used for the dir '/'
`kernel /boot/bzlinuz ro` `root=/dev/hda1`	The kernel is `/boot/bzlinuz` and some parameters like `ro` and `root=/dev/hda1` is given to the kernel when started.
`initrd`	Ramdrive for booting (if used by kernel)
`map (hd0,1) (hd0,0)` `map (hd0,0) (hd0,1)`	Used to swap the assignment of physical partitions. Useful to let Windows 98 boot from a partition which is not the first one (picky fellow!!) and make it think that it is.
`rootnoverify (hd0,1)`	Set GRUB's root device without mounting.
`chainloader +1`	Jump to the Boot Sector of the root partition and hope a boot loader is there waiting
`makeactive`	Make the partition active.

To boot from a CD/Floppy/HD and use the root directory of another Linux as it own root dir (/) then use the kernel parameter:

`root=/dev/hda4`

How does GRUB work?

`Stage1` file is written in the MBR.

It contains the physical address of the `fssys_stage1_5`. (`fssys`=filesystem)

GRUB Booting sequence:

MBR (`stage1`) is loaded

`stage1` loads `fssys_stage1_5` (filesystem converter)

`fssys_stage1_5` loads `stage2` file

`stage2` loads the `menu.lst`

After boot menu item selection is done, `stage2` loads the kernel (`vmlinuz`) and possibly the `initrd`

1.102.3 Make and install programs from source

Description: Candidates should be able to build and install an executable program from source. This objective includes being able to unpack a file of sources. Candidates should be able to make simple customizations to the Makefile, for example changing paths or adding extra include directories.

Weight: 5

Key files, terms, and utilities:
```
gunzip
gzip
bzip2
tar
configure
make
```

Tools and files used

```
gzip
gunzip
bzip2
tar
configure
Makefile
make
```

Difference between scripts and compiled programs

The CPU only understands binary instructions. Programs must be translated from the programming language to binary. A compiled program is done once and program file is binary. With a script, each line is translated to binary then executed as it runs.

Verifying the validity of the package's content

Get the MD5 checksum file from the location where you downloaded the file.

Put the tar file and the checksum file in the current directory

```
md5sum --check <checksumfilename>
```

Standard file extentions for packages

Tarred files	`*.tar`
Compressed tarred files	`*.tar.gz or *.tar.bz2 or *.tgz`
Zipped files	`*.gz`
Bzipped files	`*.bz2`

Unpacking packages

Compressed tar files (a new directory will be created in destination directory):

```
cd <DestinationDirectory>
tar fvxz <tarfile>.tar.gz   or   zcat <tarfile>.tar.gz  | tar xvf -
tar fvxj <tarfile>.tar.bz2  or   bzcat <tarfile>.tar.bz2 | tar xvf -
```
Uncompressed tar files:
```
tar fcx tarfile.tar
```
Compressed files:
```
gunzip <file>.gz      ---->   File  (original <file>.gz is overwritten)
bunzip2  <file>.bz2  ---->   File  (original <file>.bz2 is overwritten)
bzip2 -d <file>.bz2  ---->   File  (original <file>.bz2 is overwritten)
```

Packing files

Uncompressed tar files:
```
tar fvc newfile.tar /dir/to/pack
```
Compressed tar files:
```
tar fvcz newfile.tar.gz  /dir/to/pack
tar fvcj newfile.tar.bz2 /dir/to/pack
```
Compressed files
```
gzip filename  ---->  <filename>.gz   (original <filename> is overwritten)
bzip2 filename ---->  <filename>.bz2   (original <filename> is overwritten
```

Compilation process

```
cd <SourceBaseDirrectory>
```

`./configure`	This script studies system environment and creates Makefile
`make` or `make all`	Reads Makefile and start the compiling of the source files.
`make clean`	Deletes all the already compiled binary files so that the next make starts afresh.
`make install`	Installs the compiled files and possibly others in the system. Normally only possible to run as root.

Note: `make` examines the timestamps of the various files to determine whether the binary file should be recompiled or not. It looks to see if the source has been changed since last compile.

Modifying Makefile manually:
   Changes to the Makefile would normally be done to adjust the installation paths. These changeable parameters are normally at the beginning of the Makefile. They are in the normal bash variable assignment format: `var=value`

1.102.4 Manage shared libraries

Description: Candidates should be able to determine the shared libraries that executable programs depend on and install them when necessary. Candidates should be able to state where system libraries are kept.

Weight: 3

Key files, terms, and utilities:
```
ldd
ldconfig
/etc/ld.so.conf
LD_LIBRARY_PATH
```

Libraries are SHARED between running programs within RAM. So only one copy of a shared library is needed to be loaded in RAM for all programs using it.

Sequence of events

`bash` tells the kernel to start a program

The kernel starts the Dynamic Library Linker `ld.so`

`ld.so` searches for all libraries needed for the program in the following order

Looks in the ':' separated paths listed in the shell environment variable `LD_LIBRARY_PATH`

Looks in the paths listed in the library cache `/etc/ld.so.cache`

Looks in `/lib` and `/usr/lib`

`ld.so` loads itself

`ld.so` loads the program in memory and passes control on to the program

Tools and files used

`LD_LIBRARY_PATH`	Bash environment variable containing list of paths of libraries to search.
`ldd /path/to/program`	Lists all the libraries a program needs.

`/lib`
`/usr/lib`
`/usr/local/lib`
	Standard directories where are most libraries are installed

`ldconfig`	Program that keeps track of all libraries in system. When a library is installed in a directory other than one of the above standard library locations then we need to: Enter new library path in `/etc/ld.so.conf` Run ldconfig. This updates the library path cache: `/etc/ld.so.cache`
`/etc/ld.so.conf`	Configuration file of `ldconfig`
`/etc/ld.so.cache`	Library path cache

1.102.5 Use Debian package management

Description: Candidates should be able to perform package management skills using the Debian package manager. This objective includes being able to use command-line and interactive tools to install, upgrade, or uninstall packages, as well as find packages containing specific files or software (such packages might or might not be installed). This objective also includes being able to obtain package information like version, content, dependencies, package integrity and installation status (whether or not the package is installed).

Weight: 8

Key files, terms, and utilities:

```
unpack
configure
dpkg
dselect
dpkg-reconfigure
apt-get
alien

/etc/dpkg/dpkg.cfg
/var/lib/dpkg/*
/etc/apt/apt.conf
/etc/apt/sources.list
```

TODO

1.102.6 Use Red Hat Package Manager (RPM)

Description: Candidates should be able to perform package management under Linux distributions that use RPMs for package distribution. This objective includes being able to install, re-install, upgrade, and remove packages, as well as obtain status and version information on packages. This objective also includes obtaining package information such as version, status, dependencies, integrity, and signatures. Candidates should be able to determine what files a package provides, as well as find which package a specific file comes from.

Weight: 8

Key files, terms, and utilities:
```
/etc/rpmrc
/usr/lib/rpm/*
rpm
grep
```

Filename format of RPM pacakges

```
PackageName-VersionNumber.Architechture.rpm
```

Content of RPM packages

Information about the package

List of files to install

List of Dependencies

4 Scripts:
Before Installation, Before De-Installation, After Installation, After De-Installation

RPM database

`/var/lib/rpm/*`	Directory of RPM Database of installed packages(in binary format)
`/usr/lib/rpm/*`	Directory of RPM tools needed to manage RPM packages
`rpm --rebuilddb`	To rebuild the RPM Database

Syntax

```
rpm Action [Options] Packagename[.rpm]
```

Action

Short Format	Long Format	Description
`-i`	`--install`	Install the package. Works only when no older package is already installed.
`-U`	`--upgrade`	Upgrade the package. Works like Install but will also erase an older version of the package.

Short Format	Long Format	Description
-F	--freshen	Upgrade the package. Works only when an older version of the package is already installed.
-e	--erase	Uninstall the package.

Installation Options

Short Format	Long Format	Description
	--nodeps	Installs and does not check dependencies.
	--noscripts	No Pre/Post-Install scripts will be run.
	--test	Do not install, just simulate installation.
	--excludedocs	Install but without the documentation.
	--replacepkgs	Install all even if some packages are already installed.
	--replacefiles	Overwrite already installed files if they exist.
	--oldpackage	Allow downgrading a package version.
	--force	Install all no matter what. It can be seen as the same as --replacepkgs --replacefiles --oldpackage

De-Installation Options

Short Format	Long Format	Description
	--nodeps	De-installs and does not check dependencies.
	--noscripts	No Pre/Post-de-install scripts will be run.
	--test	Do not de-install, just simulate de-installation.
	--allmatches	De-install all packages names that matches pattern. In this case no errors would be produced if the pattern matched 2 or more packages.

Package queries

Use the `-q` `–query` option plus other query options listed below. If a query is made on installed packages the package name needs to be naked without the version or revision number or .rpm. If a query is made for an RPM file, then the actual file name including the .rpm must be given as the package name.

Short Format	Long Format	Description
`-q`[options]	`--query`	Queries info on the package (without `.rpm` in the name)
`i`	`--info`	Information header of package.
`l`	`--list`	List of all files
`c`	`--configfiles`	List of Configuration files.
`d`	`--docfiles`	List of Documentation files.
	`--provides`	Programs/Libs provided by the package.
`R`	`--requires`	List of files on which this package depends.
	`--changelog`	Display log of package changes.
	`--scripts`	Displays all 4 Install/Uninstall scripts.
	`--dump`	List of all files and their attributes.
	`--filesbypkg`	Same as --list + package name per line
	`--last`	Date of last installations of the package.
	`--state`	`--LIST` + Files Installation status: `normal, not installed` or `replaced`
	`--qf %{QUERYTAG}` or `--queryformat %{QUERYTAG}`	Extracts specific items from info header. eg. `rpm -q --qf %{DESCRIPTION} apache` Displays only description part of the info. eg. `rpm -qa --qf "%{NAME}\n"|sort|less` Lists only names of all installed packages.
	`--querytags`	Lists the QUERYTAGs usable in `--queryformat`.

Query Package selection (combined with -q option)

Short Format	Long Format	Description
`a`	`--all`	Query all installed packages
`f`	`--file filename`	Query installed package owning file (incl. path)
`p`	`--package`	Query Specific uninstalled packages (`.rpm`)

Short Format	Long Format	Description
	`--whatrequires`	Query all installed packages that depend on this one. rpm -q --whatrequires --qf "%{NAME}\n" apache| less Displays all names of packages that depends on apache package.
	`--whatprovides`	program_or_libname(incl. path) Query all installed packages that provides this program or library. rpm -q --whatprovides --qf "%{NAME}\-%{VERSION}\-%{RELEASE}\n" /bin/sed Displays names of packages that provides /bin/sed. Same output as rpm -qf /bin/sed
`g group`	`--group group`	All installed packages belonging to group Note: rpm -qa --qf "%{GROUP}\n" | sort -u | less Lists group names of which some packages are installed.

Examples

`rpm -qil Package`	Information and install file list of package.
`rpm -qa | sort | less`	Display all installed packages (all .rpm files)
`rpm -qai | grep -2 "^Release" | less`	Same as above but more complete info.
`rpm -hiv Package.rpm`	Install with progress bar (hash #)
`rpm -hiv --replacefiles Package.rpm`	Install on top of existing package with progress bar (hash #)
`rpm -hUv Package.rpm`	Upgrade with progress bar (hash #)
`rpm -hUv --force  Package.rpm`	Upgrades and overwrite existing package even if conflict or lack of dependencies exists.
`rpm -qf  filename(incl PATH)`	Tells which packet this file belongs to
`rpm -qdf filename(incl PATH)`	Tells which help documents came with this file

Querying rpm packages that are not installed

`rpm -qpi PackageName.rpm`   header information of this package.

`rpm -qpl PackageName.rpm`   List of files where this package installs

Advanced Examples

- To display a list of all already installed packages and their summary description:
  `rpm -qa --qf "%{NAME} : %{SUMMARY}\n" | sort | less`

- To search for an already installed PackageName by pattern:

```
rpm -qai | awk -F: ' /^Name|^Version/ {print $1,$2} /^Version/ \
                    {print ""}' | cut -b-30 | grep -1 PackageName
```

- To search through RPM files for a filename:
```
rpm -qp --filesbypkg *.rpm | grep filename
```

- To list all installed packages names and their short descriptions:
```
rpm -qa --qf "%{NAME}\ \-\-\-\ %{SUMMARY}\n" | sort | less
```

Verifying integrity of packages

`rpm -V PackageName` Verify integrity of the installed package

`rpm -Va` Verify integrity of all installed packages

The result of both of these above commands will be shown as follows:

One line per file is displayed.

Each line contains a status field (8 chars), a file type (1 char) and a filename.

`eg. S.5....T c /etc/samba/smbpasswd`

Meaning of Status field:

.	OK
S	Size of file has changed
U	File Owner has changed
M	Access rights has changed
G	Group of file has changed
5	MD5 Checksum doesn't match
T	Timestamp has changed
L	ReadLink system call failed
D	Major/Minor numbers of device has changed
missing	The file is missing from its expected locations in the filesystem.

Meaning of file type

<space>	Normal File
c	Configuration file.
d	Documentation file
g	Ghost file, file content is expected to get changed
l	Licence file
r	Readme file
?	Couldn't check (maybe because read access failed)

PGP and GPG Signature test

Syntax: `rpm --checksig Packagefilename.rpm`

result should be: `Packagefilename.rpm md5 gpg OK`
                 `^^^^^^^^^^`

In this example the package was checked against the MD5 Checksum and its 'GPG' signature. If the MD5 checksum is ok but the signature(gpg) is NOT ok then the result would be:

        `Packagefilename.rpm` `md5 GPG NOT OK`

Extract from RPM Man page

QUERYING AND VERIFYING PACKAGES

```
rpm {-q|--query} [select-options] [query-options]
rpm {-K|--checksig} [--nogpg] [--nopgp] [--nomd5] PACKAGE_FILE ...
rpm {-V|--verify} [select-options] [--nodeps] [--nofiles] \
    [--nomd5] [--noscripts]
```

INSTALLING, UPGRADING, AND REMOVING PACKAGES

```
rpm {-i|--install} [install-options] PACKAGE_FILE ...
rpm {-U|--upgrade} [install-options] PACKAGE_FILE ...
rpm {-F|--freshen} [install-options] PACKAGE_FILE ...
rpm {-e|--erase}   [--allmatches]    [--nodeps] [--noscripts] \
    [--notriggers] [--repackage]      [--test]   PACKAGE_NAME ...
```

MISCELLANEOUS

```
rpm  {--initdb|--rebuilddb}
rpm  {--querytags|--showrc}
rpm  {--addsign|--resign}    PACKAGE_FILE ...
rpm  {--setperms|--setugids} PACKAGE_NAME ...
```

SELECT-OPTIONS

```
[PACKAGE_NAME] [-a,--all] [-f,--file FILE] [-g,--group GROUP]
[-p,--package PACK-AGE_FILE] [--querybynumber NUMBER]
[--triggeredby PACKAGE_NAME] [--whatprovides  CAPABILITY]
[--whatrequires CAPABILITY]
```

QUERY-OPTIONS

```
[--changelog]  [-c,--configfiles] [-d,--docfiles] [--dump]
[--filesbypkg] [-i,--info]             [--last]          [-l,--list]
[--provides]   [--qf,--queryformat QUERYFMT]        [-R,--requires]
[--scripts]    [-s,--state]           [--triggers,--triggerscripts]
```

INSTALL-OPTIONS

```
[--allfiles]  [--badreloc] [--excludepath OLDPATH] [--excludedocs]
[--force]     [-h,--hash]      [--ignoresize]       [--ignorearch]
[--ignoreos]  [--includedocs] [--justdb]            [--nodeps]
[--noorder]   [--noscripts]   [--notriggers]        [--oldpackage]
[--percent]   [--prefix  NEWPATH]  [--relocate OLDPATH=NEWPATH]
[--repackage] [--replacefiles][--replacepkgs]       [--test]
```

Note: Options for Building packages are left out here. See man page for further info.
Other source of info are: `http://www.rpm.org`

Topic 103: GNU & Unix Commands

Summary

In this section the candidate learns to work with the command line of the bash shell as well as with the commands which are needed to perform certain user and administration tasks which, the commands can be entered by hand or interpreted in scripts. It is through these commands that administrators access the optimum exploitation of automatization in Linux.
Many of those commands are used in the init scripts that are starting the services under Linux.

1.103.1 Work on the command line

Description: Candidates should be able to Interact with shells and commands using the command line. This includes typing valid commands and command sequences, defining, referencing and exporting environment variables, using command history and editing facilities, invoking commands in the path and outside the path, using command substitution, applying commands recursively through a directory tree and using man to find out about commands.

Weight: 5

Key files, terms, and utilities:

```
.
bash
echo
env
exec
export
man
pwd
set
unset
~/.bash_history
~/.profile
```

- Command format (command, options and parameters)

    short (-) and long (--) form options.

    short form options combinations

- Entering commands

    Which are in the PATH

    Which are not in the PATH

    '.' as part of PATH and ./command

    Where am I?: pwd

- Prompt ($PS1) and Incomplete command syntax ($PS2)

- Entering command sequences
    With ';' '&'

- Characters interpretation inside a bash command line:
    - bash scans a non-quoted command line and interprets the following characters:
        ```
        $  &  ;  (  )  {  }  [  ]  <  >  |  #  *  ?  !  \
        ```
        Any above special preceded with the char.'\' will have it's special meaning deactivated.
    - bash scans a command line and interprets ONLY the following special characters if they are enclosed inside double quotes("...."").
        ```
        $  !  \        all other characters are seen as litteral part of text.
        ```
    - bash will NOT interpret any of the characters that are enclosed primarily inside single quotes. ('....'). These single quotes lose their meaning when inside double quotes. eg.   Echo "I want to speak to 'Marty' the carpenter"
                In this above example the single quotes are seen as normal characters.

Shell (local) and Environment (exported) variables

Exported variables (Environment variables)

env	Lists all environment variables(LPI recommended)
printenv	Same as env
export	Lists all exported (environment) variables
declare -x variable [=value]	Sets the environment variable
export variable[=value]	Sets the environment variable

Setting and unsetting variables

set	Lists all local and environment variables incl. functions
variable=value	Sets the shell variable
unset variable	Unsets (removes) an environment variable

Read-Only Variables (variable cannot be changed or unset)

readonly	Lists all read-only variables
readonly variable	Sets the variable to read-only

$TERM (present terminal type)

screen	Console in 'screen' mode
dumb	From cron
linux	From tty1-tty6
xterm	Xserver terminal

Terminal info Database

/etc/termcap   Old file, still used by SuSE

/etc/terminfo/*   New file names used by Debian

Command substitution

`command` old syntax

$(command)   new syntax

e.g.

```
echo "My present directory is `pwd`"
ls -la /lib/modules/$(uname -r)/*
```

Command history and editing

Command history navigation

`set +o history`	Turns history recording OFF
`set -o history`	Turns history recording ON
`$HISTFILE`	Variable containing the history file name. Normally `~/.bash_history`
`$HISTFILESIZE`	Variable containing the maximum number of commands the history file can contain. Default=500
`$HISTSIZE`	Variable containing the maximum number of commands in history. Default=500
`history`	Displays the whole history
`history 10`	Displays the last 10 lines of history
`fc -l -10`	Displays the last 10 lines of history
`fc -l Pattern`	Search the history for `Pattern` and display the result
`<Ctrl>-r`	Reverse search in history
`history -c`	Clears the whole history
`!!`	Most recent command
`!n`	Command `n` in the history
`!-n`	Backwards command `n` in history
`! string`	Last recent command starting with `string`
`!? string`	Last recent command containing with `string`
`^string1^string2`	Quick substitution `string1` to `string2`
`<Ctrl>-p`	Previous Line in history (also up-arrow)
`<Ctrl>-n`	Next Line in history (also down arrow)
`<Alt>-<`	Go to beginning of History
`<Alt>->`	Go to end of History

Command Line Editing commands

E-macs editing commands: `readline` library

`<Ctrl>-l`	Clear screen
`<Ctrl>-b`	Back one character (also left arrow)
`<Ctrl>-f`	Forward one character (also right arrow)
`<Ctrl>-a`	Go to beginning of line (also `Pos1` key)

`<Ctrl>-e`	Go to end of line (also End key)
`<Ctrl>-k`	Delete text from cursor to end of line
`<Ctrl>-d`	Delete a character on the right (or under cursor)
`<Alt>-d`	Delete from cursor to end of current word
`<Ctrl>-y`	Paste text previously cut (deleted)

Applying commands recursively (-r,-R,--recursive)

Command	Short format	Long format
`ls`	`-R`	`--recursive`
`chown`	`-R`	`--recursive`
`chmod`	`-R`	`--recursive`
`chgrp`	`-R`	`--recursive`
`grep`	`-r`	`--recursive`
`cp`	`-r` and `-R`	`--recursive`
`rm`	`-r` and `-R`	`--recursive`

man and info

`man [n] command`

Call up the man page for a command. `n` represents the man page type (1-9)

1	Executable programs or shell commands
2	System calls (functions provided by the kernel)
3	Library calls (functions within program libraries)
4	Special files (usually found in `/dev`)
5	File formats and conventions eg. `/etc/passwd`
6	Games
7	Miscellaneous (including macro packages and conventions), e.g. `man(7)`, `groff(7)`
8	System administration commands (usually only for root)
9	Kernel routines [Non standard]

1.103.2 Process text streams using filters

Description: Candidates should be able to apply filters to text streams. Tasks include sending text files and output streams through text utility filters to modify the output, and using standard UNIX commands found in the GNU textutils package.

Weight: 6

Key files, terms, and utilities:
```
cat
cut
expand
unexpand
fmt
head
join
nl
od
paste
pr
sed
sort
split
tac
tail
tr
uniq
wc
```

Commands list

cut	Extracts columns/fields from files
expand	Expands TABs to SPACES in text files
unexpand	Un-expands SPACES to TABs in text files
fmt	Format of text files
head	Display first x lines of text file
join	Joins lines of a data file on common fields
nl	Number the lines of a text file
od	Display file content in Octal, Hex or Decimal.
paste	Pastes corresponding lines of 2 text files
pr	Convert text files ready for printing
split	Splits large files into multiple smaller files
cat	Concatenate files / Display files content

`tac`	Displays content of text file bottom to top
`tail`	Display last x lines of text file
`tr`	Translate or delete characters of file
`wc`	Counts number of chars, words, lines of files
`xargs`	Extends the argument list of a command
`sed`	Stream file editor
`sort`	Sorting content of files
`grep`	Filtering/extracting text from files
`more`	Display content of files - Page Forward
`less`	Display content of files - Lines Forward/Backward

Command Examples

cut -dx -fy

`cut -d: -f1,6 /etc/passwd (Extract field 1 and 6)`

Extracts columns from file: field(y) separator(x)

expand

`expand /etc/init.d/at > ~/atnew`

Expands (converts) TABs to SPACEs in text files.

unexpand

`unexpand -a /etc/services > ~/serv ; vi ~/serv`

Opposite of expand: Converts SPACEs to TABs in text files.

fmt

`fmt -w50 /usr/share/doc/packages/bash/INTRO`

Format text files before printing (for continuous text only). Each line must have at least one space within it.

head [-|+][n]x

Display first x lines of text file (default 10)

`head -40 /etc/services`

Displays the first 40 lines of the file

join

`join -t: -11 -21 /etc/passwd /etc/shadow`

47

Joins lines of a data file on common fields

nl

Number the lines of a text file.

`nl -ba filename`	Numbers empty lines as well

Default options: `v1 -i1 -l1 -sTAB -w6 -nrn -hn -bt -fn`

Examples:

`nl -s" - " /etc/services`	Number the lines, adding " - " after line number
`nl -bp"^#" file1`	Numbers only the lines starting with '#'

od -bih -t x

Display file content in Octal (`-b`), Decimal(`-i`), Hexadecimal.(`-h`). Example:

`od -h /bin/ping`

    x = Format type

`-a`	same as `-t a`, select named characters
`-b`	same as `-t oC`, select octal bytes
`-c`	same as `-t c`, select ASCII characters or '\' escapes
`-d`	same as `-t u2`, select unsigned decimal shorts
`-f`	same as `-t fF`, select floats
`-h`	same as `-t x2`, select hexadecimal shorts
`-i`	same as `-t d2`, select decimal shorts
`-l`	same as `-t d4`, select decimal longs
`-o`	same as `-t o2`, select octal shorts
`-x`	same as `-t x2`, select hexadecimal shorts Note: `-x` is not the same as `-tx`

paste

Pastes corresponding lines of 2 text files

    Example 1:

`paste /etc/passwd /etc/shadow`

    Example 2:

```
cut -d: -f1 /etc/passwd > file1
cut -d: -f3 /etc/passwd > file2
paste -d: file1 file2 > file3
```

pr

Convert text files for printing. Example:

```
pr /etc/services | less
```

split -lx -by[b|k|m]

Splits files into multiple files containing (x) lines, (y) bytes, kilobytes or megabytes.

Syntax:

```
split [options] filename prefix
```

Example 1:

```
split -l100 /etc/services serv
```
creates servaa servbb etc.
To get the original back, run:
```
cat serv?? > servicesnew
```

Example 2:

```
split -b1440k /bin/rpm rpms
```
For backups to diskettes.
creates `rpmsaa rpmsab` etc.
To get the original back, run:
```
cat rpms?? > rpmnew
```

cat

Displays content of text file top to bottom and exits.

Example 1:

```
cat -n /etc/hosts
```
Show all lines of file with line numbers(-n)

Example 2:

```
cat -b /etc/hosts
```
Numbers only the non-empty lines

tac

Displays content of text file bottom to top and exits (reverse of `cat`)

```
tac /etc/passwd
```
List starts with the lasts users created in system

tail [-|+][n]x

Display last x lines of text file (default 10)

Example 1:

```
tail -30 /etc/services
```
Display last 30 lines

Example 2:

```
tail +100 /etc/services
```
Bypass first 100 lines and display the rest till end of file

Example 3:

```
tail -fs5 --retry /var/log/httpd/error_log
```

Read the last 10 lines of the file every 5 sec. and keep retrying even if the file is not available

tr -d

Translate or delete characters of file

Examples:

```
tr "a-z" "A-Z" < /etc/motd        translates a-z to A-Z
tr -d "#" < /etc/services | less  deletes all #
```

wc -l|-c|-w

Counts number of lines, words or chars of text file. Without options it counts all lines, words and chars.

```
wc /etc/motd
```

xargs

Reads text from pipe and provides it as parameter(s) to specified command - up to max 64kb per command launch.

```
find /etc -name *.conf | xargs cat > /root/confs
```

Finds all `.conf` files in `/etc` and accumulates their contents all in one file called `/root/confs`.

sed

Stream file editor

```
sed 's/#/;-/g' /etc/services
sed '12,$s/Versions/Revisions/g'
```

Start global(g) substitution at line 12 till end of file ($)

sort -ky[n] -tx

Sort text file by field(y) with field separator(x)default separator:<space>

```
ls -la | sort -k5n        sorted by file size: field 5
ls -la | sort -n +0.28  Same result as above:
                          excludes characters 0 to 28 in sorting
```

grep [-virns]

Extract all lines of text where pattern is [not] found

```
grep -ins "^f.p.*SSL$" /etc/services
```

Display all lines of file where pattern (ignoring case (−i) is found with its line numbers (−n) and no error messages (−s)

```
ps -ax | grep httpd | grep -v grep
```

Display all instances of processes where httpd is found excluding (−v) the grep httpd command itself

more

Forwards only display of text file content

```
more -30 /etc/services
```

Scrolls display next 30 lines when pressing space bar, press enter to scroll to the next line

less

Scrollable display of text file/pipe content. Press v to edit the file

```
less -X +G /etc/services
```
Go to the end of the file ($+G$) and leave the display as is (-X) when leaving less.

```
less -phttps /etc/services
```
Load file and go to first occurence of search pattern: `https`

uniq

Filters consecutive line repetitions of a file.

```
rpm -qa --qf "%{LICENSE}\n" | sort | uniq | less
```
   or
```
rpm -qa --qf "%{LICENSE}\n" | sort -u | less
```

Display all the licences types used by installed packages.

awk -Fx

Programmable text formatter fields delimited (x)

```
awk -F: '{ print $1,"\t- ", $3 }' /etc/passwd
```

1.103.3 Perform basic file management

Description: Candidates should be able to use the basic UNIX commands to copy, move, and remove files and directories. Tasks include advanced file management operations such as copying multiple files recursively, removing directories recursively, and moving files that meet a wildcard pattern. This includes using simple and advanced wildcard specifications to refer to files, as well as using find to locate and act on files based on type, size, or time.

Weight: 3

Key files, terms, and utilities:
```
cp
find
mkdir
mv
ls
rm
rmdir
touch
file globbing
```

cd

`cd /<newdir>`	Change directory using absolute path
`cd <newdir>`	Change directory using relative path
`cd ~foo`	Changes to the home directory of user foo

ls

`ls [dir|file]`	List content of directory or file information.
`ls -lai /etc`	Long format lists of files inc. inode numbers

cp

`cp source destination`	Copy files or directories
`cp source1 source2 ...  .`	Copy all files in the current directory
`cp /dev/null newemptyfile`	Create a new empty file

mv

`mv source destination`	Move or rename file or directories
`mv -f file1 file2`	-f is the default. Allows overwriting of file2 if it already exists
`mv -i file1 file2`	Request confirmation before overwriting

mkdir

Create directories.
Options:

```
-p|--parents    Creates full paths, existing or not
-m 755          To set the access rights mode
```

rmdir

Deletes Directories. Options:

```
-p|--parents
```

Deletes parent directories specified on command line.
Parent directories must be empty (contain no files).

touch

Change file modification time of a file.

Can also be used to create an empty file:

```
touch file1
```

File naming wildcards (globbing)

```
* ? [...] [...-...] [!...]
```

Finding files with find

See `man find`

1.103.4 Use streams, pipes, and redirects

Description: Candidates should be able to redirect streams and connect them in order to efficiently process textual data. Tasks include redirecting standard input, standard output, and standard error, piping the output of one command to the input of another command, using the output of one command as arguments to another command and sending output to both stdout and a file.

Weight: 5

Key files, terms, and utilities:
```
tee
xargs
< and <<EOF ... EOF
> and >>
Pipes: |
` ` and $(....)
```

Standard I/O

`STDIN`

File handle 0. Programs get input from this file, unless otherwise specified

`STDOUT 1`

File handle 1. Programs send output to this file, unless otherwise specified

`STDERR`

File handle 2. Programs send error output to this file, unless otherwise specified.

pipes ('|')

Send the output of the first command to the input of the second command.

Note: '|' redirects only the `STDOUT` and NOT the `STDERR`

`prg1 2>&1 | prg2`

Redirects `STDOUT` and `STDERR`

| xargs

Uses the output of one program as list of arguments for another program.

`[prgm1] | xargs prgm2`

same as

`[prgm2] $(prgm1)`

The difference is that `xargs` will deliver the arguments in chunks of 64kBytes to `prgm2` and run `prgm2` multiple times until all arguments (output of `prgm1`) are used up.

Example:

```
find /etc -name "issue*" 2>/dev/null | xargs grep -c "Mandrake"
```

Prints a tally of the number of file matching `/etc/issue*` that contain the word "Mandrake".

`find` outputs a list of files that match "`/etc/issue*`", and `xargs` sends each of those filenames in turn as a parameter to `grep`. `grep` will run as many times as there are matching filenames.

Redirection

```
>  >>  <<  <  1>  2>  &>  2>&1
```

>

First overwrites existing file / creates new file, then processes the command, then writes the STDOUT of command into the file.

```
sed 's/#/;/g' file1 > file1
```

Overwrites `file1` with an empty one !!!

```
>newfile
```

Same as `touch newfile`

>>

Similar to '>', but appends output to the file if it already exists

<

Redirects STDIN from a file instead of the keyboard.

```
prgm < file1
```

Reads its input from `file1`.

<<

```
'here-document'
```

```
prgm << EOF Text goes here ....
EOF
```

`prgm` gets its input from text between first OEF and last OEF

Combining outputs

```
prgm 2>&1 1>file
```

```
prgm &>file
```

Both commands combine STDOUT and STDERR to be sent to `file`

tee

```
program | tee filename
```

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Redirects to STDOUT and `filename`

```
prg1 | tee file1 | prg2|tee file2 | prg3 >file3
```

gives the same result as the following detached commands:

```
prg1 > file1
prg2 < file1 > file2
prg3 < file2 > file3
```

1.103.5 Create, monitor, and kill processes

Description: Candidates should be able to manage processes. This includes knowing how to run jobs in the foreground and background, bring a job from the background to the foreground and vice versa, start a process that will run without being connected to a terminal and signal a program to continue running after logout. Tasks also include monitoring active processes, selecting and sorting processes for display, sending signals to processes, killing processes and identifying and killing X applications that did not terminate after the X session closed.

Weight: 5

Key files, terms, and utilities:

```
&
bg
fg
jobs
kill
nohup
ps
top
```

PID: Process ID, a unique 16-bit integer identifier given to a process by the kernel when it starts.

PPID: Parent Process ID – the `PID` of a process's parent.

Process Viewing Commands

`ps`

Show process table

Examples:

`ps waux`	All processes with user in a wide format
`ps caux`	All processes with user with true command name. Practical for killall command.
`ps -fe`	All processes (-e) with full listing (-f)
`ps -la`	All processes (-a) excluding session leaders

`ps -eo "%p%P%n%y%x%c"`

Formatted output as:

```
PID     PPID    NICE    TTY     TIME        COMMAND
%p      %P      %n      %y      %x          %c
```

`pstree`	Show process tree
`top`	Interactively show most processor 'time hungry' processes

Signalling active processes

`kill SIGxxx`

Send signals to a process

Example:

`kill SIGHUP 1329`   same as   `kill HUP 1329` or `kill -1 1329`

`nohup prgm`   Runs prgm with HUP signal immunity.
`STDOUT` and `STDERR` is sent to `./nohup.out`
or `$HOME/nohup.out`

`kill -l`   List of signals possible

Terminating processes

`Kill [-9]` Brutal killing of a process

`killall`   Kill many processes with the same name with one command

`xkill`   X Program to kill a process owning a window

`pkill`   See man pkill

`skill [signal] [option] parameter`

Allows sending signals to multiple processes at the same time.

skill Options(optional) & parameters:

`-t terminal`   Affects all processes running off a specific
terminal. (ttyx or pts/x)

`-u username1 [username2....]`

Affects all process belonging to one or more users.

`-p PID1 [PID2 ...]`

Affects all process owning the PID(s).

`-c CommandName`

Affects process having the `CommandName`

examples:

`skill -KILL -v pts/*`

Kill and list (−v) all processes on new-style PTY devices

`skill -STOP viro lm davem`

Stop 3 users: viro lm and davem

Shell job control and '&'

`bg [%n]`

Resume current or stopped job n in the background

`fg [%n]`

Move current or background job n into foreground

`jobs [option]`

Display status of all jobs

Options:

    `-n`   Status since last job change

    `-r`   List of running jobs only

    `-s`   List stopped jobs only

    `-l`   display status of all jobs and their process ID's

    `-p`   display process ID's of all jobs

`jobs -x command`   Replace job n in command with corresponding process group id, then execute command

`kill [-signal] %n`   Send specified signal to job n (default 15)

`stop %n`   Stop job n

`stty [-]tostop`   Allow/prevent background jobs from generating output

`suspend`   Suspend execution of current shell

`wait`   Wait for all background jobs to complete

`wait %n`   Wait for background job n to complete

`Ctrl-z`   Stop current job

`disown [option] [%n]`   Disown the last activated (+) background job
or job $\%n$. Disowned job will not die when shell dies.

   Disown options:

```
        -a   Disown all the background jobs
        -r   Disown only the running jobs
        -h   Disown active job (+) from shell only when shell is closed:
```

Job Name Format

```
  %%, %+     current job
  %n         job n
  %-         previous job
  %string    job whose name begins with string
  %?string   job that matches part or all of string
```

1.103.6 Modify process execution priorities

Description: Candidates should should be able to manage process execution priorities. Tasks include running a program with higher or lower priority, determining the priority of a process and changing the priority of a running process.

Weight: 3

Key files, terms, and utilities:
```
nice
ps
renice
top
```

Possible nice values: 19(min) to -20(max)

Users can only change to a lower priority than the current one

Priority when normally starting a program: 0

```
nice
```

Start a job with pre-defined priority

`nice --8 prgm` Start `prgm` with priority -8

`nice -11 prgm` Start `prgm` with priority 11

`nice -n-12 prgm`   Start `prgm` with priority -12

```
renice
```

Change priority of a running process

`renice -n-6 1247`   Change priority of prgm w/ PID-1247 to -6

`renice -n8  1247`   Change priority of prgm w/ PID-1247 to 8

```
snice
```

Change priority of a multiple running processes by category.
Syntax:

`snice [newpriority] [options] category`

e.g. `snice +7 seti crack`   Slow down seti and crack processes

`snice -17 root bash`   Give priority to root's shell.

1.103.7 Search text files using regular expressions

Description: Candidates should be able to manipulate files and text data using regular expressions. This objective includes creating simple regular expressions containing several notational elements. It also includes using regular expression tools to perform searches through a filesystem or file content.

Weight: 3

Key files, terms, and utilities:

```
grep
regexp
sed
```

grep

Search for patterns in text. Syntax:

```
grep "regexp" filename
```

See also: `grep -F, grep -E`

sed

Edit text using patterns. Ranges are declared as `start, end`

`sed '1,$s/^\#/##/'`	Substitute from line 1 till end($) of document
`sed -f sedscr file1`	Uses sed commands in sedsrc
`sed -e 'cmd1' -e 'cmd2' file1`	Multiple commands
`sed 's/pattern/replacement/g'`	Global substitution
`sed '/pattern/d'`	Delete matching lines or grep -v "pattern"
`sed 's/^\(.*\) \(.*\)/\1_\2/'`	Using Variables(\1 \2) Last example inserts '_' between first 2 words in all lines.

Regular expressions(regex)

Basic: `.  *  ^  $  \<  \>  \b  \B  [..]  \(..\)  \{..\}  \+  \?  \|`

Extended: `.  *  ^  $  \<  \>  \b  \B  [..]  (..)  {..}  +  ?  |`

1.103.8 Perform basic file editing operations using vi

Description: Candidates should be able to edit text files using vi. This objective includes vi navigation, basic vi modes, inserting, editing, deleting, copying, and finding text.

Weight: 1

Key files, terms, and utilities:
```
vi
/, ?
h,j,k,l
G, H, L
i, c, d, dd, p, o, a
ZZ, :w!, :q!, :e!
:!
```

Action	Keystroke	Comments
Search	/<pattern>	Search forwards for <pattern>
	?<pattern>	Search backwards for <pattern>
Repeat Search	/	forwards
	?	backwards
Goto	n	forward next found
	N	Backward next found
Cursor move	l	forward
	h	backward
	k	up
	j	down
	w,W	Forward one word
	b,B	Backward one word
	e	End of current word
	0	Beginning of line
	$	End of line
Goto	0	Beginning of line
	$	End of line
	H	Top of screen
	L	Bottom of screen
	:1	First line
	G Last line	

Topic 103: GNU & Unix Commands

Action	Keystroke	Comments
	`23 Line 23`	
Editing	`<esc>`	Command mode
	`i`	Insert mode
	`:sp`	Split screen in 2
	`<Ctrl>w w`	Change to other spilt window
Delete & clipboard	`x`	Deletes the char on the right or under the cursor (DEL)
	`d`	Delete current char or line till (incl.) next cursor move.
	`dl`	Delete next char. on the right. Same as x
	`dk`	Delete current line & one line above
	`d0`	Delete from cursor till begin of line.
	`d$`	Delete from cursor till end of line.
	`c`	Same as d but starts inserting after
	`ch`	Delete 1 char backward then insert mode.
	`cj`	Delete current line then insert mode.
	`C`	Delete till end of line and then insert mode.
	`dd`	Delete lines
	`dd`	Delete current line
	`3dd`	Delete 3 lines (incl. current line)
Clipboard Copy and Paste	`yy,nyy`	Copy current line, n lines to clipboard
	`p,P`	Paste Clipboard before, after cursor position
Start editing (insert mode)	`i, a, A`	Insert text before, after cursor, at end of line
	`o, O`	Open new line for text below, above cursor
Undoing actions	`u, <Ctrl>r`	Undo last action in command mode.
	`<Alt>u`	Undo last action in insert command mode.
Saving/switching file	`:wq  :x   ZZ`	Save file and exit
	`:w   :w!`	Save file, Save file (overwriting files)
	`:w  file`	Save file under....(no overwrite)
	`:w! file`	Save file under....(can overwrite)
	`:x   file`	Save file under....(no overwrite)

Topic 103: GNU & Unix Commands

Action	Keystroke	Comments
	`:n    :N`	Show the next, previous buffer
	`:f`	Show name of current file
Load/Reload/Quit	`:e   file`	Loads a new `file` if current file is saved.
	`:e! file`	Loads a new `file` even if current file is not saved.
	`:r file`	Insert the content of `file` at cursor position
	`:!  cmd`	Run shell command (`cmd`) and come back to current file editing.
	`:e!`	Load last saved version of this file
	`:q!`	Quit without saving
Substitutions	`:1,$s/pattern /replacement/g`	same as `sed`
Running a shell command	`:range! shellcommand`	Runs the range of text through shell command (filter) and replace the original with the results.

Topic 104: Devices, Linux Filesystems, FHS

Summary

I-nodes

A fixed number of inodes are created when a filesystem is created depending on the size of the hard disk.

Directories are files (type 'd') containing filenames and their respective inodes.

Storage element on disk are called clusters under MSDOS, and called blocks underLinux

The normal size of blocks is1024 Bytes
Other possible sizes are512, 1024 & 2048 Bytes

Each Linux filesystem partition contains:

    1 Boot block
    1 SuperBlock
    inodes area
    Data area

Content of boot Block

Boot sector normally used to store a Boot Manager

Content of Super Block (partial)

Depending on filesystem, includes:

    Number of blocks in filesystem
    Size of Blocks
    Address of first free Data Block
    Address of first free iNode
    Various status flags

```
tune2fs -l /dev/hda2
```

Full content of superblock of partition.

Content of Normal inodes

Type and access rights
Number of hard links
UID
GID
Filesize in bytes
mtime (last content modified)
ctime(last properties modified)
atime(last time accessed)
Address of Block 0

....

Address of Block 9
Address of single-indirection block
Address of double-indirection block
Address of triple-indirection block

Block 0 to 9:   Block containing data
Single-indirection block: Block listing up to 128 Data Blocks
Double-indirection block: Block listing up to 128 Single-indirection Blocks
Triple-indirection block: Block listing up to 128 Double-indirection Blocks

EXT2 Filesystem

The main difference between other filesystems and the EXT2 is the content of the inodes which are slightly different to accommodate future expansion and special features.

Content of EXT2 inodes:

permissions		Nr. of Hard links	owner(UID)	group(GID)
size			properties change time(ctime)	
modification time(mtime)			access time(atime)	
deletion time(dtime)			blockcount	
flags(attributes)			file version (NFS)	
file ACL			dir ACL	
fragment addr.	fr. size	frag. nr	reserved	
1. block data			2. block data	
3. block data			4. block data	
5. block data			6. block data	
7. block data			8. block data	
9. block data			10. block data	
11. block data			12. block data	
simple indirect			double indirect	
triple indirect			reserved	
reserved			reserved	

Some differences between EXT2 and normal filesystem

Deletion Time entry: Helpful for un-deleting files

Field for 12 attributes(flags): A,a,c,d,i,S,s,u.

Topic 104: Devices, Linux Filesystems, FHS

Useful are:

```
Append (+a)
```

Allows only to append to it via redirection(>>)

```
Immutable (+i)
```

Not changeable, no new hardlinks, not deletable

```
Safe-delete (+s)
```

Fills file with '0s' before deleting it.

```
chattr attribute filename
```

Changes the file's attributes. Root only

```
chattr +i file
```

Turns attribute i ON

```
chattr -i file
```

Turns attribute i OFF

```
lsattr filename
```

Lists a file's attributes

File Version Entry: Can be used by NFS server.

File ACL and Dir ACL: (Access Control List) for better access control.

Support for fragmented files

12 Direct Block Addresses instead of 10 (standard)

The Superblock has multiple backups of itself at the start of some block groups. I found between 6 to 10 copies (backups) in 3 to 10 GB Partitions

Ext2 superblock has extra entries:

Valid-Flag Entry: if ON means the filesystem was not unmounted properly. e2fsck uses this flag to know if it should do a full check.

```
e2fsck -f
```

forces the full check.

Max-Mounts before full check and mount-count Entries: Used by e2fsck. If mount-count=Max-Mounts before full check then e2fsck does a full check at boot time.

Percent of full partition space reserved for root Entry: Normally 5%.

tune2fs can manipulate these above superblock entries.

Warning: Partition should NOT be mounted as ReadWrite if changing any of these entries.

Journaling Filesystems

EXT3:	Is an EXT2 filesystem with a journal file and journalling functions.
Reiserfs:	Stores a report of all transactions bigger than 1 block. Up to 10 times faster than EXT3 when reading.
Xfs:	Ported from IRIX system. Meant for handling very large files. Max 9,000 Peta Bytes. (9 mega mega mega bytes!)

1.104.1 Create partitions and filesystems

Description: Candidates should be able to configure disk partitions and then create filesystems on media such as hard disks. This objective includes using various mkfs commands to set up partitions to various filesystems, including ext2, ext3, reiserfs, vfat, and xfs.

Weight: 3

Key files, terms, and utilities:
    fdisk
    mkfs

Notes

Max number of Primary partitions per hard disks: 4
Max number of extended partitions per hard disk: 1
Maximum number of partitions per Hard drive:
(Including Primary, Extended and Logical)
        IDE: 63   (Note: some sources say max.=11 :-))
        SCSI: 15

Partitions names:

```
hda----IDE-Ctrl1------hdb         hdc----IDE Ctrl 2-----hdd
master                slave        master                slave
hda1 (pri/ext)
hda2 (pri/ext)
hda3 (pri/ext)
hda4 (pri/ext)
     hda5 (logical)
     hda6 (logical)
     ..........
     hda15 (logical)
```


Partitioning

`fdisk -l`   Display all hard disks and partitions recognized in the system.

`fdisk /dev/hda`   Partition hard disk hda.

`fdisk` **commands:**

```
            Command (m for help):m
            Command action
               a   toggle a bootable flag
               b   edit bsd disk label
               c   toggle the dos compatibility flag
               d   delete a partition
               l   list known partition types
               m   print this menu
               n   add a new partition
               o   create a new empty DOS partition table
               p   print the partition table
               q   quit without saving changes
               s   create a new empty Sun disk label
               t   change a partition's system id
               u   change display/entry units
               v   verify the partition table
               w   write table to disk and exit
               x   extra functionality (experts only)
```

Creating a new partition:

```
n --> primary-->.....
```

Changing its partition system id:

```
t--->l(list)-->83(linux) or 82(swap)
```

List partitions:

```
p Shows the partition table
```

When all finished:(warning: last change to verify and correct if needed)

```
w Writes the partition table on disk!!!
```

Note: Linux does not need the activation of the bootable flag, but Windows does. So if Windows is installed and the flag is on for its partition, then leave it there.

Creating a filesystem.

```
mkfs -t filesystem [options] device [blocks]
```
or
```
mke2fs [options] device [blocks] (for ext2 filesystem)
```

Possible commands and their synonyms:

```
mke2fs    =  mkfs.ext2       = mkfs -t ext2
mkfs.ext3 =  mkfs.ext2 -j    = mkfs -t ext3
mkdosfs   =  mkfs.msdos      = mkfs.vfat = mkfs -t vfat
mkfs.xfs  =  mkfs -t xfs
mkfs.bfs, mkfs.minix, mkfs.xiafs
```

filesystems:

```
ext2, ext3, vfat, msdos, reiserfs, xfs, minix, bfs, xiafs
```

Options:

-b   Block size. Valid values: 1024, 2048, 4096

-c   Before creating the filesystem, check the device for bad blocks

-i n Specify the number(n) of bytes per inode. Min = Block size. This helps to calculate the number of inodes to create. Number of i-nodes is dependent on the size of partition.

-N n Specify the absolute number(n) of i-nodes to create.

device: /dev/xxxx   xxxx=hda1.... hdc4 etc.

blocks: Optional. Size in blocks of the filesystem to create.
    If not given the size is auto detected.

Making a reiser filesystem.

```
mkreiserfs     options device
```
  or
```
mkfs -t reiserfs    "  "    "  "
```
  or
```
mkfs.reiserfs       "  "    "  "
```

Converting an ext2 to ext3 filesystem.

```
tune2fs -j device
```

1.104.2 Maintain the integrity of filesystems

Description: Candidates should be able to verify the integrity of filesystems, monitor free space and inodes, and repair simple filesystem problems. This objective includes the commands required to maintain a standard filesystem, as well as the extra data associated with a journaling filesystem.

Weight: 3

Key files, terms, and utilities:
```
du
df
fsck
e2fsck
mke2fs
debugfs
dumpe2fs
tune2fs
```

Disk Usage

`du`   Note: `du` is recursive by default.

Examples:

> `du -sh /root`   Display amount of space used by `/root` directory
>
> `du -h --max-depth=0 /home`
> Amount of space used by `/home` (non recursive)

Disk Free

`df`   List (in kilobytes) free & used space on mounted partitions

`df -h`   Same as above but in human readable format (K,M,G)

`df -i /dev/hda3`   Show number of free inodes on hda3
Note: `df -i` doesn't show inode info for `reiserfs` or `XFS`, since they create inodes dynamically.

File system check

`fsck`

Check file system

Shortcut aliases for fsck:

`e2fsck = fsck.ext2`	For EXT2 and EXT3
`reiserfsck`	For Reiserfs
`fsck.minix`	For minix
`fsck.msdos`	For Ms DOS FAT
`fsck.vfat`	For DOS VFAT
`fsck.xfs`	For XFS

Note: `fsck` should only be run on a non-mounted or read-only mounted filesystem.

Syntax:

```
fsck [options] filesystem
```

options: (mostly for the ext2/ext3 filesystem)

`-A`	Checks all filesystems listed for check in /etc/fstab
`-f`	Force checking even if the Valid-Flag is not set(filesystem ok)
`-p`	Auto Repair without asking
`-n`	NO-Simulation. No writing of any changes on disk
`-y`	YES- Answer yes to any questions coming up. Dangerous!

File system debugging

```
debugfs
```

Interactive command driven debugging program.
Created to fully control and manipulate the ext2 filesystems.
Default is in read-only mode. `-w` option overrides this.
Command help shows all valid commands.

File system info dump

```
dumpe2fs
```

Displays lots of information about the structure of the ext2 filesystem.
Incl: Superblock content, free inodes categorized per block groups
     Location(offsets) of the superblock backups, etc.

Can be useful to be saved in a file and used to recover a damaged system.

File system tweaking

```
tune2fs
```

Allows manipulation of some of the parameters of the ext2 filesystem located in the superblock. Here are a few examples:

`tune2fs -l /dev/hda5`   List the content of the superblock

`tune2fs -j /dev/hda3`   Converts the ext2 filesystem to ext3

`tune2fs -c 30 /dev/hda2` Change the max-mount-count to 30

`tune2fs -C 0 /dev/hda9` Reset the number of mounts counter to 0.

Extra examples:

`dumpe2fs /dev/hda7 | grep '[mM]ount count'`

    dumpe2fs 1.19, 13-Jul-2000 for EXT2 FS 0.5b, 95/08/09
    Mount count: 7
    Maximum mount count: 20

`tune2fs -C 9 /dev/hda6`

    tune2fs 1.19, 13-Jul-2000 for EXT2 FS 0.5b, 95/08/09
    Setting current mount count to 9

1.104.3 Control mounting and unmounting filesystems

Description: Candidates should be able to configure the mounting of a filesystem. This objective includes the ability to manually mount and unmount filesystems, configure filesystem mounting on bootup, and configure user mountable removeable filesystems such as tape drives, floppies, and CDs.

Weight: 3

Key files, terms, and utilities:
```
/etc/fstab
mount
umount
```

Syntax of mount command

```
mount -t <fstype>  <SourceDevice>  <MountPoint>
```

Example:

```
mount  /dev/hdc  /cdrom
```

```
mount -a
```

Try to mount all the devices listed in `fstab` as it happens at boot time.

`/etc/fstab` file format

Device order	Mount point	Files system	Options	Dump	fsck
/dev/hda1	/boot	ext2	defaults	1	1
/dev/hdb1	/	ext2	defaults	0	2
/dev/hdb3	swap	swap	defaults	0	1
/dev/cdrom	/cdrom	iso9660	ro,noauto,user	0	0
/dev/floppy	/floppy	auto	noauto,user	0	0
/dev/hdc1	/windows	vfat	user,umask=000	0	0

Default options

```
rw,suid,dev,exec,auto,nouser,async,atime
```

(async=buffered)

List of all options

auto	noauto	Mounting at boot time ?
exec	noexec	Execute binaries found on device ?
sync	async	Buffered data when writing ?
atime	noatime	Update inode access time when accessed ?
dev	nodev	Accept special character and block devices ?
suid	nosuid	Allow suid on mounted file system ?
user	nouser	Allow user to mount device ?
rw	ro	Read/Write(rw) or Read only(ro) ?
remount		Remount the already mounted device.
umask=		Sets the umask for writing on the partition (good for vfat)

Notes:

The option user implies: noexec,nosuid and nodev unless overridden by subsequent contradictory options.

Normal options for vfat Partition:

```
user,umask=000
```

The option mount -w ... is the same as mount -o rw

Almost all options can also be entered using mount -o. Example:

```
mount -o ro,umask=000 -t vfat /dev/hdd /windows
```

Display already mounted devices

`mount`	Most complete info
`cat /etc/mtab`	Not always refreshed immediately
`cat /proc/mounts`	Always current
`df -h`	Mounted devices and space used/free

1.104.4 Managing disk quota

Description: Candidates should be able to manage disk quotas for users. This objective includes setting up a disk quota for a filesystem, editing, checking, and generating user quota reports.

Weight: 3

Key files, terms, and utilities:
```
quota
edquota
repquota
quotaon
```

Summary

The user is allowed to cross the soft limit for the length of time limited by the grace period, after which he's not allowed to write anything on the partition.

The hard limit may never be exceeded by the user.

The quota limits may be expressed in number of 1k blocks or in number of inodes (total number of files and directories) or both.

Procedure for installing quotas

Edit /etc/fstab and enter usrquota,grpquota in options field for filesystem

```
/dev/hda3 /home    ext2 defaults,usrquota,grpquota  1  1
```

Remount the filesystem

```
mount -o remount /dev/hda3
```

Initialize the quota databases files(aquota.user,aquota.group)

```
quotacheck -avugm
```

Set quota for each user:

```
edquota -u paul
```

or

```
edquota paul
```

Edit grace period for all the users:

```
edquota -tu
```

Turn quotas ON:

```
quotaon -u /dev/hda3
```

Check quota for user:

```
quota paul
```

Create a quota report for all users:

```
repquota -u /dev/hda3
```

Create a quota report for all groups:

```
repquota -g /dev/hda3
```

Turn quotas OFF(when needed)

```
quotaoff -u /dev/hda3
```

Detailed preparation of quotas

Enter the following options in /etc/fstab for the partitions that must use quotas.

```
/dev/hda2 /srv/www  ext2 defaults,usrquota,grpquota  1  1
```

```
/dev/hda3 /home     ext2 defaults,usrquota,grpquota  1  1
```

Remount the filesystems:

```
mount -o remount /srv/www
```

```
mount -o remount /home
```

Enter the following command to verify existing used space by each user and group:

```
quotacheck -avugm
```

This command will also update two files in the /home directory:

```
   quota.group, and quota.user
```

if version 2 of quotas is used then the two files will be:

```
   aquota.group, and aquota.user
```

Start editing the quota for each user:

```
edquota -u john
```

or

```
edquota john
```

> Edits the filesystem quota for the user john. The quota editor(vi) will appear and
> will allow changes to the soft and hard quota for user john.
> Note: The value 0 for soft or hard quota means N O L I M I T.

```
+----------------------------------------------------------------+
| Filesystem    blocks    soft    hard    inodes    soft    hard  |
| /dev/hda7      3288     4000    6000      649     2000    3000   |
+----------------------------------------------------------------+
```

> This above example means that john:
> Already uses 3288 blocks(kb) of data on /dev/hda7 in 649 inodes (files)
> The soft quota is set to 4000 kB and hard to 6000 kB
> The soft limit is set to 2000 inodes and hard limit to 3000 inodes

```
edquota -tu
```

Edits grace period for all users. It is not possible to set grace period for individual users
(month(s),day(s),hour(s),min(utes),sec(onds))

```
+----------------------------------------------------------------+
| Filesystem    Block grace period    Inode grace period         |
| /dev/hda7            7days                  5days               |
+----------------------------------------------------------------+
```

To copy the quota for other users with the same limit values, easiest way is:

```
edquota -p john patrick
```

This command will give patrick the same quota limits as john.

To verify the status of the quota for the user john use the commands:

```
su -

quota john
```

The result:

```
+---------------------------------------------------------------+
| Disk quotas for user john (uid 5001):                         |
| Filesytem blocks   quota  limit grace  files  quota  limit grace |
| /dev/hda7   3288    4000   6000           649   2000   3000     |
+---------------------------------------------------------------+
```

This means that the user john has 649 files using 3288 Kb of hard disk space.
His soft limit is 4000 Kb or 2000 inodes and hard limit is 6000 kb or 3000 inodes

Repquota

Repquota produces summarized quota information for a file system. Here is a sample of the output that repquota gives:

```
# repquota -a
*** Report for user quotas on device /dev/hda7
Block grace time: 7days; Inode grace time: 5days
          Block limits                 File limits
User       used     soft      hard  grace    used  soft  hard  grace
root    -- 175419      0         0         14679     0     0
john    +-   6000   4000      6000           650  2000  3000
uucp    --    729      0         0            23     0     0
user1   --  13046  15360     19200           806  1500  2250

repquota -g /home
```

Report of groups quota

```
repquota -u /home  (same as repquota /home)
```

Report of users quota

Quotaon and Quotaoff

```
quotaon  -u /dev/hda2
```

turns ON quota accounting in kernel for users(-u)

```
quotaoff -u /dev/hda2
```

turns it OFF.

Actually both files are similar. They are executed at system startup and shutdown.

Files involved with disk quotas

quota (1)	Display disk usage and limits. quota reports the quotas of all filesystems listed in /etc/mtab. For mounted NFS filesystems , a call to rpc.rquotad on the server machine is performed to get the information.
setquota (8)	Set disk quotas with one command without editing like edquota
edquota (8)	Edit user quotas

quotaoff (8)/	
[quotaon]	Turn filesystem quotas on and off
quotacheck (8)	Scan a file system for disk usage, create and check the files `aquota.user` and `aquota.group` on each partition limited by quotas
repquota (8)	Summarize quotas for a filesystem

1.104.5 Use file permissions to control access to files

Description: Candidates should be able to control file access through permissions. This objective includes access permissions on regular and special files as well as directories. Also included are access modes such as suid, sgid, and the sticky bit, the use of the group field to grant file access to workgroups, the immutable flag, and the default file creation mode.

Weight: 5

Key files, terms, and utilities:
```
chmod
umask
chattr
```

File type

These are displayed against the left margin in ls -l listings

-	Regular files
l	Symbolic Links (eg. /sbin/init.d/rc2.d......all files)
d	Directories and sub-directories
b	Block Device Files (eg. /dev/hda1...)
c	Character Device Files (eg. /dev/tty1....)
p	FIFO Named pipe (eg. /dev/log, /dev/xconsole)
s	Socket (eg. /var/spool/postfix/private/bounce...)

File and directory names that start with a Dot (.) are hidden from display by certain programs like ls etc.

Files and directory access rights

Access rights are restrictions applied to the content of a file or directory. They don't restrict the deletion of a file or directory. Only the parent directory's access rights controls that.

Changing a file's access rights

Syntax:

```
chmod [-R] [ugoa][+=-][rwx stXugo] or [0000 to 7777] file
```

Examples:

```
    chmod u+w,g-x,o=wx file1

    chmod 750 file2

    chmod 4755 program1            SUID=ON

    chmod u+s,g+s,o+t program2     SUID=ON, SGID=ON, StickyBit=ON

    chmod -R u=rwX,g=rX,o=rX dir1
```

Recursively sets 755 for directories and 644 for files.
Exceptions: doesn't shutdown the rights 'x' for files that have it set already.

Directory access rights

The read (r) without the search (x) access rights for directories makes no sense and the read is ignored.

Any file in a directory set to write access for everybody can be erased by anybody, regardless of who the current user is.

Extra access rights			user			group			others		
SUID (s)	SGID (s)	Sticky Bit (t)	r	w	x	r	w	x	r	w	x
4	2	1	4	2	1	4	2	1	4	2	1

SUID and **SGID** for programs (-rw**s**rw**s**rwx) (-rw**S**rw**S**rwx)

SUID=ON: Effective user is the owner of the program

SGID=ON: Effective group is the group owner of the program

SGID for Directories

Forces subdirectories and files created in it to have the same group as the directory's group independent of the creating user's group. Subdirectories created within this directory will inherit the same SGID.

Sticky Bit for Directories

Files in the directory can only be deleted by their owner even if the directory is set to write access for all. Sticky bit is normally set on /tmp to prevent another user's processes from deleting your files.

Note 1: Normally any file (belonging to the user or not) under a directory set to write access for group or others can be erased by any user.

Note2: The owner of the directory can erase any file in it even if the sticky bit is set.

Sticky Bit for programs:

Allows a running program to be stored in ram (buffers) until the system goes down.

Advantage: Programs load faster..

Disadvantage: Uses lots of RAM

Note: Sticky bit for programs is obsolete. Linux has never used it and no modern Unix has used it for years – swap memory does the same thing more effectively

`chmod o+t` Sets the sticky bit

result = (`-rwxrwxrwt`) or (`-rwxrwxrwT`)

`chmod u+t` Sets the SUID

result = (-rwsrwxrwt) or (-rwSrwxrwT)

`chmod u+t` Sets the SGID

result = (-rwxrwsrwt) or (-rwxrwSrwT)

Note: When adding a sticky-bit to a file/dir with an x for Others, the sticky-bit is displayed as t otherwise as T if the x was not present. The same applies to SUID and SGID (`-rwSrwSrwT`)

Attributes (chattr & lsattr)

Setting the 'append only' attribute on a directory or file.

> `chattr +a` *filename* or *directoryname*

> User must necessarily not be root

> A file with this attribute may be appended to, but may not be deleted, and the existing contents of the file may not be overwritten. If a directory has this attribute, any files or directories within it may be modified as normal, but no files may be deleted.

Setting the 'immutable' attribute on a directory or file.

> `chattr +i` *filename* or *directoryname*

> User must be root

> A file or directory with this attribute may not be modified, deleted, renamed, or (hard) linked

Display Attributes of files and directories

> `lsattr`

List the special attributes of files and directories

Attributes list

`A`	Atime record is not modified. Prevents too much disk access for laptops. Still in testing mode
`a`	Sets it to append mode only (can not erase it, only append new content) Only root can set this attribute
`c`	The kernel compresses this file before writing to disk, and decompresses it when reading it from disk. NOT Implemented yet by kernel
`d`	Will not be backed up by the program "dump"
`i`	Cannot be modified, erased, renamed or hard linked. Only root can change this attribute
`s`	When this file is erased, the blocks it used are over-written with '0' to prevent recovery at a later date.
`S`	Any change to this file will be immediately written to the disk instead of in the file system buffer. (equivalent to 'sync' mount option)
`u`	When this file is deleted, its content are saved. It can therefore be undeleted later. NOT implemented yet by kernel.

umask for new files and directories

Sets default access rights for newly created files and directories:

New file access rights   = 666 !| umask (!|=Logical NOR)
New directory access rights   = 777 !| umask

Note: umask specifies which attributes will NOT be applied

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Examples:

umask	New files (access rights 0666)	New Directories (access rights 0777)
0022	-rw- r-- r--	-rwx r-x r-x
0135	-rw- r-- -w-	-rw- r-- -w-
0216	-r-- rw- ---	-r-x rw- --x

1.104.6 Manage file ownership

Description: Candidates should be able to control user and group ownership of files. This objective includes the ability to change the user and group owner of a file as well as the default group owner for new files.

Weight: 1

Key files, terms, and utilities:
```
chown
chgrp
chmod
```

chown

Changes user and group ownership of a file or directory
IMPORTANT: only root is allowed to change ownership(chown) of files or directories.

Syntax
```
chown [options] [user][:group] filename
chown [options] [user][:group] dirname
```

Examples:

`chown user:group Filename`	Change user and group ownership of file
`chown user Filename`	Change user ownership of file
`chown user. Filename`	Change user and **his** group ownership of file
`chown user: Filename`	Change user and **his** group ownership of file
`chown .group Filename`	Change group ownership of file

Important Options:(from man page)

`-R -recursive`	Recursively affects all files and directories inside directory trees
`--dereference`	Affect the referent of each symbolic link, rather than the symbolic link itself.
`-h, --no-dereference`	Affect symbolic links instead of any referenced file. (available only on systems that can change the ownership of a symlink)
`--from=CURRENT_OWNER:CURRENT_GROUP`	
	Change the owner and/or group of each file only if its current owner and/or group match those specified here. Either may be omitted, in which case a match is not required for the omitted attribute.
`-f, --silent, --quiet`	Suppress most error messages
`-c, --changes`	Like verbose but report only when a change is made
`--reference=RFILE`	Use RFILE's owner and group rather than the specified OWNER:GROUP values.
`-v, --verbose`	Output a diagnostic for every file processed

chgrp

Change group ownership of a file or directory

Syntax:

```
chgrp [options] newgroup filename
```

Examples:

```
chgrp -R ftp /srv/www
```

Changes recursively all the files and directories inside the dir. `/srv/www` to be owned by group ftp

```
chgrp -R --reference=/home/hans /srv/ftp
```

Changes recursively the group ownership of all the files and directories contained in `/srv/ftp` to the group owning the directory `/home/hans`

Options:

`-R, --recursive`	Operate on files and directories recursively
`--dereference`	Affect the referent of each symbolic link, rather than the symbolic link itself
`-h, --no-dereference`	Affect symbolic links instead of any referenced file (available only on systems that can change the ownership of a symlink)
`-f, --silent, --quiet`	Suppress most error messages
`--reference=RFILE`	Use RFILE's group rather than the specified GROUP value
`-v, --verbose`	Output a diagnostic for every file processed
`-c, --changes`	Like verbose but report only when a change is made

chmod

Change the access rights of a files or directories

Syntax:

```
chmod SymbolicAccessRights file1 file2 fiel3 ....
chmod OctalAccessRights file1 file2 fiel3 ....


chmod [ugoa][+=-][rwx stXugo] or [0000 to 7777] file
```
examples:
```
     chmod u+w,g-x,o=wx file1
     chmod 750 file2
     chmod 4755 program1          (SUID=ON)
     chmod u+s,g+s,o+t program2  (SUID=ON,SGID=ON,StickyBit=ON)
     chmod -R u=rwX,g=rX,o=rX dir1
                                   Recursive 755 for directories.
                                   and 644 for files.
```

- **Directories access rights**

- The read(`r`) without the search(`x`) access rights for directories makes no
 sense and the read is ignored.
- Any file (belonging to the user or not) under a directory set to write access to
everybody can be erased by anybody.

Extra access rights			user			group			others		
SUID (s)	*SGID (s)*	*Sticky Bit(t)*	*r*	*w*	*x*	*r*	*w*	*x*	*r*	*w*	*x*
4	*2*	*1*	*4*	*2*	*1*	*4*	*2*	*1*	*4*	*2*	*1*

- **SUID and SGID for programs** (`-rwsrwsrwx`)(`-rwSrwSrwx`)
  - SUID=ON: Effective user is owner of the program(w/SUID) started
  - SGID=ON: Effective group is the group of the program(w/SGID) started

- **SGID for Directories**
  Forces the subdirectories and files created in it, to have the same group as the directory. Independent of the user's group creating it.

- **Sticky Bit for <u>Directories</u> :**
  Sets the rights to erase files only to their owner even if the directory is set to write for everybody. The sticky bit on **/temp** prevents that users processes erase files belonging to other users.
  Note 1: Normally any file (belonging to the user or not) under a directory set to write access to group or others can be erased by users.
  Note2: The **owner of the directory** can still erase any file even if the sticky bit is set.

- **<u>Sticky Bit for programs</u>:**
  - Allows an already run program to get stored in the ram (buffers) till the system goes down.
    Advantage: Fast load of program.
    Disadvantage: Uses lots of RAM

- **Command :**
  `chmod o+t` (sets the sticky bit)
        result= (`-rwxrwxrwt`) or (`-rwxrwxrwT`)
  `chmod u+t` (sets the SUID)
        result= (`-rwsrwxrwt`) or (`-rwSrwxrwT`)
  `chmod u+t` (sets the SGID)
        result= (`-rwxrwsrwt`) or (`-rwxrwSrwT`)
  Note: When adding a sticky-bit to a file/dir with an **<u>x</u>** for Others,
  the sticky-bit is displayed a **<u>t</u>** otherwise as **<u>T</u>** if the x was not present.
  The same applies to SUID and SGID (`-rw`**<u>S</u>**`rw`**<u>Srw</u>**<u>T</u>)

1.104.7 Create and change hard and symbolic links

Description: Candidates should be able to create and manage hard and symbolic links to a file. This objective includes the ability to create and identify links, copy files through links, and use linked files to support system administration tasks.

Weight: 1

Key files, terms, and utilities:
```
ln
```

Creating a Symbolic link:

```
ln [options] -s source destination
```

or

```
cp -s source[list] destination
```

Examples:

```
ln -s /bin/cat /home/hans/bin/cat
```

Creates a new symbolic link called /home/hans/bin/cat pointing to /bin/cat

Creating a Hard Link:

Note: Hard links are new files which have the same inode

```
ln source destination
```

or

```
cp -l source destination
```
(Not accepted as answer in LPI Exam)

Examples:

```
ln /bin/ping /home/hans/bin/ping
```

Creates a new hard link called /home/hans/bin/ping pointing to /bin/ping

Options:

`-f, --force`   Remove existing destination files

`-i, --interactive`   Prompt whether to remove destinations

`-s, --symbolic`   Make symbolic links instead of hard links

`--target-directory=DIRECTORY`
                                      Specify the DIRECTORY in which to create the links

`-v, --verbose`   Print name of each file before linking

Important Notes:

- Although the man page says that it is possible to make a hard link to a directory, in reality it is not possible under Linux ... yet. In this case to simulate a hard link of a directory just use the "bind" option whith mount:

```
mount /SourceDir /MountPoint -o bind
```

- Hard links are limited to the same partition as the original file

- Symbolic links are NOT limited to the same partition as the original file

- The command:
```
cp source destination
```

Copies the referenced file (the file that the symlink points to) when the source is a symbolic link.

Example:

```
 cp linktest3 linktest5
```

> (`linktest3` is a symbolic link to `linktest` file)
> Copies the content of `linktest` to `linktest5` as a normal file.

The second field of the command `ls -l` filename shows how many files are hard linked to that inode.

```
ls -l  linktest*
-rw-r--r--  3 michel   video   0 2003-11-20 08:45 linktest
-rw-r--r--  3 michel   video   0 2003-11-20 08:45 linktest2
-rw-r--r--  3 michel   video   0 2003-11-20 08:45 linktest3
```

The command:

```
     stat filename
```

also shows how many files are hard linked to that inode.

Example:
stat linktest

```
File: `linktest'
Size: 0     Blocks: 0         IO Block: 4096   regular empty file
Device: 305h/773d       Inode: 876319      Links: 2
Access: (0644/-rw-r--r--) Uid: (  500/ michel)  Gid:( 33/  video)
Access: 2003-11-20 08:45:10.000000000 +0100
Modify: 2003-11-20 08:45:10.000000000 +0100
Change: 2003-11-20 08:45:22.000000000 +0100
```

1.104.8 Find system files and place files in the correct location

Description: Candidates should be thoroughly familiar with the Filesystem Hierarchy Standard, including typical file locations and directory classifications. This objective includes the ability to find files and commands on a Linux system.

Weight: 5

Key files, terms, and utilities:
```
find
locate
slocate
updatedb
whereis
which
/etc/updatedb.conf
```

find

Recursively searches the filesystem to find files

Syntax:

```
find startdirectory [search_criteria_options] [-exec command \;]
find startdirectory [search_criteria_options] [-ok command \;]
```

Examples:

Finds all directories located in the current directory

```
find . type d -maxdepth 1
```

Recursively finds all files in directory /etc whose names include the pattern 'XF'

```
cd /etc/ ; find . -name "*XF*"
```

Searches /opt/kde and subdirectories up to 2 levels deep for files whose names end with the word 'edit'

```
find /opt/kde -maxdepth 2 -type f -name "*edit"
```

Search the current directory for files whose properties were changed less than 5 minutes ago
```
find . -follow -cmin -5
```

Timestamp syntax:

```
-cmin +5   Properties of file changed more than 5 minutes ago
-amin -6   Content of file accessed less than 6 minutes ago
-mmin +8   Content of file modified more than 8 minutes ago

-ctime +5  Properties of file changed more than 5 days ago
-atime -7  Content of file accessed less than 7 days ago
-mtime -3  Content of file modified less than 3 days ago
```

```
find /etc -type f -name '*.conf' -exec grep -H "hosts" {} \;
```

Above command searches the /etc directory for files with the extension .conf. Executes grep on those files looking for the string "hosts". When found, also displays the filename it was found in.

```
find /etc -type f -name '*.conf' -ok grep -H "hosts" {} \;
```

Above command does the same actions as previous command except that `-ok` option asks find to prompt for confirmation (with y) of the command before executing it.

locate

Locate files in the whole system using a database of filenames.

Syntax:

```
locate filename
```

Searches the locate database for the filename
This database is in `/var/lib/locatedb`
It is updated via the command: `updatedb` [options]
The configuration file for updatedb is `/etc/updatedb.conf`

Options:

```
-d path, --database=path
```

Instead of searching the default file name database, search the file name databases in path, which is a colon-separated list of database file names. You can also use the environment variable LOCATE_PATH to set the list of database files to search.
The option overrides the environment variable if both are used.

```
-e, --existing
```

Only print out such names that currently exist (instead of such names that existed when the database was created).
Note that this may slow down the program a lot, if there are many matches in the database.

```
-i, --ignore-case
```

Ignore case distinctions in both the pattern and the file names.

slocate

Secure version of locate

Secure Locate provides the same features as locate but it will also store file permissions and ownership so that users will not see files they do not have access to.

Syntax:

```
slocate [options] filename
```

> The slocate database is not the same as the locate database. It needs to be built by issuing the slocate command with proper options:

Database Build Options:

```
-u
```

Create slocate database starting at path /

```
-U <dir>
```

Create slocate database starting at path <dir>

```
-e <dir1,dir2,...>
```

Exclude directories from slocate database

```
-f <fstype1,...>
```

Exclude files on specific file systems from the slocate database.

```
-c
```

Parse /etc/updatedb.conf when updating the slocate database.

```
-l <level>
```

Security level:
0   Turns security checks off. This will make searches faster.
1   Turns security checks on. This is the default.

```
-o <file>, --output=<file>
```

Specifies the database to create.

```
-v, --verbose
```

Verbose mode. Display files when creating database.

Slocate Search Options:

```
-i
```
Does a case insensitive search.

```
-q
```
Quiet mode. Error messages are suppressed.

```
-n <num>
```
Limit the amount of results shown to <num>.

```
-r <regexp>, --regexp=<regexp>
```
Search the database using a basic POSIX regular expression.

```
-d <path>, --database=<path>
```
Specifies the path of databases to search.

whereis

Search for a program and possibly its man pages from a predefined path.

Syntax:

```
    whereis filename
```

Searches a predefined (hard coded) list of directories for the filename and man pages. They must be in the path predefined during compilation of whereis program.

which

Search for the first occurrence of a program in the PATH.

Syntax:

```
    which filename
```

Searches the PATH for the first occurrence of the filename.

type

Seaches through the bash built-in commands then aliases then in $PATH for a command.

```
    type command
```

The filename can be a list of files.

```
type -p filename
```

Same as above `which filename`

Topic 110: The X Window System

Total weight for this topic   **13**

Summary

TODO

1.110.1 Install & Configure XFree86

Description: Candidate should be able to configure and install X and an X font server. This objective includes verifying that the video card and monitor are supported by an X server, as well as customizing and tuning X for the video card and monitor. It also includes installing an X font server, installing fonts, and configuring X to use the font server (may require a manual edit of `/etc/X11/XF86Config` in the `Files` section).

Weight: 5

Key files, terms, and utilities:
```
XF86Setup
xf86config
xvidtune
/etc/X11/XF86Config
/etc/.Xresources
~/.Xresources
```

X Window System

The X-Window System is a **network based** graphic Window system using the **Client/Server principle**. The X-based program is the client. The program X is the server. The X-Protocol can be transported via **TCP/IP** or local **Unix Socket**s.
The X-Server offers an **empty display** where programs that support the **X-Protocol** will be displayed and controlled via the **mouse and keyboard**. The X-Server takes control of the local Graphic card, monitor, mouse and keyboard and possibly other devices like joystick, graphic tablet etc. The X-Server is a network service for local or remote clients (X-Programs).

XWindow System was implemented as part of a project called Athena at the Massachusetts Institute of Technology. The X-Server has been developed **for many hardware platforms**. Most X-Server implementations are proprietary. **XFree86 is free software**, and is the one explained below. It is is a free porting of the popular Unix based Version 11 release 6 know as X11R6.

XFree86 **Version 3 contained several executable X Servers** for different resolutions and colour depths and Graphic cards types. The X-Servers' names are in the format: `XF86_Servertype.`

XFree86 **Version 4 contains a core X program** which is hardware independent and **modules** which are hardware dependant.

Alist of hardware support is found at: `www.xfree86.org/4.0/Status.html`.

The system card should have minimum 8MB RAM.

Make sure the path `/usr/X11R6/bin` is in the PATH variable. The libraries should be also findable by the `ld.so` by making sure that the entry `/usr/X11R6/lib` is enters in the file `/etc/ld.so.conf`.

Configuration

The configuration of the X-Server needs to have the proper parameters for the following:

· Graphic card

· Monitor

- Keyboard
- Mouse
- Other input devices like: joystick, tablette, 3D Direct Rendering Interface etc.

XF86Config file

`/etc/X11/XF86Config` is the main XFree86 configuration file.

XF86Config search path:

When X is started <u>as a normal user</u>:

```
/etc/X11/XF86Config
/usr/X11R6/etc/X11/XF86Config
   Then Common search path
```

When X is started <u>as the **root** user</u>.

```
XF86Config
/etc/X11/XF86Config
/usr/X11R6/etc/X11/XF86Config
$HOME/XF86Config
   Then Common search path
```

<u>Common search path</u>:

```
/etc/X11/XF86Config-4
/etc/X11/XF86Config
/etc/XF86Config
/X-Rootdir/etc/X11/XF86Config.<hostname>
/X-Rootdir/etc/X11/XF86Config-4
/X-Rootdir/etc/X11/XF86Config
/X-Rootdir/lib/X11/XF86Config.<hostname>
/X-Rootdir/lib/X11/XF86Config-4
/X-Rootdir/lib/X11/XF86Config
```

Note: In the above 2 paths **/X-Rootdir** is normally `/usr/X11R6/`
Note2: In the case of `/usr/X11R6/etc/X11/XF86Config.<hostname>` it is mostly used where the `/usr/` directory is used (mounted)by multiple computers.

Depending on distributions the configuration files of X-Server Version 3 and Version 4 are located in different locations. Often used locations and names are:

Version 3	**/etc/XF86Config** /etc/X11/XF86Config
Version 3 and Version 4	/etc/X11/XF86Config (V.3) /etc/X11/XF86Config-4 (V.4) or /etc/XF86Config (V.3) /etc/X11/XF86Config (V.4)
Version 4	/etc/X11/XF86Config /etc/X11/XF86Config-4

XF86 Configuration programs

These are helper programs that write an XF86Config file

xf86config	First text-based configuration program. Provided and supported by the XFree86 development team. Belongs to standard X-Server packages.
XF86Setup	Graphic-based (640x480-VGA 16 colors) configuration program. Also provided and supported by XFree86 development team.
xf86cfg	Graphic-based configuration program. More complex and more for advanced administrators. Provides the possibility of dynamically edit some of the settings by pressing an 'Apply' button. Provides auto-detection of graphic cards. Also provided and supported by XFree86 development team.
SAX	SuSE graphics-based configuration programs for XFree86 Version 3. Provides auto-detection of graphic cards.
SAX2	SuSE graphics-based configuration programs for XFree86 Version 4. Provides auto-detection of graphic cards.
Xconfigurator	RedHat text-based configuration programs. Improved version of xf86config. It does auto-detection of graphic cards. Works in interactive mode or in automatic-install mode.
dexconf	Debian system installation program. No user startable program. To reconfigure the X-Server execute: (dexconf runs in the background) dpkg-reconfigure xserver-xfree86
Xfdrake	Mandrake(Mandriva) X config program

All of the above configuration programs do 2 things:

Configuration of the XF86Config file.

Creation of a symbolic link to the configured X-Server (Version 3 only)

Note: It is possible to test if the current X-server supports the graphic card by issuing the command:

```
X -probeonly
```

This command can have side effects of freezing the screen in some instances during the probing.

Running the X-Server

Start the X server and window manager without display manager:

```
startx (script)
```

The script ~/.xinitrc is run after the X server is started. If no ~/.xinitrc exists then the default /usr/X11R6/lib/X11/xinit/xinitrc is used. Both files must have the last command run using the exec command or the background command (&) otherwise the X server will end right after the last command is terminated.

Start the X server and window manager with display manager:

```
init 5
```

Topic 110: The X Window System

<u>The symlink to the configured X Server</u>

Version 3

`/usr/X11R6/bin/X ==> /var/X11R6/bin/X ==> /usr/X11R6/bin/XF86_Servertype`
The double linkage was because on Read-Only mounted `/usr` the link was impossible to change.

Version 4

`/usr/X11R6/bin/X ==> /var/X11R6/bin/XFree86`

Version 4 on Debian only
`/usr/X11R6/bin/X` loads `/var/X11R6/bin/XFree86`

Fine Tune the monitor settings:

Manually with monitor's buttons or via the **xvidtune** program

Changing configuration of an active X Server:

Dynamic settings:

The X-Server can be dynamically (non permanently) controlled with the `xset` command

Display the x-server settings values
`xset q`

Changing the keyboard rate:

`xset r rate 250 30`   (Delay=250ms 30 char/sec.)

Changing the mouse speed parameters
`xset m 10/20`   (10 Pixels/20 Mouse moves)

Changing the screen saver parameters

Deactivating the screen saver
`xset s off`

Activating the screen screen saver

`xset s on`

Start the screen screen saver NOW

`xset s activate`   (better put as command in a desktop icon)

Layout of the XF86Config file

Sections:

Files	Location of fonts and fonts server(s)
	If no FontPath are specified then it defaults to:
	`/usr/X11R6/lib/X11/fonts/misc`
	`/usr/X11R6/lib/X11/fonts/Speedo`
	`/usr/X11R6/lib/X11/fonts/Type1`
	`/usr/X11R6/lib/X11/fonts/CID`
	`/usr/X11R6/lib/X11/fonts/75dpi`
	`/usr/X11R6/lib/X11/fonts/100dpi`
ServerFlags	Server flags

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Module	Dynamic module loading
Device	Graphics device description. Graphic card Chipset, clocks, Memory size, Help Program: `SuperProbe` (not included in SuSE)
Monitor	Monitor description Display size, Horizontal & Vertical Refresh rates
Screen	Screen configuration. List of Modes per depth
ServerLayout	Overall layout Components used for the X-Server

InputDevice	Input device description (Version 4)
	Can be for the keyboard or the mouse
	For keyboard:
	    The type: `pc101,pc102,pc104,pc105`
	    Layout: (`de,en` etc)
	    Options: `nodeadkeys` etc
	For the mouse:
	    Connector type: `serial, PS/2, USB`
	    Protocol: `imps/2,microsoft,logitech,mmseries` etc
	    Buttons: 2 or 3
	    Options: Emulate3Buttons, ZAxisMapping 4 5

Modes	Video modes descriptions. WARNING: Can destroy monitors.
	    Modelines descriptions
	Resolution ClockSpeed H-Timings V-Timings
	
	1024X768 65 <u>1024 1032 1176 1344</u> <u>768 771 777 806</u>
	Clock Frequence: 65
	Horiz: Number of display pixels horizontally
	        Horizontal sync start
	        Horizontal sync end
	        Total horizontal pixels
	Vert: Number of display pixels vertically
	        Vertical sync start
	        Vertical sync start
	        Total vertical pixels

DRI	Direct Rendering Interface for Direct access to card processor
Vendor	Vendor-specific configuration
Keyboard	Keyboard configuration (Version 3)
Pointer	Mouse configuration (Version 3)

Details of Files section of XF86Config

Section "Files"

Lists of paths either of:
- Fonts directory (`FontPath` *Path*)
- Fonts servers (`Fontpath` *FontserverAddr*)
- RGB color descriptions file (`RgbPath` *Path*) rarely used.
- Modules (`ModulePath` *Path*) rarely used only needed if non default

Loading Fonts Directive:
```
FontPath="/usr/X11R6/lib/X11/fonts/local","/usr/X11R6/lib/X11/fonts/misc"
```
or
```
FontPath="/usr/X11R6/lib/X11/fonts/local"
FontPath="/usr/X11R6/lib/X11/fonts/misc"
```
Examples of X11 Fonts and Fonts server

Fonts Directory
```
FontPath "/usr/X11R6/lib/X11/fonts/TrueType"

FontPath "/usr/X11R6/lib/X11/fonts/75dpi:unscaled"
```
Font server:
```
FontPath "unix/:7100"
```
(Font server on local Unix socket – runs on port `7100`)

xset

Allows to temporarily change dynamically the X-Server's FontPath settings:

Adding a FontPath

```
xset +fp /usr/X11R6/lib/X11/fonts/TrueType
```
Places the new font path at the <u>beginning</u> of the font path list
or
```
xset  fp+/usr/X11R6/lib/X11/fonts/TrueType
```
Places the new font path at the <u>end</u> of the font path list

Deleting a FontPath

```
xset –fp /usr/X11R6/lib/X11/fonts/TrueType
or
xset  fp–/usr/X11R6/lib/X11/fonts/TrueType
```

Format of font names

```
Author       Weight   Width     Pixels  XRes   Spacing    ISO-Standard
   |            |        |          |      |       |            |
  -b&h-lucida-medium-r-normal-sans-18-180-75-75-p-106-iso8859-1
        |            |          |     |     |     |            |
    Fontname      Attribute   Style   Points YRes Average Options
              (i or *=Italic)        (1/72 in)    Width
              (r=roman)
```

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Installing new fonts

New fonts need some preparation before they can be used. Besides the font files (with extensions `.snf` `.pcf`) located in the font directories, some extra files need attention:

- `fonts.dir`

  Contains the number of fonts available in this directory (on first line) and one line per font description. The format is:

  First line: `Number of fonts listed in this file. (eg. 439)`
  Rest of the file: `FontFilename Font_Description`

  Example:

  ```
  439
  putbi.pfa -adobe-Utopia-bold-i-normal—0-0-0-0-p-0-adobe-standard
  putbi.pfa -adobe-Utopia-bold-i-normal—0-0-0-0-p-0-iso10646-1
  putbi.pfa -adobe-Utopia-bold-i-normal—0-0-0-0-p-0-iso8859-1
  ...
  ```

  To create this file the program `mkfontdir` must be run

  Syntax:

  ```
  mkfontdir /path/to/font/directory
  ```

  Valid font types: PCF (`.pcf`), SNF (`.snf`)

- `fonts.alias`

  List entered by manually assigning a non existing font name to an existing one.
  Format:

  ```
  alias_name existing_name
  ```

  Example:

  ```
  fixed       -misc-fixed-medium-r-semicondensed—13-120-75-75-c-60-iso8859-1
  variable    -*-helvetica-bold-r-normal-*-*-120-*-*-*-*-iso8859-1
  5x7         -misc-fixed-medium-r-normal--7-70-75-75-c-50-iso8859-1
  5x8         -misc-fixed-medium-r-normal—8-80-75-75-c-50-iso8859-1
  x9          -misc-fixed-medium-r-normal—9-90-75-75-c-60-iso8859-1
  6x10        -misc-fixed-medium-r-normal—10-100-75-75-c-60-iso8859-1
  6x12        -misc-fixed-medium-r-semicondensed—12-110-75-75-c-60-iso8859-1
  6x13        -misc-fixed-medium-r-semicondensed—13-120-75-75-c-60-iso8859-1
  6x13bold    -misc-fixed-bold-r-semicondensed—13-120-75-75-c-60-iso8859-1
  ...
  ```

- `fonts.scale`

  List of fonts that are scalable. The format is:

  First line: `Number of fonts listed in this file.(eg. 439)`
  Rest of file: `FontFilename Font_Description`

  Example

  ```
  439
  putbi.pfa -adobe-Utopia-bold-i-normal—0-0-0-0-p-0-adobe-standard
  putbi.pfa -adobe-Utopia-bold-i-normal—0-0-0-0-p-0-iso10646-1
  putbi.pfa -adobe-Utopia-bold-i-normal—0-0-0-0-p-0-iso8859-1
  ```

Setting-up a Font server (xfs)

xfs is the standard Font Server which listens for requests on port 7100.
(do not confuse the name of the font server (xfs) with the filesystem from SGI (XFS) –
note the capitalization

<u>Settings of client XF86Config configuration file:</u>

```
FontPath "unix/:7100"
```
                                        Local Font server on Unix socket
or
```
FontPath "unix/:-1"
```
                                        ""   ""   ""   ""

    or

```
FontPath "tcp/myserver.fd.com:7100"
```
   Remote font server

<u>xfs configuration file:</u>
    Older path:
```
/usr/X11R6/lib/X11/fs/config
```

    Standard location:
```
/etc/X11/fs/config
```

  or `/etc/X11/xfs.conf`

Starting the font server as a daemon:

```
xfs -config /etc/X11/fs/config -daemon
```
or in SuSE
```
rcxfs start
```
or `/etc/init.d/xfs start`

To refresh the font list in the server:
    Make changes to the config file and issue a `kill -HUP $(cat /var/run/xfs)`
    or in SuSE: `rcxfs reload`

Example **xfs** configuration file:

```
#no-listen = tcp        If activated, then only the unix sockets can be used.
port = 7100
client-limit = 10
clone-self = on
use-syslog = on
deferglyphs = 16


catalogue = /usr/X11R6/lib/X11/fonts/misc:unscaled,
            /usr/X11R6/lib/X11/fonts/75dpi:unscaled,
            /usr/X11R6/lib/X11/fonts/100dpi:unscaled,
            /usr/X11R6/lib/X11/fonts/japanese:unscaled,
            /usr/X11R6/lib/X11/fonts/baekmuk:unscaled,
            /usr/X11R6/lib/X11/fonts/Type1,
            /usr/X11R6/lib/X11/fonts/URW,
            /usr/X11R6/lib/X11/fonts/Speedo,
            /usr/X11R6/lib/X11/fonts/CID,
            /usr/X11R6/lib/X11/fonts/PEX,
            /usr/X11R6/lib/X11/fonts/cyrillic,
            /usr/X11R6/lib/X11/fonts/latin2/misc,
            /usr/X11R6/lib/X11/fonts/latin2/75dpi,
            /usr/X11R6/lib/X11/fonts/latin2/100dpi,
            /usr/X11R6/lib/X11/fonts/latin2/Type1,
            /usr/X11R6/lib/X11/fonts/latin7/75dpi,
            /usr/X11R6/lib/X11/fonts/kwintv,
            /usr/X11R6/lib/X11/fonts/truetype,
            /usr/X11R6/lib/X11/fonts/uni,
            /usr/X11R6/lib/X11/fonts/ucs/misc,
            /usr/X11R6/lib/X11/fonts/ucs/75dpi,
            /usr/X11R6/lib/X11/fonts/ucs/100dpi,
            /usr/X11R6/lib/X11/fonts/hellas/misc,
            /usr/X11R6/lib/X11/fonts/hellas/75dpi,
            /usr/X11R6/lib/X11/fonts/hellas/100dpi,
            /usr/X11R6/lib/X11/fonts/hellas/Type1

# in decipoints
default-point-size = 120
default-resolutions = 75,75,100,100
# font cache control, specified in KB
cache-hi-mark = 2048
cache-low-mark = 1433
cache-balance = 70
```

Note: To make all local fonts available through the font server then, get the same list of fonts Paths (FontPath ....) in the [Files] section of
/etc/X11/XF86Config or /etc/X11/xorg.conf and enter them in the font server' configuration file: /etc/X11/fs/config under the catalogue section.

IMPORTANT: In this font server configuration file, the list of font paths does not have the keywords 'FontPath' or quotes("...")around the paths, but each font path must end with a comma ',' except the last line. See the example above.

SuSE Font configuration program.
NAME

> **fonts-config** - configures installed X11 fonts.

SYNOPSIS

> `fonts-config [OPTION]...`

OPTIONS

`-f, --force`	Force the update of all generated files even if it appears to be unnecessary according to the time stamps.
`-q, --quiet`	Work silently, unless an error occurs.
`-v, --verbose`	Print some progress messages to standard output.
`-d, --debug`	Print a lot of debugging messages to standard output.
`--(no)ooo`	generate (or don't generate) font setup for OpenOffice
`--version`	Display version and exit.
`-h, --help`	Display a short help message and exit.
`--(no)gs-fontmap`	generate (or don't generate) a `Fontmap` file for Ghostscript.
`--(no)ttcap`	generate (or don't generate) TTCap entries in `fonts.dir` file.

TTCap entries can be used with the `xtt` module and with recent versions of the `freetype` module.
So, There are 3 types of `fonts.dir` formats:
> Traditional format
> Freetype extended format
> TTcap extended format

Xtt can handle all of 3 formats.
Freetype can handle Traditinal and Freetype extended formats.
Other engine (bitmap, type1 and so on) can handle only Traditional format.

On my understanding, both `freetype` and `xtt` modules **do not** refer `fonts.scale` on runtime. They refers `fonts.dir` only.

<u>Traditional format:</u>
> a010013l.pfb -urw-urw gothic l-book-r-normal--0-0-0-0-p-0-iso8859-1
> a010015l.pfb -urw-urw gothic l-demibold-r-normal--0-0-0-0-p-0-iso8859-1

<u>Freetype Extended format:</u>
> :2:mincho.ttc -misc-mincho-medium-r-normal--0-0-0-0-c-0-jisx0208.1990-0
<u>TTCap Format:</u>
fn=1:ai=0.3:dfhsmw3.ttc -dynalab-pmincho-medium-i-normal--0-0-0-0-p-0-iso8859-1

`fn=` means "Face number", `ai=` means "Automatic Italic: specifies how the glyph is slanted.

DESCRIPTION

Configures installed X11 fonts. Basically it does the following things:

call fc-cache

creates cache files for fonts to use with client side font rendering via `libXft`, for details see fc-cache(1). `fonts.cache-1` cache files are generated in all directories which are configured in `/etc/fonts/fonts.conf` and all their subdirectories.

call cidfont-x11-config

`cidfont-x11-config` is another little perl script which configures CID-keyed fonts for use with `X11`, see `cidfont-x11-config`(1).

creates fonts.scale and fonts.dir files

To find the list of directories currently used for server side fonts, `/etc/X11/XF86Config` is parsed and merged with a hardcoded list of directories. If the font server xfs is running, `/etc/X11/fs/config` is also parsed and the list of directories found there is merged as well.

For each directory from this list, the time stamps of the directory, the `fonts.scale` file, the `fonts.dir` file and an extra time stamp file `.fonts-config-timestamp` are checked. If not all the time stamps are equal or any of these files is missing, the `fonts.scale` and `fonts.dir` files will be updated as follows:

First of all a `fonts.scale` file is created by calling `mkfontscale`.

Then, the entries found in the `fonts.scale` file are merged with the entries from all `fonts.scale.*` files.

`fonts.scale.*` files may be supplied by rpm-packages or manually added by the user to override or amend the entries created automatically by `mkfontscale`. Entries in a `fonts.scale.*` file have higher priority than entries automatically created by `mkfontscale`. All entries generated automatically by `mkfontscale` for a certain font file are discarded if any `fonts.scale.*` file contains an entry for the same font file.

If the `xtt` module is configured to load in `/etc/X11/XF86Config`, additional entries may be created to make use of the artificial bold and italic features of `xtt`. The time stamp of `/etc/X11/XF86Config` is not checked, i.e. you have to use `fonts-config --force` after editing `/etc/X11/XF86Config` to switch between the `xtt` and `freetype` modules.

After the final list of entries has been written back to `fonts.scale`, `mkfontdir` is called.

Finally, the time stamps of the directory, `fonts.scale`, `fonts.dir`, and `.fonts-config-timestamp` are set to the time when `fonts-config` started.

If any `fonts.scale` file in the directory list needed an update, a Ghostcript `Fontmap` is also generated for all scalable fonts in the directory list and the result is written to `/usr/share/ghostscript/*/lib/Fontmap.X11-auto`.

Usually `fonts-config` is called automatically via `SuSEconfig`
(`SuSEconfig --module fonts`), which is usually automatically called by `YaST2`.
But you can also execute `fonts-config` directly, which is mainly useful to debug
it.

FILES

/etc/sysconfig/fonts-config

Default values for some command line options of `fonts-config` are read from
this file if it exists. The options currently supported in this file are:

GENERATE_TTCAP_ENTRIES

can be set to "yes" or "no" and sets the default for the option --(no)ttcap.

GENERATE_GHOSTSCRIPT_FONTMAPS

can be set to "yes" or "no" and sets the default for the option --(no)gs-fontmap.

GENERATE_OOO_FONT_SETUP

can be set to "yes" or "no" and sets the default for the option --(no)ooo.

SEE ALSO

`fc-cache(1), cidfont-x11-config(1), mkfontdir(1), mkfontscale(1)`

1.110.2 Set up a display manager

Description: Candidate should be able setup and customize a Display manager. This objective includes turning the display manager on or off and changing the display manager greeting. This objective includes changing default bitplanes for the display manager. It also includes configuring display managers for use by X-stations. This objective covers the display managers XDM (X Display Manager), GDM (Gnome Display Manager) and KDM (KDE Display Manager).

Weight: 3

Key files, terms, and utilities:
```
/etc/inittab
/etc/X11/xdm/*
/etc/X11/kdm/*
/etc/X11/gdm/*
```

Starting an X session

An X session can be started in 2 ways:

Log in from a virtual terminal (text based) and then run the script `startx`.

`startx` in turns starts `xinit`.

`xinit` configuration file:

```
$HOME/.xinitrc
```

if found otherwise

```
/var/X11R6/lib/xinit/xinitrc
```

Via an X-Display-Manager (XDM): The user log-in in is done graphically.

The display manager is started at boot time (runlevel 5) in the background as a daemon and provides graphical logins to users.

Note: For this we need to make sure that default runlevel is set to 5 in `/etc/inittab`

Display managers

Popular display managers are

Name	Config files directory	Main configuration file
xdm	`/etc/X11/xdm/`	`xdm-config`
kdm	`kde_rootdir/share/config/kdm/`	`kdmrc`
gdm	`gnome_rootdir/gdm/`	`gdm.conf`

`kde_rootdir`

Main root directory for kde desktop system. For kde3 it is:

```
/etc/opt/kde3
```

`gnome_rootdir`

Main root directory for Gnome desktop system. For Gnome 2 it is:

```
  /etc/opt/gnome
```

Properties of the Display Managers

`kdm` is based on `xdm` and uses many of its configuration files.

`gdm` is ta new development and is therefore independant from `xdm`.

xdm configuration

The configuration files of the XDM are as follows:

Xresources	Inital Rescouces/Configuration of Xlogin window
Xaccess	How can hosts connect to this host
Xservers	Specify loac and remote Xservers without XDMCP
Xdm-config	Main configuration file of the XDM
Xsetup	Script run each time the XDM displays itself with a login prompt.

xdm is a typical X11 program that offers only a logo, background and login fields. The parameters to change its behaviour are in:

`/etc/X11/xdm/`**`Xresources`**

Example:

```
xlogin*greeting:          Welcome to CLIENTHOST
xlogin*namePrompt:        \040\040\040\040\040\040\040Login:
xlogin*fail:              Login incorrect
xlogin*login.greetFont:   *-FAMILY-bold-SLANT-normal--*-140-*-*-*-*-
iso8859-1
xlogin*login.promptFont:  *-FAMILY-bold-r-normal--*-120-*-*-*-*-iso8859-1
xlogin*login.Font:        *-FAMILY-medium-r-normal--*-120-*-*-*-*-iso8859-1
xlogin*logoFilename       /xxxxx.xpm
xlogin*useShape:          true
xlogin*greetColor:        CadetBlue
xlogin*failColor:         red
xlogin*borderWidth:       0
xlogin*frameWidth:        5
xlogin*innerFramesWidth:  2
xlogin*Foreground:        black
xlogin*Background:        #c0c0c0
xlogin*hiColor:           #e0e0e0
```

`/etc/X11/xdm/`**`Xaccess`**
Controls which remote host and how they will connect to the local XDM via XDMCP.

Example:
```
*                                      #any host can get a login
window

*              CHOOSER BROADCAST       #any indirect host can get a chooser

# If you'd prefer to configure the set of hosts each terminal sees,

# then just uncomment these lines (and comment the CHOOSER line above)

# and edit the %hostlist line as appropriate

#%hostlist      host-a host-b

#*              CHOOSER %hostlist       #
```

/etc/X11/xdm/**Xservers**

Controls the terminal on which the local Xservers will be started
well as which are the remote Xservers, that do not support XDMCP protocol, should be
polled be XDM for remote XDM login.

Example:

```
192.168.100.60:0 foreign

# "reserve" means that the X server gets only started on request (only kdm)

:0 local /usr/X11R6/bin/X -br vt7
:1 local reserve /usr/X11R6/bin/X  -br :1 vt8
:2 local reserve /usr/X11R6/bin/X  -br :2 vt9
:3 local reserve /usr/X11R6/bin/X  -br :3 vt10
:4 local reserve /usr/X11R6/bin/X  -br :4 vt11
:5 local reserve /usr/X11R6/bin/X  -br :5 vt12
```

/etc/X11/xdm/**Xdm-config**

This is the main XDM configuration file. It holds the configuration of which
configuration file or script will be used. It holds also the parameter that will allow XDM
to listen for XDMCP contacts via the network.
Example:

```
! xdm-config:    Configuration of the xdm

DisplayManager.errorLogFile:    /var/log/xdm.errors
DisplayManager.pidFile:         /var/run/xdm.pid
DisplayManager.authDir:         /var/lib/xdm
DisplayManager.keyFile:         /etc/X11/xdm/xdm-keys
DisplayManager.servers:         /etc/X11/xdm/Xservers
DisplayManager.accessFile:      /etc/X11/xdm/Xaccess
DisplayManager.willing:         su nobody -c /etc/X11/xdm/Xwilling

DisplayManager.*.authName:      MIT-MAGIC-COOKIE-1
DisplayManager.*.authComplain:  false
DisplayManager._0.authorize:    true
DisplayManager._1.authorize:    true

! The scripts handling the setup, the startup, the session its self,
! and the reset of an X session.
DisplayManager.*.setup:         /etc/X11/xdm/Xsetup
DisplayManager.*.chooser:       /etc/X11/xdm/RunChooser
DisplayManager.*.startup:       /etc/X11/xdm/Xstartup
DisplayManager.*.session:       /etc/X11/xdm/Xsession
DisplayManager.*.reset:         /etc/X11/xdm/Xreset

DisplayManager._0.terminateServer:      true
DisplayManager*resources:       /etc/X11/xdm/Xresources
DisplayManager.*.terminateServer:       false

! SECURITY: do not listen for XDMCP or Chooser requests
! Comment out this line if you want to manage X terminals with xdm
DisplayManager.requestPort:     0
```

/etc/X11/xdm/**Xsetup**

xdm runs a script called _/etc/X11/xdm/Xsetup_ each time it presents a login window.
There we can run programs that change the background etc.

Some examples of programs: xpmroot , xsetbg etc
```
    /usr/sbin/xpmroot /etc/X11/xdm/background.xpm
```

kdm configuration

kdm works quite similar to xdm and uses many of its configuration files located in:

> **/etc/X11/xdm/***

The standard location of KDM configuration files is:
> **/etc/X11/kdm/***
or   **/etc/opt/kde3/share/config/kdm/**

Note: Many distributions like SuSE have gone away from this rule by placing the configuration files in: /etc/opt/kde3/share/config/kdm/*

The /etc/X11/kdm/Xservers file is a symbolic link to /etc/X11/xdm/Xservers
The rest of the config files used by KDM are assigned in the kdmrc configuration file.

This configuration file is normally modified via the <u>K-Control-Center</u> is:
Standard: /etc/X11/kdm/kdmrc

SuSE: /etc/opt/kde3/share/config/kdm/kdmrc

The pictures of the users shown in kdm login are (valid formats: .xpm or .png)

> /opt/kde3/share/apps/kdm/pics/users/*username*.png

> The default is default.png

gdm configuration

gdm has its own configuration files separate from xdm/kdm. Main configuration file:

> /etc/X11/gdm/gdm.conf
or   /etc/opt/gnome/gdm/gdm.conf

Method of configuring gdm.conf:

> manual (editor) and (much better) through the config program: gdmconfig

Other tool for configuring individual user's pictures in gdm login:

> gdmphotosetup

Running XTerminals using xdm/kdm

Note 1: The display port number (:1 etc) can be chosen at will from the client as long as the same port is not chosen multiple times in the same client host. This number can also be eg. :1.0 which means the first graphic card used (0). Since it's mostly the case we only use eg. :1 and it's enough.

Note 2: For these configuration files changes to take effect kdm/xdm needs to be restarted.

Activate XDMCP (XDM Control Protocol - Port 177)

Edit /etc/X11/xdm/xdm-config, add a '!' at the beginning of the following line (normally the last line):

!DisplayManager.requestPort: 0

If KDM is used then edit the file `/etc/opt/kde3/share/config/kdm/kdmrc`: to enable XDMCP and the listening to TCP ports and restrict the shutdown to only Root:

```
[Xdmcp]
Enable=true

[X-*-Core]            (Greeter config for all remote displays)
AllowShutdown=Root

[X-:*-Core]           (Core config for local displays)
#ServerArgsLocal=-nolisten tcp (Comment it out ('#') to activate the TCP listening)
```

Allow access through the network

Edit `/etc/X11/xdm/Xaccess`:

For direct query from a client

On server:

   Enter or activate (remove the '#') the following lines:

```
*                   #Allow any host to remotely login
```

or

```
*.linux.local       #Allow any host from my domain
```

or

```
myhost.linux.local  #allow only myhost to remotely login
```

The client uses a command like

```
    X -query kdmserver :1
```

For Broadcast or indirect queries from clients

On server:

   Enter or activate (remove the '#') the following lines:

```
*                   CHOOSER BROADCAST
```

or

```
*.linux.local       CHOOSER BROADCAST
```

or

```
myhost.linux.local  CHOOSER BROADCAST
```

The client uses the command:

```
    X -broadcast :2
```

or

```
    X -indirect kdmserver :2
```

For Unattended x-login

xdm/kdm actively initiates the contact with the client. The client doesn't have to make a request: He only needs to start his X-Server on the right display port is necessary.

On server:

Edit the file

```
kde_rootdir/share/config/kdm/Xservers
```

enter the following line:

```
XTerminalName:2 foreign
```

where XTerminalName=Client Host name or IPNr.

The client uses the command:

```
X :2
```

gdm XDMCP configuration

Use the program

```
gdmconfig ---> Expert sub-menu ---> Activate XDMCP
```

or

Edit the file `gnome_rootdir/gdm/gdm.conf`

Enable the Xdmcp:

```
[xdmcp]
Enable=true
```

1.110.4 Install & Customize a Window Manager Environment

Description: Candidate should be able to customize a system-wide desktop environment and/or window manager, to demonstrate an understanding of customization procedures for window manager menus and/or desktop panel menus. This objective includes selecting and configuring the desired x-terminal (xterm, rxvt, aterm etc.), verifying and resolving library dependency issues for X applications, exporting X-display to a client workstation.

Weight: 5

Key files, terms, and utilities:
```
.xinitrc
.Xdefaults
xhost
DISPLAY  environment variable
```

Window manager

The window managers allow application windows to be moved, resized or iconified. Most display a window title bar, some also display a menu system or allow drag-&- drop between applications. The window manager is normally started from the `~/.xinitrc` as the last program to get stated and should be started using the `exec` command or put it in the background(&).

Common window managers:

Simple window managers:

> twm, mwm, fvwm2, qvwm, olwm

More feature full window managers:

> kde, gnome, windowmaker, blackbox, Enlightenment, openbox,
> icewm, icewm-themes, ice-default
> metacity, metacity-themes
>
> xfce-desktop, xfwm4, xfce-panel, xfce-panel-plugins

Configuration files of window managers:

> Many window managers have a default system configuration file located in:
> `/usr/X11R6/X11/WinManagerName/` directory.

Different for each one but most seem to have a `.xxxxrc` format. They are normally in the $HOME directory. Examples:

```
.mwmrc
.fvwm2rc
.olwmrc
etc.
```

Starting an X-Window session

Starting an X session with `startx`

An X-Window session including a window manager can be started in 2 ways:

- **`startx`** written in a non-graphic console after successful login.

`startx` in turns starts `xinit`.

`xinit` starts:
- the X Server
- starts the `xinitrc` script file: `$HOME/.xinitrc` if found
- otherwise `/var/X11R6/lib/xinit/xinitrc`

eg.

`startx`	Starts the default window manager for the X-Window session.
`startx -- :2.0`	Starts an X-Window session with the default window manager but using the display port :2.0
`startx windowmaker`	Starts an X-Window session with Windowmaker as window manager.
`startx blackbox -- :4`	Starts an X-Window session with BlackBox as window manager using display port `:4`

The `startx` script will start `xinit` which runs the following files.

`$HOME/.xinitrc`   if found otherwise

`/etc/X11/xinit/xinitrc`

The purpose of the `xinitrc` is:
- Define the keyboard key definition's contained in the files:
  `/etc/X11/Xmodmap`   and   `~/.Xmodmap`
- System wide and private X11 resoucses will be loaded:
  `/etc/X11/Xresources, ~/.Xdefaults` and `~/.Xresources`
- Start of some x-Programs
- Start of the desired window manager.

Starting an X session with a Display Manager

- The user login is done graphically.
  The display manager is started at boot time (runlevel 5) in the background as a daemon and provides graphical logins to users.

  Note: For this we need to make sure that default runlevel is set to 5 in
  `/etc/inittab`

Starting the Display Manager (xdm/kdm/gdm)

The display manager is normally automaticaly started at boot-up if the the default runlevel is considered a runlevel that starts it. The standard is runlevel 5:

Not all Linux distributions are using this run level here are some examples:

Distribution	Runlevel without DM	Runlevel with DM
SuSE till 7.2	2	3
SuSE from 7.3	3	5
RedHat	3	5
Slackware	3	4
Debian	2	3

When the Xsession is started via a Display Manager, both of the following scripts are run:
`/etc/X11/xdm/Xsession` then `~/.xsession` (if it exists).

Note: Some distributions are running the `~/.xinitrc` from `Xsession` to keep the same environment consistent.

X-server display name:

Each time an X-program starts, it need to know with which X-server (Display Name) it needs to communicate. Unless its command line contains this display name, (eg. `-display DisplayName`), it will use the content of the environment variable 'DISPLAY' as Display name. Without any Display Name available the X-program will not start.

The display name is in the format:
     `[Hostname]:Port[.Screen]`
`Hostname` and `Screen` are optional parameters:
The default for `Hostname` is the local X-server.
The default for `Screen` is first graphic card.

Here are 2 ways to prepare this variable:
(Both examples below have the same effect on the `xterm` X-program)
eg.   `DISPLAY=ruby.linux.site:2.0 xterm`

or   `export DISPLAY=ruby.linux.site:2.0`
      `xterm`

Configuration of X Clients (X programs)

Many X clients (X programs) are storing their user's configurations in the home directory (`~/.appname`) and in case it is not present it uses the default values contained in : `/usr/X11R6/lib/X11/app-defaults`

File format for resources files:

     The file **~/.Xresources**

     `X-ProgramName*attribute: value`

  Example: (commented lines start with a '!')

```
xterm*background:     LightYellow2
xterm.eightBitInput: true
!xterm*font: -adobe-courier-bold-r-normal--14-140-75-75-m-90-iso8859-1
```

These parameters can be overridden by starting an X-Program with arguments.

```
xterm -fn 9x15bold -geometry 100x40+30+40 -bg LightYellow2 \
        -T "Test_Xterm" -sb -rightbar
```

User controlled settings:

X-Server can also be controlled to provide certain configurations when X-client programs are started using the ~/.Xresources file.

Note: In SuSE ~/.Xresources is a symbolic link to ~/.Xdefaults

Sequence for reading resource files:

Global config files for each separate X-program are first read from the directory:
  /etc/X11/app-defaults/*

and then the

  ~/.Xresources

file is read. Any user- and machine-specific resources may be specified by setting the XENVIRONMENT environment variable to the name of a resource file to be loaded by all applications. If this variable is not defined, a file named ~/.Xdefaults-*hostname* is looked for instead, where hostname is the name of the host where the application is executing.

New changes in any of those 2 files will become active after restarting the X-Server or after executing the command:
  xrdb -merge .Xresources

The -merge option makes sure that the parameters that are not concerned by the content of .Xresources will stay active.

~/.Xresources **or** ~/.Xdefaults **file**

Note: in SuSE ~/.Xresources is a symbolic link to ~/.Xdefaults if it exists at all !!.

File syntax:

```
ProgramName*Resource: Value
```

Examples of Xterm settings in ~/.Xresources:

```
xterm*background:        LightYellow2
xterm*Foreground:        Blue
xterm.eightBitInput:     true
xterm*multiScroll:       on
xterm*jumpScroll:        on
xterm*font:              -adobe-courier-bold-r-normal—14-140-75-75-m-90--
xterm*ScrollBar:         on
```

```
xterm*SaveLines:        2000
xterm*VisualBell:       true
xterm.eightBitOutput:   true
Xterm*geometry:         90x30
```

Actualizing changes made in the `~/.Xresources` file without restarting the X Server:

```
xrdb -merge .Xresources
```

Note: Some programs like xterm allows to change the fonts dynamically and quickly by using: `CTRL-RightMouseButton` over the `xterm`'s window.

Keyboard keys definition

The program `xmodmap` is used to set the keyboard keys definitions after X has been started.
The keyboard mapping files are normally located in:

`/usr/X11R6/lib/X11/Xmodmap`	Default keyboard key mapping definitions. (SuSE: this is a symlink to `/etc/X11/Xmodmap`)
`/etc/X11/Xmodmap`	Extra definitions modifying the default settings.
`~/.Xmodmap`	User's mapping definitions.
`/etc/X11/Xmodmap.remote`	Default keyboard key mapping definitions for remote X programs and terminals.
`/usr/X11R6/lib/X11/XKeysymDB` `xev`	Keycodes database used for `Xmodmap` files. Program to get the keycodes of keyboard keys under X Humm .. doesn't work under SuSE 9.3

X-Color definitions

The X-server color definitions database used by applications can are found at:
`/usr/X11R6/lib/X11/rgb.txt`
The program `xcolors` (SuSE package `xcolors`) can also be used to display and test colors and get their names.
The X-server's colors definition database can be defined in `/etc/X11/XF86Config` file under section `[Files]` as eg.
`RgbPath        "/usr/X11R6/lib/X11/rgb"`

Configuration of X Clients / X programs
(on the command line)

Many X Clients will accept many of the following X11 standard parameters:

```
xterm -T "Title" -fn 9x15 -display :0 -geometry 100x40+30+40
```

-display

This option allows to set the destination display(X-server) on which the xterm will appear and be controlled.
Syntax:
```
-display [Hostname]:Port[.Screen]
```
Hostname and Screen are optional parameters:
The default for Hostname is the local X-server.
The default for Screen is first graphic card.

This value can also be replaced by the content of environment variable DISPLAY.
eg. `DISPLAY=[Hostname]:`*`Port[.Screen]`* `xterm`

or   `export DISPLAY=[`*`Hostname`*`]:`*`Port[.Screen]`*
     `xterm`

-geometry

This option positions and sizes the window when starting an X Client

Syntax: `-geometry <Hsize>x<Vsize><Hpos><Vpos>`

<Hsize> is numbered in Horizontal characters   (Dependant on character size)
<Vsize> is numbered in Vertical Lines   (Dependant on character size)

<Hpos> '+' is right, '-' is left (in screen pixels). E.g. +10 is right 10 pixels

<Vpos> '+' is down, '-' is up (in screen pixels). E.g. +10 is down 10 pixels

Examples: `-geometry 1x1+0+0`   1 char Horiz, 1 char Vert, top left corner

`-geometry 5x20-10+30`

5 characters wide horizontally,
20 characters tall vertically,
Positioned from top right corner
10 pixels horizontally to the left
30 pixels down vertically
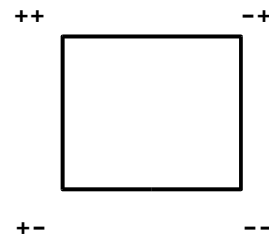
Note: The geometry can also be set for individual X clients by editing `~/.Xresources`.
Example:

`Xterm*geometry: 90x30`

Getting information about an existing window:

   - Start an X-terminal program as user
   - Run **xwininfo** in the terminal
   - Click over the desired window
   - Read the information in the terminal

Selecting a font for X Clients

-fn fontname

Specifies a font to use in the window

Short list of some fixed-sized fonts:

```
7x14  6x10  6x13   8x13  9x15  10x20 12x24
```

eg.
```
xterm -fn 10x20
```

or

```
xterm -fn -misc-fixed-medium-r-normal--20-200-75-75-c-100-iso8859-1
```

Note: Fonts can also be set for individual X clients by editing `~/.Xresources`

```
Xterm*font: 90x30
```

-bg backgroundColor
-fg foregroundColor

```
xterm -bg blue -fg bisque2
```

X11 on the network

Preparing the X Client

Since almost all X Client programs can use the argument -display :xx, we can start a client program and send its output to any existing X server that will allow the connection.

All X Client programs need to know where the X Server intended to host the program is located. This information is given to the program when we start it either via the above argument (`-display :xx.xx`) or via the environment variable DISPLAY.

To do so the following command prepares the content of this variable:
```
export DISPLAY=X-ServerHost:xx
```
then run the X client program.

Preparing the X-Server for access through network

For reasons of security, the X-Server by default will allow only the local user's programs to be displayed. For other users locally or hosts to be allowed to display their X-Programs programs on it, the X-Server needs to open it's security restrictions.

Two security authentication systems are available to X:
- Host Address based authentication : controlled by the command `xhost`
- Token authentification based. Controlled by the command `xauth`.

Host Address based authentication

The X-Server does not need any special options to have the Hosts Address based authentication.

Syntax:

```
xhost [+|-] ClientHostName/IP
```

Examples:

```
xhost + localhost
```

> Allows other users X-programs on the local host to connect to this X-server.

```
xhost +
```

> Allows everybody from anywhere to connect to this X-Server. Dangerous!!!

```
xhost + myfriend
```

> Allows the host `myfriend` to connect to this local X-Server.

```
xhost - bugger
```

> Take the host "bugger" out of the list of allowed hosts.

```
    xhost -
```
> Activates the access control mechanism and only the already listed hosts can connect.

Note 1: Only the owner of the X-Server process is allowed to issue the `xhost` command.

Permanently allowing access to an X-Server

There are 2 regular methods to permanently a list of hosts access to the local X-Server:

1. Edit the file enter the command `xhost` for all the hosts allowed in `~/.xinitrc` script, or

2. Create a file called `/etc/Xn.hosts` and enter all the hosts allowed to use the local X-Server. (n=X-Server display port number.)

Token Based Authentication

This authentication method works as a complement to the Host Address based Authentication method. This means that only the hosts that are not in the list of allowed hosts of the Host Address based Authentication method will be affected by this Authentication Method. We can see it like this: The Host Address based Authentication method sets the general rules of which hosts are allowed to connect to the X-Server and the Token based Authentication method sets the rules of who else from other hosts are also allowed. Normally the X-server will compare its tokens stored in the local user's `~/.Xauthority` file with the the incoming client's tokens. The incoming client's tokens are also taken from it's user's `~/.Xauthority` file. If one of them matches, the X-program of the user from the foreign host will be allowed to connect.

For the X-Server to use the Token Based Authentication, an option needs to be given to it when it gets started.
eg. `X -auth AuthenticationFileName`
or   `startx -- -auth AuthenticationFileName`

Fortunately the popular Display Managers like KDE or GNOME do take care of this.

To list the hosts and keys stored in the user's `~/.Xauthority` on his host:

    `xauth [-n] list`
    The option `-n` allows to see the real address of hosts written in the file.

Managing the Token Based Authentication

The incoming user's token file is also `~/.Xauthority` on his host. This way the local user's X-programs will always be allowed to connect since the local user's file used by the X-program is the same as the X-server's authentication file.

The program `xauth` is normally used to manage the Authentication token files.
It is better than editing the file by hand.
`xauth` alows to:

    add, remove, merge, generate and extract tokens to/from that file.
Syntax:

    `xauth add Host:Display Protocol TokenKeyValue`
    `xauth remove Host:Display`
    `xauth merge ExternalAuthFile`
    `xauth merge -`   ('-' means the STDIN)
    `xauth extract Outputfile Host:Display`
    `xauth extract - Host:Display`   ('-' means the STDOUT)
    `xauth -niv generate servername:0 .`

In the `add` function, the TokenKeyValue should be a large hexadecimal value of an even number of digits: eg.   `xauth add marty:0 . 6e7ac1d17814ca478fcf68236d2fb4cb`
Note: the dot ('.') as protocol means the standard MIT-MAGIC-COOKIE-1.

Tip: The 'generate' command is the best way to get the remote's X-server's key and store it in the user's `~/.Xauthority` in the client's host. For this to function, the remote X-server should allow temporary access of the client via the command:

    `xhost + ClientHostName`

So here is how it goes best:

- The user on the X-server side issues the command:
    `xhost + ClientHostName ServerHostName`
    (allows the client host to connect to the X-server to generate the key.)
    `xauth -niv generate ServerHostName:0 .`   (done only once)
    (The user generates it's own X-Server's key and stores it in `~/.Xauthority`)

- The remote client user the issues the command:
    `xauth -ni generate ServerHostName:0 .`
    (Connects to the remote X-server, gets the X-server's key and stores it in local user's `~/.Xauthority` file.
    Options: `n`=Do not resolve the X-server's address and store it as address
           `i`=Ignore the lock on the `~/.Xauthority` made from `kdm`
    the '.' at the end(as protocol) means the standard MIT-MAGIC-COOKIE-1.

- The user on the X-server side issues the command:
    `xhost - ClientHostName`
    (Access is again not granted to client unless he has the right key)

- The user on remote client host(and only this user) can now connect to the X-server. eg. `xterm -display ServerHostName:0`

Checking library dependencies for X-Client programs

In the matter of library dependencies, there is no difference between normal programs and X-Client programs. The program **ldd** does the job.

NOTE: The **ldd** program can also be useful to find out if an X-program is been written for the KDE or Gnome environment by looking at it's libraries dependencies.

eg.

```
ldd $(which kwin)
```

Glossary of Terms

This list contains the complete list of terms assumed by LPI tests. Knowledge of these terms will be important in preparing for LPI exams, but no exam question should depend on knowledge gleaned solely from this list.

Note that the list will be updated occasionally (so it is not yet exhaustive). If you have any additions or comments, please let us know.

The purpose of this list is to delineate the terms (jargon and acronyms) that will be used in the LPI Linux certification exams. Before writing or reviewing items, please review this list (and check it out periodically afterwards as updates occur).

Any jargon term or acronym which does not appear on this list, or is in the "deprecated alternatives" column, should NOT be used in an LPI test.

If this is not perfectly clear or if you need help deciding whether something is jargon or an acronym, please contact an appropriate LPI coordinator, the list maintainer or us.

Other useful and authoritative glossaries of terms can be found in these RFC's:

RFC1208: A Glossary of Networking Terms

RFC1983: Internet User's Glossary

RFC2828: Internet Security Glossary (also see `http://freesoft.org/CIE/RFC/Orig/rfc2828.txt`)

For explanation of PC hardware components, see:

http://www.pcguide.com/ref/

Term	Deprecated Alternatives	Comment
*NIX		A term for any operating system resembling UNIX(R)(TM), including Linux and a large number of free and commercial systems; also UN*X.
10Base2		So-called Thin Ethernet, using RG-58 coax cables and BNC connectors to construct a chain of cables, which must be terminated by resistors; supports a maximum (theoretical) transmission of 10 Mbit/s.
10Base5		The older Thick Ethernet, which used vampire taps into a single cable; supports a maximum (theoretical) transmission of 10 Mbit/s.
10BaseT		Ethernet over UTP cables, using hubs to produce a star topology; supports a maximum (theoretical) transmission of 10 Mbit/s.
100BaseT		Ethernet over UTP cables, using hubs to produce a star topology; supports a maximum (theoretical) transmission of 100 Mbit/s.
access		To connect to and utilize a device (computer, printer) or file.
account		The symbol or number that refers to a user for accounting purposes.

Glossary of Terms

Term	Deprecated Alternatives	Comment
address [1]		A location in memory; specifically, the I/O-port used by a device to communicate with the processor.
address [2]		A unique identifier assigned to an interface on a network-attached device such as a network interface card. Notice: a host can have multiple interfaces, hence multiple addresses.
address [3]		The name|number|both given to a computer, device or resource so it can be identified, found and accessed on a network.
administer		(to make it work. ;-) To control the operation and use of a computer or other device; the task of a system administrator.
algorithm		A formal description of a procedure that, when suitable input is entered, will generate output as a result that satisfies specific requirements.
alias [1]		Within a shell, a substitute word for a command string (e.g.: alias dir = "ls --color").
alias [2]		An additional IP address on an interface.
alias [3]		Refers to another name given to an e-mail account, in order to accept mail for one e-mail address and forward it to another.
ALT		the Alternative key on a keyboard
analog		Refers to a physical measure that can take any value within a continuous range; e.g., the voltage used to encode loudness when transmitting a signal over a conventional copper telephone line. cf. digital.
ANSI	American National Standards Institute	A standards body responsible for many protocols.
API	Application Programming Interface	A specification which allows simple access to functionality of a library or other system resources when writing a program; operating system functionality is made available through an API.
application		A program that runs on top of an operating system.
application layer		The name of the top layer of both the seven-layer ISO/OSI model, and the four-layer TCP/IP protocol stack; although some of the functionality of the session and presentation layers of the former may be assigned to the latter. It includes protocols such as telnet, FTP, HTTP, SMTP, etc.
archive [1]		A backup of data to be preserved.
archive [2]	tarball	A file that contains one or more components and an index (e.g. in tar, cpio, rpm or deb format).

Glossary of Terms

Term	Deprecated Alternatives	Comment
argument		A piece of information passed to a command or function (usually typed in behind it), that modifies its behaviour, or that is operated upon by the command or function. e.g. in `cat motd`, "motd" is the argument. cf. parameter.
ARP	Address Resolution Protocol, arp	See RFC826. A low-level protocol which, given an IP address on the local network, returns the Ethernet MAC address of the corresponding interface. cf. RARP .
ASCII	American national Standard Code for Information Interchange	A specification of characters widely used in the UNIX world and beyond.
aspect ratio		The ratio between the width and the height of a pixel on a computer display.
assembler		A program that compiles programs written in assembly language into object code.
assembly language	assembler	A low-level computer language that can be translated directly to the object code of the computer processor.
ATA	AT Attachment	A popular 16-bit interface standard that extends the ISA bus of the IBM PC-AT to attach peripherals; it has evolved through over 5 generations; the original ATA is better known as IDE.
ATAPI	AT Attachment Packet Interface	An enhancement of the ATA protocol to be able to connect CD drives etc.
Authors	Super heroes, men and women of gold	This list was compiled by (in alpha order): Les Bell, David DeLano, Alan Mead, Tom Peters, Richard Rager.
background [1]		A state of process execution which does not produce output to the terminal (execution may stop if the process tries to write to the terminal); it is common to run system processes and long running user applications in the background; cf. foreground [1].
backup [1] (noun)		A copy of essential data stored on- or off-site as insurance against failures of system hardware, software or user.
backup [2] (verb)		To make a backup.
binary [1] (adj)		taking two discrete values (e.g. bits), as opposed to decimal (= taking ten discrete values).
binary [2] (noun)		A file that is not intended to be read by humans but by applications or the operating system; especially in plural ("binaries") for compiled sources; cf. text.

Glossary of Terms

Term	Deprecated Alternatives	Comment
BIOS	Basic Input/Output Operating System	A simple, low-level operating system which supplies a uniform API to higher-level operating systems; BIOS is generally implemented in ROM of some sort.
bit		The smallest entity of information: can have one of two states (0-1, on-off, open-closed, etc.).
bitplanes	bit planes, bit-planes	The number of bits available for each display pixel to code for visual appearance (color, proximity, etc.).
block device		A device that exchanges data with the operating system in sizable blocks (e.g., 512 bytes) at a time.
boot loader		Software, usually installed on the MBR of Intel machines, which exists to load the operating system kernel and begin its functioning.
boot		To cause the operating system to begin to function. Takes its name from "pulling oneself up by the bootstraps", a whimsical analogy applied to the BIOS loading itself and then running the "boot loader". (Also reboot).
BOOTP		See RFC951; cf. DHCP .
bridge		A device that propagates packets between two computer networks; it operates at the second, data link layer within the ISO/OSI model, and broadcasts packets based on the address, but does not do routing. cf. repeater, router.
broadcast (noun)		A frame or datagram addressed to all interfaces on a network.
BSD	Berkeley Systems Distribution	A variant of UNIX originally developed at the University of California, Berkeley. The BSD TCP/IP stack is the model for most subsequent TCP/IP implementations.
buffer		temporary storage; cf. cache
BUGTRAQ		A mailing list for discussions regarding network security (daemons, programs, operating systems, routers).
build		To run a sequence of compile and link steps to produce a new version of an executable program.
bus		A cable for transmitting signals between various components within one computer system.
byte		A data type of 8 bits.
C		A compiled computer language closely associated with UNIX.
C++		An object-oriented computer language derived from C, that needs a compiler.

Glossary of Terms

Term	Deprecated Alternatives	Comment
cache		Any readily accessible storage area used to keep data handy which is (somehow) indicated to be needed again shortly; the purpose being to speed up the access of that data and improve system performance. Specifically: the fast computer memory that is used as a buffer for data and program instructions between the CPU and the slower main memory (cf. RAM).
caching-only DNS		A domain name server that does not have any domains files.
Caldera OpenLinux	Caldera, OpenLinux, CSOL	A commercial Linux distribution.
card		Any device that can be plugged into a computer expansion slot.
CD-ROM	Compact Disc Read Only Memory	A removable medium of considerable popularity which comes in several variations, the most popular being ISO9660.
CERT	Computer Emergency Response Team	A team of people that study Internet security, and provide incident response services; see http://www.cert.org/
cf.		"confer", which means "consult" in the meaning of "also see" or "compare". N.B.: Avoid this. Use only in parenthetical examples (cf. e.g., i.e.) but avoid "cf." by putting examples in text like this. Also see "e.g.", "i.e.".
CGI	Common Gateway Interface	A standard for allowing server applications to be executed as part of a HTTP request.
CHAP	Challenge Handshake Authentication Protocol	
char	character	C data type (usually one byte) used to store letters (cf. character).
character	char	A letter or sign usually represented by 1 byte in ASCII code.
character device		A device which exchanges data with the operating system in one character (or byte or even word) at a time.
child process		Any process created by another, so-called parent process; usually used in reference to a particular parent process.
CIDR	Classless Inter-Domain Routing	See RFC1519; cf. variable length subnet mask
CIFS	Common Internet File System	Microsoft's successor to SMB, a suite of protocols for sharing file and print services (among Windows machines or UN*X machines running CIFS servers like Samba).

Glossary of Terms

Term	Deprecated Alternatives	Comment
clean		In reference to a drive being mounted, clean means that the drive was unmounted properly and thus (theoretically) does not need to be checked; otherwise a drive is dirty
client		A computer or process which connects to and receives a service from a server computer or process.
coax	co-axial cable	Cable with inner and outer conductors used for TV cables and for Ethernet LANs, where the computers usually have T-joints to attach to a single chain of cables which needs to be terminated by resistors.
colormap	color map, color-map, color table	A table used to encode a palette of colors for images.
command line interface	CLI	An interactive user interface which allows commands to be given to a computer program or shell through a text-based terminal (or terminal emulator in a window within a graphical user interface).
compiler		A program which examines program source code and translates it into an equivalent object code file; cf. interpreter.
compression		Removal of redundant information from a file or data stream, to reduce its size, the storage space it needs, or the time needed for transmission. Lossy compression actually discards information that is considered not essential, and is only appropriate for data like images or sound.
computer		A digital, electronic, general-purpose, programmable, information processing automate.
console		The primary, directly attached, user interface of a computer. Some system administration functions may only be performed at a console.
control panel		A collection of buttons, switches, lights or display used to configure and control a router, printer, computer or other device.
core dump	coredump	The content of memory written to a file on disk (usually called "core") when a program crashes.
corrupted		damaged (said of a file or disk contents)
CPU	Central Processing Unit	The main component that makes a computer work; these days usually a "micro-processor" on a single silicon chip (cf. processor).
crack		To gain access to a computer system without proper authorization (e.g. by guessing a legitimate user's password), and possibly interfere with its normal operation or integrity.
cracker [1]		Someone who tries to crack; cf. hacker.

Glossary of Terms

Term	Deprecated Alternatives	Comment
cracker [2]	crack	A software program used to crack, for instance by guessing passwords.
crash		A sudden stop of normal operation. Supposedly, the original hard drives would sometimes experience a catastrophic failure in which the read/write heads would crash into the media, possibly sending the media flying; hence a crash is a unintentional termination of software or hardware due to some failure or error - especially a termination in a final, catastrophic, or unpleasant way.
CSLIP	Compressed Serial Line IP	SLIP with added VJ compression of IP headers. See RFC1144.
CTRL		the Control key on a keyboard
current working directory	cwd	
cylinder		A number of tracks located at the same radius on the several surfaces of a hard disk. A hard disk with four platters has eight surfaces, so that at each position of the read-write heads, eight tracks can be read without head movement and these eight tracks form a cylinder.
daemon		A program that runs in the background to offer system services.
data		"that which is given", for instance as input to a computer; cf. information.
data link layer		Layer two of the ISO/OSI seven-layer model. Responsible for establishing an error-free communication path between network nodes over the physical link layer, it frames messages for transmission, checks the integrity of received messages, manages access to and use of the media, and ensures proper sequencing of transmitted data. These functions are generally provided by a network card driver. The IEEE in its 802.x series of standards splits this layer in two: the LLC layer and the underlying MAC layer.
database [1]		A usually large collection of ordered and readily accessible data.
database [2]		A program to manage a database and extract information from it.
datagram		packet, especially as used in UDP (Note: not IP-specific - other protocols use the term datagram in their documentation).
Debian	DEBorah & IAN (Murdock)	A GNU/Linux distribution built by a volunteer organization.

Glossary of Terms

Term	Deprecated Alternatives	Comment
default		The value of a parameter that a program uses if it is not explicitly given a value.
DEL		the Delete key on a keyboard
delete		remove or erase a file|character|directory .
dependency		A state in which other libraries|programs|packages are required to make a program work.
DES	Data Encryption Standard	A USA government-sanctioned standard for the encryption of data now considered insecure to high-end brute force attacks.
desktop		The screen from which all programs are started and run on X.
device [1]		A "peripheral" piece of hardware that is an optional part or can be attached to a computer (even one that is actually housed within the computer's casing): interface cards, drives, printers etc.
device [2]		The software interface used within Unix (Linux) to represent a computer peripheral: interface cards, drives, printers, etc.; see the /dev/ directory .
DHCP	Dynamic Host Configuration Protocol	Provides for automatic downloading of IP address and other configuration data from a server to a client. Allows for reuse of IP addresses so that the number of hosts can exceed the number of available IP addresses. See RFC2131, cf. BOOTP.
dial-in, dial-up, dial-out (adj)	Refers to a connection made over the Public Switched Telephone Network (PSTN), as opposed to a permanent, or leased-line, connection.	
die		To cease execution, especially in a final or complete manner.
digital		Refers to an entity that can assume only a limited number of discrete states and not an arbitrary value; e.g. binary. cf. analog.
directory		A special type of file which contains information about other files, such as file name, location, permissions, size etc.
dirty		not clean
disk		Rotating magnetic media which supports direct or random access; cf. floppy disk, hard disk.
display	screen	A human readable device to display text, graphics or other data.

Glossary of Terms

Term	Deprecated Alternatives	Comment
distribution		A (usually) complete collection of software needed to operate a computer including the Linux kernel and various utilities and applications.
DMA	Direct Memory Access	A hardware protocol which allows a special controller circuit (DMA controller) to transfer a block of data from a peripheral device's buffer memory directly to main memory without CPU involvement; cf. PIO.
DNS	Domain Name System	A hierarchically-structured distributed directory service which translates human-intelligible names like www.lpi.org into the corresponding IP addresses. See RFC's 1034 and 1035 and also 1032 and 1033.
documentation		
domain name server	DNS, nameserver	
domain [1]		One or more computer networks that serve an organizational group.
domain [2]		The name assigned to a network domain.
drive		Any device that can store and retrieve data in a relatively permanent fashion on media (which may be removable or built into the device).
driver		
dynamic		
e.g.		"for example" (Latin: "exemplum gratii"). N.B.: Avoid this. Use only in parenthetical examples (e.g., like this) but avoid "e.g." by putting examples in text like this. Do not confuse with "i.e.". Also see "cf.".
editor		
EIDE	Enhanced IDE	Western Digitals proprietary extension of the IDE interface standard with ATA-2 and ATAPI features, used to connect hard drives and CD-ROMS to a PC.
e-mail	email, electronic mail	
emulate		To simulate the actions of a device or program so that the simulation can actually perform the same functions as the original.
emulator		A program that emulates the functions of some device or other program.
environment		A collection of variables associated with a process so that it knows about the user preferences and configuration of the system; they are inherited by a child process.
environment variables	envars, environmental variables	The variables that define an environment.

Glossary of Terms

Term	Deprecated Alternatives	Comment
ergonomic		easy to use by humans
ESC		the Escape key on a keyboard
Ethernet		A type of LAN computer network interface using coax (10Base2 or 10Base5) or UTP cables (10BaseT or 100BaseT). The specifications are described in IEEE standard 802.2 . cf. MAC.
event		
execute		To set to work (a program); cf. run.
execute permission		Permission set on a file on a Unix filesystem so that it may be run as a program by the "operating system.
executable		A file that is a binary or a script that can be run as a program (may assume execute permission).
export		
FAT	File Allocation Table	A simple filesystem using a table to index files on a block device (floppy or hard disk). It comes in the varieties of FAT-12 (MS-DOS), FAT-16 (MS-DOS, MS-Windows 3.x) and "FAT-32" (MS-Windows 9x).
FHS	Filesystem Hierarchy Standard	A proposed standard for the location of files on a Unix system. See http://www.pathname.com/fhs/.
file		A named sequence or stream of bytes at a known location in storage.
filesystem	file system	The data structures placed on a logical disk or partition (by mkfs) which allow the operating system to record information about files stored there.
filter		To remove unwanted data.
firewall		A gateway that restricts data communication between the "inside" network and the Internet "outside" the firewall.
floating-point (adj)		used with numbers that may represent a fraction; cf. integer
floppy disk	floppy, diskette	A magnetic storage medium with a flexible disk inside; cf. hard disk.
floppy drive	floppy	A device that can read and write floppy disks.
font		The shape of each of the letters in a character set.
foreground [1]		The context in which a process is having access to a terminal for output, i.e. is not running in the background.
foreground [2]		The color of text on a computer display (as opposed to the text's background).
foreground [3]		Refers to the window 'in front of' all others and with which the user is interacting.

Glossary of Terms

Term	Deprecated Alternatives	Comment
fork (verb)		When an executing process creates an exact executing duplicate (except for the different PID) of itself; see child process, spawn.
format [1] (noun)		Specification regarding how data are stored.
format [2] (verb)		To apply the requisite format to storage media in preparation to making a filesystem.
forwarding		The act of receiving an e-mail and then resending it to another destination.
frame		A packet as assembled and transmitted over the physical layer of a network (e.g. Ethernet, Token Ring, etc.).
free [1]		Not costing anything.
free [2]		Not inhibited. As applied to source code it allows modification, study and adaptation, not inhibited by excessively restrictive commercial license terms. cf. GPL, Free Software Foundation.
FSF		Free Software Foundation: a tax-exempt charity that raises funds for work on the GNU project; see http://www.fsf.org.
FSSTND	FileSystem StaNdarD	A standard for the location of files on a Linux system; replaced by the FHS.
FTP	File Transfer Protocol	A protocol for transferring files over the Internet and the software to accomplish the transfer. See RFC959.
gateway		A device or relay mechanism that connects two or more computer networks and which directs packets between the networks in an internet. In common usage today, a gateway is a general-purpose computer with a general-purpose operating system [e.g. Linux] which *may* be performing other functions, and in that role it operates at the third, network layer in the ISO/OSI model; while a router is a special-purpose computer with a special purpose operating system [e.g. IOS], generally from a specialist supplier [e.g. Cisco]. cf. bridge.
GB	giga-byte, gigabyte, Giga-Byte, GigaByte, Gb	1000 (or rarely 1024) MB (1,000,000,000 or 1,048,576,000 or 1,073,741,824 bytes)
GID		Group ID
global		A variable, configuration section, procedure etc. having a scope which is unlimited (i.e., applies everywhere unless contradicted locally)
GNU	GNU's Not Unix	A Free Software Foundation project to build Unix (R)(TM)-compatible utilities and programs exclusively based on free program source code.

Glossary of Terms

Term	Deprecated Alternatives	Comment
GPL	General Public License	A license for distribution of free software which permits copying, modification and redistribution. It was created by the Free Software Foundation for its projects like GNU, and has been applied to Linux as well. See http://www.gnu.org/copyleft/gpl.html
graphics		images, pictures; in contrast to text
graphical user interface	GUI	An interactive interface using a graphics display. N.B.: refer to a "graphical user interface" only if there actually is a graphical interface (like X), and do not use it for interactive programs on text terminals (based on ncurses or slang). Use "interactive interface" as a catch-all. cf. command line interface.
group		Refers to a list of one or more users having the same access rights; see /etc/groups .
hack		To accomplish a result in an unorthodox way.
hacker		Someone who hacks: a title assigned to people with remarkable computing skills; cf. cracker.
hang		cf. crash
hard disk		A computer device that uses solid disks as magnetic medium to store data. cf. floppy disk.
hard link		In Unix filesystems, an entry in a directory that points to a file in another directory on the same disk or partition, and shares the inode of that file; cf. symbolic link.
hardware		All physical parts making up the computer ("the parts that can be kicked" ;-)
HDLC	High-level Data Link Control	ISO/IEC 3309 standard; relevant in PPP.
high-level (adj)		Refers to a computer language with a higher level of abstraction from the computer architecture than a low-level language.
host		Any computer attached to an IP-based internet, especially computers that can act as a server to a client program or computer.
HOWTO		A series of documents, each on a particular topic, which form a significant portion of the documentation for Linux. HOWTO's originated with, and are generally published by, the Linux Documentation Project.
HTML	HyperText Markup Language	A standard for specifying the structure of a document indicated by tags in the document text; used on the World Wide Web with HTTP.
HTTP	HyperText Transfer Protocol	The succession of application layer protocols used for communication between a WWW browser and a WWW server. See RFC2616.

Glossary of Terms

Term	Deprecated Alternatives	Comment
hub		Generally, a device connected to several other devices; specifically in computer networks, a repeater in the center of a network with star topology, usually with 10BaseT or 100BaseT Ethernet.
i.e.		"that is" (Latin: "id est"). N.B.: Avoid this. Use it only in parenthetical asides (i.e., asides like this one) and then only to clarify a point. Do not confuse with "e.g.". Also see "cf.".
I/O	Input/Output	
ICMP	Internet Control Message Protocol	A required protocol (RFC792) for the notification of errors between gateways and hosts on IP-based internets. It operates at the level of the IP protocol in the internet layer. Interestingly, although ICMP is required (*must* be implemented), hosts and gateways are not required to generate ICMP messages, and hosts are not required to respond or react to incoming ICMP messages (in fact, mostly, they don't, relying on higher-level protocols like TCP to simply time-out and retransmit, so you can't say that ICMP _handles_ errors). Also, because IP is a packet-oriented connectionless protocol, there's no concept of duration of transmissions.
ID		IDentifier
IDE	Integrated Drive Electronics	A popular interface to attach hard drives to PC's, where the electronics of the controller are integrated with the drive instead of on a separate PC card; also see ATA.
Integrated Development Environment	IDE	A programming environment integrated into an application; rare on Linux.
idle		inactive; waiting for a task or a wake up call
IEEE	Institute of Electrical and Electronics Engineers	USA based, international organization of professional engineers; also an important standards body
IMAP [1]	Interactive Mail Access Protocol	See RFC1203
IMAP [2]	Internet Message Access Protocol	See RFC2060 on IMAP4 (beats me why there's two names for the same thing, with the same acronym yet).
implement		To create an actual object (program, device) that conforms to abstract specifications.
include file		A file which contains constants and parameters, possibly shared between two or more programs, and included into the source code when these programs are compiled.
information	info	Something worth knowing, in contrast to just plain data.

Glossary of Terms

Term	Deprecated Alternatives	Comment
inode		In Unix filesystems, a block of administrative data for a file on the disk partition.
input		Any data that are entered into a running program, or into a file.
install		Transferring a new program to a computer's permanent storage (e.g., hard disk) and performing any necessary configuration or administration.
integer		A data type used to represent a whole (integer, non-fraction) number within a limited range.
integrity		correctness
interactive		Adjective, meaning: having the property to be able to interact, i.e. respond to stimulation from the outside. Used in the context of programs or interfaces.
interactive interface	CLI and|or GUI	An interface between a computer and a user which allows them to interact and exchange input and output (commands and data).
interface		A connection (through a hardware device or through a software program) between different components of a computer system (usually performing some kind of translation between protocols internal to the components); used especially in the contexts of network communication, or communication between computer systems and their users.
Internet	internet, (the) net	The worldwide distributed network of computers linked by the Internet Protocol.
internet layer		The network layer in the TCP/IP protocol stack: this alternative name may be used to distinguish it from the underlying network access (physical) layer. cf. Internet Protocol.
Internet service provider	ISP, IAP, Internet Access Provider	A company which provides connections to the Internet.
interpreter		A program which examines a script or program source code and executes it, line by line; cf. compiler.
interrupt		
intranet		A network (usually a LAN) based on IP but, unlike the Internet, allows only restricted access.
invoke		induce execution of; call
ioport	address	The memory address peripheral devices use to communicate with the CPU; see /proc/ioports .
IP	Internet Protocol	The network layer protocol used on IP-based internets. See RFC791.
IRQ	Interrupt ReQuest	

Glossary of Terms

Term	Deprecated Alternatives	Comment
ISA	Industry Standard Architecture	An increasingly obsolete PC bus standard.
ISDN	Integrated Services Digital Network	A baseband protocol used by telephone companies to offer one, two or more B-channel (Bearer channel) lines of 64 Kbit/s each on a single copper pair of up to 5.5 km length. Each B-channel can be used to provide a high-quality voice line, or fax or data services.
ISO	International Standards Organization	One of several bodies which exist to promote standards, including computer standards.
job		A task which has been sent to the background or has been submitted for later execution.
k	K, kilo	a factor of 1000, but with computers usually 1024 (2^10)
KB	kilo-byte, kilobyte, kb, kB	1024 bytes
kbit/s	kilobit per second, kbps, Kbps, Kbit/s	Data transfer rate in units of 1000 bits per second.
Kbyte/s	kilobyte per second, kbps, Kbps, KBps, KB/s, kbyte/s	Data transfer rate in units of 1024 bytes per second.
kernel		The core of an operating system, which provides multitasking (process creation, interprocess protection, interprocess communication), memory management, and basic I/O management.
key [1]		A token which is used to encrypt plain text or decrypt cipher text in an encryption system.
key [2]		A database field which may be used as the basis of a query.
key [3]		A marked switch on a keyboard which used to be a common computer input device before they were eaten by mice ;-).
keyboard		An input device having many keys marked with letters and other symbols.
LAN	Local Area Network	A small network, usually with one or a few segments, which supports broadcasting and direct connections between hosts; e.g. Ethernet, Token Ring, Appletalk and ARCNet; cf. WAN.
LDP	Linux Documentation Project	
library		A collection of (often related) subroutines to be linked to a program.
LILO	LInux LOader	A boot loader: a program that loads the kernel so Linux can boot; can also boot other operating systems.

Glossary of Terms

Term	Deprecated Alternatives	Comment
link		To bind a program to the subroutines it references (calls). These are typically located in object modules or libraries.
Linux	Linux Is Not UniX?	A Unix-like operating system first developed, still maintained by, and named after Linus Torvalds. It is freely available under the General Public License. But if you didn't know all that already, what are you doing here?
LLC	Logical Link Control	An IEEE network standard (#802.2) that fits within the ISO/OSI Layer 2: data link layer, on top of the MAC sub-layer. It deals with error detection, flow control, and frame formats.
load		To transfer from disk into memory.
local		within easy reach, on the local area network, not remote.
logfile	log	record of activities
	logic	In the jargon of electronics engineers: the electronic components and circuitry of a device. This use of the term should be avoided because of the confusion with the conventional meaning of: abstract formal reasoning, which is involved in computer programming.
login		
logoff		
logon		
logout		
loopback		
low-level (adj)		Refers to a computer language in which statements are similar to instructions for the processor (or: in which statements are more like object code than in a high-level language).
LPI	Linux Professional Institute	Non-profit organization founded to create a widely supported certification program for Linux; see http://www.lpi.org/
MAC	Media Access Control	A layer of IEEE network standards (#802.x) that fits within the ISO/OSI Layer 2: data link layer, below the LLC sub-layer. It deals with access methods, error detection, and transmission unit formats. Well-known IEEE MAC specifications are Ethernet in its various incarnations (#802.2) and Token Ring (#802.5?).

Glossary of Terms

Term	Deprecated Alternatives	Comment
Mail User Agent	message user agent, MUA, UA, user agent	An end-user program used to access, process, read, archive, compose and send e-mail messages. See RFC1711. Such e-mail programs often include some "MTA" functionality, in particular the ability to use SMTP to send e-mail to an outgoing mail server, and POP3 or IMAP4 protocol to download mail from an inbound mail server. cf. Message Transfer Agent.
maintain		
manual [1] (noun)		A document, often of book-length, discussing the design or operation of a software package or device.
manual [2] (adj)		by hand (as opposed to some more automated means)
man page	manual page	Standard Unix manual page (usually available on the computer system in nroff format, called with the command `man`).
masquerade		To pretend to be another host for the purposes of sharing one IP address among several local hosts hidden to the outside world for reasons of resource shortages or security. cf. NAT
MB	mega-byte, megabyte, meg, Mb	1000 (or sometimes 1024) KB (1,000,000 or 1,024,000 or 1,048,576 bytes).
Mbit/s	Megabit per second, Mbps	Data transfer rate in units of 1,000,000 bits per second.
MBR	Master Boot Record	An area of the outermost cylinder of a PC hard disk which contains the partition table. This contains four entries identifying the types, starting cylinder and sizes of up to four partitions on the hard disk. One of the entries is flagged as 'active'; this marks the partition from which the machine will boot. (Floppy disks don't have an MBR, since they don't have a partition table. Instead, they just have a boot sector (same as a logical disk), which contains a Media Descriptor Table (MDT) and bootstrap loader. The MDT describes the format of a floppy disk or logical disk).
media		The physical device by which data are transmitted or (more commonly) stored.
memory		The place where a computer stores data and|or programs for direct access by the CPU: RAM or ROM (and also cache memory), not disks.
menu		

Glossary of Terms

Term	Deprecated Alternatives	Comment
Message Transfer Agent	mail transfer agent, mail transport agent, message transport agent, MTA, MDA, mail delivery agent, message delivery agent	(by L.B.?) A program which routes e-mail based on the RFC822 header and invokes the correct delivery agent, especially SMTP (RFC821) in order to route the mail towards its ultimate destination. For example: exim, qmail, sendmail, smail. Also see RFC1711 and Mail User Agent. The term "Mail Transport Agent" is used in the online "Network Administrator's Guide" to refer to rmail, which, of course, is used to process incoming mail from UUCP before passing it onto sendmail. This usage is at least confusing, if not incorrect. On MDA (Message Delivery Agent): This one really has me going. I'm not sure whether it is: "A protocol, or its implementing program, responsible for transferring messages from one host to another. For example, SMTP."; or: "A program responsible for delivering mail to the correct user mailbox on a host. For example, sendmail." I've been researching this in my paper library and on the net for the last half hour, and have not come up with any consistent or reasonably definitive examples. Personally, but based on what evidence I can't remember, I lean to the first definition, but Aileen Frisch uses the second in her "Essential System Administration" book. Hold on - after a search at http://www.imc.org , I've discovered RFC 1711, which defines MTA and UA, but has no mention of (M)DA. I think this one is what we in Australia would call "a furphy". - Hence the use of "MDA" is to be AVOIDED.
mini-HOWTO		A slimmer, more focused document otherwise like a HOWTO.
modem	MOdulator/DEModulator	A device that converts between digital signals from the computer and analog signals for communication over a telephone line.
monitor		
mouse		An input device which allows pointing to, selecting and activating objects, usually displayed in a graphical user interface.
MS-Windows NT	NT, Windows NT	A 32-bit operating system from Microsoft(C)(R) (TM).

Glossary of Terms

Term	Deprecated Alternatives	Comment
MTU	Maximum Transfer Unit	Maximum size of an IP packet that will be accepted for transmission without fragmenting it into smaller datagrams. Usually an optimal size is determined automatically; typical sizes are 296 bytes (40 header + 256 data for phone lines), and 1500 bytes (the maximum for ethernet connections).
NAT	Network Address Translation	A generic description of the process whereby the IP address of a host on a private internet is translated into an IANA-assigned unique address on the wider Public Internet. This can be accomplished by several techniques: masquerading, circuit-level gateways such as SOCKS, transparent proxying or application-level gateways.
N.B.		"take good notice" (Latin: "nota bene").
NetBEUI	NetBIOS Extended User Interface	The current implementation of the NetBIOS protocol used in MS-DOS, MS-Windows and OS/2.
NetBIOS over TCP/IP		A layer of code which implements the NetBIOS API, but utilizing TCP and UDP datagrams, which are of course encapsulated in IP datagrams. Since IP is routable, this overcomes the most significant limitation of NetBIOS. See RFC's 1001, 1002, 1088.
NetBIOS	Network BIOS	A lightweight transport protocol developed by Sytek, IBM and Microsoft for use on personal computers. NetBIOS defines three things: the protocol on the wire (datagram formats); the code which implements the protocol; the API used to employ the protocol. The major example of an application which uses the NetBIOS API is Microsoft Networks, the workstation and server code implemented in MS-DOS 3.0 and later, OS/2 and various Windows incarnations - though other applications do exist. NetBIOS employs name registration and broadcast discovery, rather than addressing, and is consequently a non-routable protocol. cf. SMB, NetBIOS over TCP/IP.
netmask		network mask: the network part of an IP address; cf. variable length subnet mask
network		An interconnected set of hosts and other network devices which share a common physical layer such as Ethernet, X.25, etc.; cf. LAN, WAN.

Glossary of Terms

Term	Deprecated Alternatives	Comment
network access layer		The lowest layer of the TCP/IP protocol stack, also known as the "physical" or "hardware" layer. Consists of the cables, connectors and associated hardware such as driver chips to implement a network such as Ethernet or Token Ring, as well as the drivers for the hardware. It approximately spans the lowest two layers of the theoretical ISO/OSI network protocol stack: the physical and data link layers.
network interface card	NIC, Ethernet card, LAN adapter	An expansion board allowing a computer to access a network.
network layer		The layer of a network protocol stack that is concerned with addressing and delivery of datagrams across a network or internet. It is layer three in the IS O/OSI seven-layer model. In the TCP/IP protocol stack, the main network layer protocol is the Internet Protocol (IP); therefore this layer is also known as internet layer.
NFS	Network File System	A protocol (developed by Sun Microsystems) enabling a UN*X machine to mount a remote disk area as part of its local filesystem; widely considered of questionable security.
NIS	Network Information System	Protocols to provide network services (such as authentication) for NFS.
object code	machine code	Instructions that can be executed by the computer processor.
offline	off-line	not connected to a computer system or network; cf. online
online [1]	on-line	connected to a computer system or network; cf. offline
online [2]	on-line	stored on and accessible through a computer system or network
operating system	OS	Central set of programs that manage the various components and devices of the computer, and its interaction with application programs and users; e.g. MS-DOS, MS-Windows NT, MacOS, Unix, Linux.
OSI	Open Systems Interconnection	The concept of a "stack" of protocols (hence "TCP/IP stack" as in "This damn Microsoft TCP/IP stack is so broken...") is due to the OSI seven-layer model, even though TCP/IP has only about four distinct layers (certain layers are combined). See physical, data link, network, transport, session, presentation, and application layers (OSI model); network access, internet, transport, and application layers (TCP/IP stack).
outbound		
output		Any data that are generated by a process.

Glossary of Terms

Term	Deprecated Alternatives	Comment
owner		The account that has its UID number associated with a file.
package		A set of related files and programs; especially a single archive file (tar, rpm) that contains them.
packet		A quantum of data transmitted over a network; specifically: a unit of TCP traffic carrying the information necessary to deliver itself, especially using the UDP protocol (datagram).
PAP	Password Authentication Protocol	
parallel		Several bits at the same time, over time (over multiple wires).
parameter		A variable with a specific value that has a meaning or function, which belongs to a program function or command; cf. argument.
parent process		A process that started one or more other, so-called child processes.
partition [1] (noun)		An arbitrary region of a storage device (almost always a hard drive) created by partitioning software before data were stored. Specifically on IBM PC-compatibles: one of up to four distinct areas on a hard drive which can be dedicated to different operating systems. One of the partition types, "extended", supports further "partitioning" into a maximum of four logical disks.
partition [2] (verb)		To make a partition.
password		A token which authenticates a user at login time.
paste		
patch level		
path		
PC	Personal Computer	A computer designed to be used by one individual at a time; specifically, one compatible with the architecture of the original IBM microcomputer.
PCI	Peripheral Components Interface	A PC bus to connect cards to the processor, replacing the original ISA bus.
peripheral		A device that is an optional attachment to the core components of a computer (CPU and memory).
permission		

Glossary of Terms

Term	Deprecated Alternatives	Comment
physical layer		The lowest layer of the seven-layer ISO/OSI network protocol stack. Consists of the cables, connectors and associated hardware such as driver chips to implement a network such as Ethernet or Token Ring. The corresponding layer of the TCP/IP protocol stack is also known as "hardware" or network access layer and has a wider scope.
PID	process ID	A numerical identifier used to track processes by the kernel.
PIO	Programmed I/O	A technique whereby the CPU executes a tightly coded loop in which it copies data from a peripheral device's buffer memory and writes it back out to main memory; used with earlier versions of ATA, but replaced by DMA.
pipe		A data structure which connects a file handle in one process to a file handle in another; by convention stdout of one process to stdin of the next. Established on the shell command line by the '|' symbol.
pixel		picture element: a dot, a grid point on a computer display, the smallest entity that can be drawn on a computer display
PLIP	Parallel Line IP	IP protocol over a parallel cable (between two machines physically connected and not too distant).
PnP	Plug and Play	
POMS	Program Objective Management System	Set of Python scripts to offer a web-interface to manage the LPI test objectives. See http://www.lpi.org/cgi-bin/poms.py.
POP	Post Office Protocol	Protocol to retrieve mail from a mail server. See RFC1939 (POP3). Various software servers typically have names derived from 'pop' like ipop3d, ipop2d, and popper.
port [1] (noun)		The name given to an individual, numbered "slot" which is available to Internetworking software. For example, HTTP servers generally listen to port 80. See /etc/services ; also see ioport.
port [2] (verb)		To adapt a computer program to operate in a new computing environment and|or in a new programming language.
POSIX compliant		
Postscript		A page description language developed and marketed by Adobe Inc. Widely implemented in laser printers, especially where high-quality output is required (e.g. photo typesetters) and, under Linux, widely emulated in software for non-Postcript printers.

Glossary of Terms

Term	Deprecated Alternatives	Comment
PPID	Parent Process ID	The PID of a process' parent process (cf. PID, parent , child process).
PPP	Point-to-Point Protocol	A physical layer protocol (RFC1661) which can be used to encapsulate IP and other network protocols, making it an excellent way of extending LAN protocols to dial-in users. PPP comprises an HDLC-like framing protocol (RFC1662), a link control protocol, and a family of network control protocols, each of which corresponds to a network protocol which PPP can encapsulate. PPP can also use PAP or CHAP (RFC1994) for authentication.
presentation layer		The sixth layer of the ISO/OSI seven-layer model, which specifies character representation (e.g. ASCII) and graphics formats, such as NAPLPS (North American Presentation Layer Protocols). In TCP/IP, the presentation layer is subsumed into the application layer, but perhaps the closest equivalent standards are ASN.1, ANSI and HTML/XML.
priority		
process		A running program; an instance of program execution.
processor		The main component that makes a computer work; these days usually a "micro-processor" on a single silicon chip (cf. CPU)
program		A sequence of instructions for the computer that implements an algorithm, especially when stored in a file in the form of either directly-executable object code, or source code for an interpreter or compiler. When loaded into memory and executed, the object-code program typically becomes a process.
prompt		An indication produced by a shell or application program that it is ready for further user commands or input.
protocol		A definition of data structures and formats to be exchanged by two programs over a network.
proxy server		A computer process, usually as part of a firewall, that relays a protocol between client and server computer systems, by appearing to the client to be the server and appearing to the server to be the client (adapted from RFC2828).
queue		A data structure which implements a first-in, first-out list; e.g. print queue, which contains a list of jobs to be printed in order.

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Term	Deprecated Alternatives	Comment
RAM	Random Access Memory	Volatile, writable memory that a computer uses as its main memory. Comes in flavors like EDO, ECC, SDRAM, etc. which are not equivalent but from the perspective of a sysadmin are very similar under normal use. cf. ROM.
RARP	Reverse Address Resolution Protocol, rarp	A low-level protocol which, given a hardware (Ethernet MAC) address on the local network, returns the corresponding IP address. cf. ARP.
read permission		
README	readme	An important document that usually comes with a software package to call attention to important issues; usually has its name in capitals, so that it appears at the top of a directory listing.
Red Hat	RedHat, RH	A commercial Linux distribution.
redundant		superfluous; said of information in the contexts of compression, or the preservation of data integrity.
regular expression		A formal expression of a string pattern which can be searched for and processed by a pattern-matching program such as vi, grep, awk or perl.
repeater		A device that propagates signals between cables; in case of computer networks it operates at the first, physical layer within the ISO/OSI model, and does not do packet filtering or makes routing decisions. cf. hub, bridge, router.
resolution		
resource		
restore		
return		
RFC	Request For Comments	Despite the name, a "de facto" official specification of Internet protocols and standards. See http://www.rfc-editor.org/ or http://www.cis.ohio-state.edu/hypertext/information/rfc.html .
ROM	Read Only Memory	Computer memory, usually involving some enduring medium like a silicon chip or a burnt laser disc which can be read but not altered; this is inconvenient when the data can change and, just to be confusing, some special ROMs can be modified under certain circumstances. cf. RAM.
root [1]		The administrative account (UID 0) on a *nix system that has all privileges; cf. superuser.
root [2]		The top-most or first or originating node or object (e.g.: root directory, "/").
route [1] (noun)		The path across one or more networks from one host to another.

Glossary of Terms

Term	Deprecated Alternatives	Comment
route [2] (verb)		To examine the destination network IP address in a datagram, and by consulting a table, direct the datagram to the next router along the path to the destination, or to the destination itself.
router		A gateway which directs IP datagrams between networks in an internet; it operates at the third, network layer in the ISO/OSI model, and assumes that the address implies a particular path (the route) to reach the destination. In common usage today, a gateway is a general-purpose computer with a general-purpose operating system [e.g. Linux] which *may* be performing other functions; while a router is a special-purpose computer with a special purpose operating system [e.g. IOS], generally from a specialist supplier [e.g. Cisco]). cf. bridge.
RPC	Remote Procedure Call	
RPM	Red Hat Package Management	A system which eases installation, verification, upgrading, and uninstalling Linux packages. See the HOWTO for more information.
run		To let it work (a program); cf. execute.
runlevel	run-level	Mode of operation of a Unix system, offering different services on each level; see /etc/inittab .
scan		
script		A computer program that is written in an interpreted programming language, and therefore stays in human-readable text format; cf. executable, binary.
SCSI	Small Computer Systems Interface	A multi-drop bus cable architecture particularly suitable for both internal and external attachment of mass storage devices such as hard drives, tape drives and CD-ROMS.
sector		
segment		A (limited) length of cable - segments can be joined by repeaters (rare), bridges (common), routers or switches (which are hardware logic bridges and routers).
serial		One bit after another, over time (over a single wire).
server		A process, or a host computer, which provides a particular service to client processes; e.g. web server, print server.
service		A process which accepts requests and returns responses in an almost endless loop; a daemon.

Glossary of Terms

Term	Deprecated Alternatives	Comment
session layer		The fifth ISO/OSI layer is the session control layer. It establishes and controls system-dependent aspects of communications sessions between specific nodes in the network. It bridges the gap between the services provided by the transport layer and the logical functions running on the operating system in a participating node. In the TCP/IP network stack, there is no session control layer, and its functions are partially implemented in the transport layer and partially in the application layer.
SGID	Set Group ID, sgid	
shadow		
shell		A program which mediates between the user and the operating system, typically accepting commands and invoking the corresponding programs. In the UNIX world, the term shell is conventionally applied to command-line driven interfaces with scripting capabilities, such as bash, csh and zsh; however, graphical shells exist, such as Windowmaker, KDE and GNOME.
shutdown		
signal		A logical interrupt to a process, which the process must generally deal with synchronously. A form of interprocess communications.
single mode		single user mode, runlevel 1
SLIP	Serial Line IP	A way of encapsulating IP datagrams for transmission over asynchronous modem connections. See RFC1055, "A Non-Standard for Transmission of IP Datagrams over Serial Lines"; cf. PPP
SMB	Server Message Block	A Microsoft protocol developed to transport originally MS-DOS, later OS/2 and MS-Windows, API calls and their arguments across a NetBIOS LAN; primarily used under Linux as a protocol for file and print sharing with Windows machines
SMTP	Simple Mail Transfer Protocol	A conversational protocol used by mail servers for delivery of e-mail over the Internet. See RFC821.
SNMP		
SNR	Signal-to-Noise-Ratio	The relative amount of useful information in a signal, as compared to the noise it carries.
socket		A TCP application layer connection.
software	SW	computer programs
source code		The plain text (usually typed in by a human) specifying the detailed operation of a program, written in a programming language. It needs to be processed by a compiler to produce a program that can be run (executed) by the computer.

Glossary of Terms

Term	Deprecated Alternatives	Comment
sources		The files containing the source code for a program or program system, from which the executable program or library can be built or ported to another computer platform.
spawn		To create a child process by means of a fork() and an exec().
spooler		
static		
stderr		The standard Unix error output device (by default to the terminal display).
stdin		The standard Unix input device (by default the terminal keyboard).
stdout		The standard Unix output device (by default the terminal display).
sticky bit		A permission bit on an executable file which causes the kernel to keep the memory image of the process after it has terminated, in order to avoid the overhead of reloading it when it is re-invoked.
stream		A sequence of data bytes with sequencing and flow control. The TCP/IP stream protocol is TCP. (Isn't there a System V stream concept as well as the network protocol? Does Linux implement it?)
subnet mask	mask	A value used in configuring the TCP/IP stack which specifies which part of a 32-bit IP address is the network address and which part the host address.
SUID	Set User ID, suid	A permission bit for files in Unix-compatible filesystems which causes the resultant process (i.e., assuming the file is executable) to enjoy access rights to other resources based on the UID of the user who owns the file, rather than the user who created the process.
superuser	super user, su, wheel	The user of the root account.
SuSE	S.u.S.E.	A commercial Linux distribution.
swap space	swap	virtual memory; called swap space because processes swap location between fast RAM and slow virtual memory if their priority changes.
switch [1]		a two-state (on|off) input device
switch [2]		In computer networks, a bridge or router that uses dedicated hardware to quickly shunt packets through the network.
symlink	soft link	Symbolic link: in Unix filesystems, an entry in a directory that points to another file name in the filesystem; cf. hard link.
synchronize [1]		To make the events in two separate sequences happen at the same time (used in communications).

Glossary of Terms

Term	Deprecated Alternatives	Comment
synchronize [2]		To make the content and state of data stored in two separate locations identical (e.g. cache, FTP sites).
syntax		The formal rules which determine how keywords or commands and their components need to be combined when writing the source code of a computer program or forming shell commands.
sysadmin	sysadm	system administrator: a person who administers a computer system and keeps it working.
system	box	A computer system; a term loosely used to refer to hardware and | or software: cf. operating system.
TCP	Transmission Control Protocol	A session-oriented streaming transport protocol which provides sequencing, error detection and correction, flow control, congestion control and multiplexing; cf. UDP. See RFC793.
TCP/IP	Transmission Control Protocol / Internet Protocol	A suite of protocols basic to Internet transmissions.
terminal	tty	The outlet of a computer, usually consisting of a display for output of text (or possibly graphics), and a keyboard (and possibly a mouse) for input, used as a device for interaction between the computer and a user. cf. workstation.
terminate		to disconnect, end, finish, quit, stop, etc.
terminator		A resistive load to indicate the end a chain of devices, usually a SCSI chain or a coax network chain.
text		A series of characters that can be displayed on a terminal display or printed on paper for human reading.
TIPS	Test Item Processing System	Set of Python scripts to offer a web-interface to manage the LPI test items. See http://www.lpi.org/cgi-bin/tips.py.
TFTP	Trivial FTP	A protocol like FTP but much simpler and even less secure; used mainly for cracking computers and booting diskless network clients. See RFC1350.
third-party		
tools		
topology		As used with computer networks: the schematic shape formed by the connections between the hosts.

Glossary of Terms

Term	Deprecated Alternatives	Comment
transport layer		The transport layer is the central layer (#4) in the ISO/OSI seven-layer model. It provides end-to-end control of a communication session once the path has been established, allowing processes to exchange data reliably and sequentially, independent of which systems are communicating and their locations in the network. The transport layer in the TCP/IP stack is not defined in the same way; although TCP provides sequencing and error correction, UDP - which is also a transport layer protocol - does not have a session concept and is unreliable. The TCP/IP transport layer primarily provides multiplexing through the use of ports.
troubleshoot		The process of finding the reason(s) of the problem(s) with networking|programming|hardware.
tune		To make small changes to configuration in order to produce more efficient operation.
TurboLinux	Pacific HighTech Linux, PHT	A commercial Linux distribution.
UDP	User Datagram Protocol	A connection-less, unreliable, transport protocol which provides multiplexing and error detection for applications which require a low-cost protocol for one-shot transactions; cf. datagram, packet, TCP. See RFC768.
UID		User ID
UN*X		A term for any variant of the UNIX(R)(TM) operating system, including Linux and a large number of free and commercial systems; also *NIX.
uninstall		Remove hardware or software from a computer system.
unload		Remove services or software from a server so that more resources (CPU time, disk space, etc.) become available.
unreliable		In the TCP/IP sense of the term, a protocol which does not perform error correction (relying on "upper" layers to detect and correct errors, usually through retransmission).
upgrade		To update hardware or software to a better state.
URL	Universal Resource Locator	An identifier for an address on the Internet, preceded by the name of the protocol that must be used to reach that address (e.g.: ftp://ftp.kernel.org/).
USB	Universal Serial Bus	A recently developed bus standard for connecting peripheral devices in a chain.
user [1]		The person that is using the resources of a computer.

Glossary of Terms

Term	Deprecated Alternatives	Comment
user [2]		A person's account or process; identification listed in /etc/passwd .
user interface	UI, GUI	see interactive interface
user mask	mask	
UTC	Coordinated Universal Time, GMT, Greenwich Mean Time	Official world time.
utility		A program to help you to do a task easier.
UTP	Unshielded Twisted Pair	Type of network cables with several parallel wires used for Ethernet. The network usually has a star topology with hubs and does not need terminators.
variable length subnet mask	VLSM	cf. CIDR
vendor		A company that provides a service or a product.
virtual		Functionality provided without additional hardware|software, often without the user needing to realize this economy; e.g.: virtual memory, virtual console or virtual web server.
virtual console	virtual terminal, VT, VC	
virtual memory	VM	Extra memory available on a system that is stored on a hard disk and is therefore essentially unlimited, although much slower than genuine RAM. Usually it is called swap space.
WAN	Wide Area Network	A network which links geographically widespread facilities (and often LANs at those locations) using point-to-point (leased line, SLIP, PPP) or packet-switched network (X.25, frame relay) links and which does not support the broadcast and direct connection capabilities of LANs.
widget		
wildcard		An placeholder used to represent any character or group of characters.
window		A region on a graphical desktop, the user interface for I/O with a child process of the desktop.
win-modem		A modem that only has a Digital Signal Processor and uses MS-Windows-specific software running on the CPU of the host computer to encode and decode data.
WINS	Windows Internet Name Service	An automatic NetBIOS name database to resolve NetBIOS names to IP addresses.
word		A data type consisting of two or four (or a different number - you cannot tell) of bytes On i386 architectures, a word is four bytes (32 bits) in size.

Glossary of Terms

Term	Deprecated Alternatives	Comment
workspace		Computer resources that are assigned to a computer user.
workstation		A computer, usually with a graphical display, for interactive use by an individual; cf. server.
write permission		
WWW	World Wide Web, (the) web	Global distributed archive of HTML documents linked through HTTP.
X	X-Windows	The X Window System: a graphical user interface originating at MIT and having several variations.
XML	eXtensible Markup Language	
X-session		
X-terminal	X-station	cf. workstation
Yellow Pages	YP	See NIS