Debian/GNU Linux

Introduction I.

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1 Computer equipment

2 Linux/Windows

3 Structure of Linux

4 Filesystem

5 Account

6 Permissions

Agenda

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The history of the computer equipment at RISC

Overview the early times at/from 1985

Needs of computing resources at RISC

- writing and printing scientific articles, using latex
- using mathematical software
  - Mathematica,1992, on floppies for NeXT-Stations

Solution-A: Unix Workstations

- Multiuser, multitasking, native networking OS
- Graphical user interface for the console user (WS:200K ATS)

Solution-B: ASCII RS232 Terminals

- using the resources of a workstation remotely
- only an ASCII window (24x80 chars) available (no X!), 10k ATS

RISC is from the beginning a place for UNIX

The history of Unix at RISC

The different workstation (and Unix) types

Only Unix workstations from the beginning on...

- Apollo Workstations (later HP Apollo) / HP Workstation
  - Apollo Domain OS Unix; from 1986; max. 14 WSs
  - (5000 Apollo Workstations by Boeing Corporationi in 1990 !)
- DEC Workstations
  - DEC Ultrix - Digital Unix; 1991-1992; 8 WSs
  - the most stable workstation ever (last switched off 2003, 12 years)
- X-Terminals
  - Graphical Terminal (1991-1995), max. 20 NCD X-Terminals
- Other Workstations
  - 2 Sun workstations; Sun Solaris Unix
  - IBM-RT workstation; IBM AIX Unix

The history of Unix at RISC

Migrating to Linux

Migrating to Linux

- NeXT-Stations
  - NeXT-Mach 3.0 Unix; with excellent GUI !!
  - in 1992, 1993. Number of WS: 12; for secretaries, too!
- Silicon Graphics Workstations,
  - IRIX SysV.3, SGI Unix; January 1993; 14 WS.
- Sequent Symmetry
  - Multiprocessor computer; 20 Intel 386 CPU; late 1991
  - 32 RS232 terminals connected (mainframe for RISC)
- Unix PCs
  - early 1991; 3 PC; Interactive Systems Unix SysV.3
  - supporting the transputer systems (16 CPUs)
- GNU/Linux Debian, 1995
  - new hardware: only PCs; Debian PCs replacing slowly WSs, X-Terms

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Short comparison of Linux and Windows

Using Linux

Advantage of Linux

- FREE, OpenSource Software by no cost !
- very stable, very secure OS
- wide Internet support (mailing lists, irc groups, etc.)
- wide free documentation
  - User Guides, HowTos, FAQs, etc.
- lot of FREE software packages are available
- multitasking OS, multiuser OS
- native networking OS (to use remote resources)
- native graphical networking capabilities (X11)
- the absolute leader OS in the server area

Short comparison of Linux and Windows

Using Linux

Disadvantage of using Linux

- no perfect support for new or specific hardware
  - reason: the manufacturer do not give free the necessary information
- upgrade to new hardware not possible immediately
  - late announcement of the HW information for drivers
- user friendly GUI was no primary goal at the beginning
  - this is not anymore the case today

Today no difference in using Windows or Linux

- in both cases: you have to click, click, click ...

Short comparison of Linux and Windows

Using Windows

Advantage of Windows

- primary goal: OS, GUI is very user friendly

Disadvantage of Windows

- bad OS security
- multitasking introduced late, only by WinNT (DEC)
- no multiuser/networking support in the home versions
- multiuser support only in the server versions !!
  - Windows NT Server Terminal Edition
  - Windows 2003 Server: pay for each user licence !! (ca. 3.000 EUR)
- very expensive, Server Licenses, especially
  - i.e. MS Exchange, etc. (6-7.000 EUR)
- Campus Licence only for the OS Workstation version
- I had: Win95,Win98,WinNT,WinXP, lot of money
  - you have to buy every new OS version, plus Office,etc.

Linux distributions

Great number of diversity

Distributions

- more as 100 different Linux distributions
  - in reality about a dozen main (full) distributions
- as a sign of the democracy in software development
- groups of sofware developer can create a new distribution
- sometimes other distro adapted for special goals
  - use in school; special security issues, special groups of people, etc.
- main distribution and more child-distributions, i.e. Ubuntu
  - Ubuntu, Kubuntu, Xubuntu, Ubuntu-Studio, Mythbuntu, nUbuntu, Ubuntu Christian
  - Mint
- check: http://distrowatch.com/

Top Ten Linux distributions

An overview of today's top distributions

Top Ten Linux Distro:

- Ubuntu
- Fedora
- Mint
- OpenSuse
- Mandriva
- Debian
- Puppy
- Sabayon
- PCLinuxOS
- Arch

Top Ten Linux distributions

An overview of today's top distributions

Ubuntu - ancient African word: humanity to others

- Ubuntu Manifesto:
  - available free of charge, despite any disabilities
  - usable by people in their local language
- it brings the spirit of Ubuntu to the software world
- lot of sub-distribution (based on Ubuntu)

Fedora

- openly-developed project designed by Red Hat
- Red Hat engineering team will support building Fedora

Mint - Ubuntu-based, more complete out-of-the-box experience

- including browser plugins, media codecs, support for DVD playback
- web-based package installation interface
- Linux Mint is compatible with Ubuntu software repositories

Top Ten Linux distributions

An overview of today's top distributions

openSUSE - a community program sponsored by Novell

- three main goals
  - make openSUSE the easiest Linux for anyone
  - force open source collaboration
  - dramatically simplify packaging processes
  - to make openSUSE most widely used Linux, most usable Linux

Mandriva Linux - launched in 1998 as Mandrake Linux

- goal: making Linux easier to use for everyone

Debian GNU/Linux - create a free Linux OS

- quality - over time pressure; lots of packages (25000)
- the most architectures supported:
  - alpha, amd64, arm, armel, hppa, i386, ia64, mips, mipsel, powerpc, sparc,
- the base for the most other Linux distributions (Ubuntu, etc)

Top Ten Linux distributions

An overview of today's top distributions

Puppy Linux is yet another Linux

- is extraordinarily small, yet quite full featured
- boots into a 64MB ramdisk; the whole thing runs in RAM
- boots off a flash card, any USB memory device, etc.

Sabayon Linux - a live DVD, transforms a PC into Gentoo Linux

PCLinuxOS - an English only live CD based on Mandrake Linux

- runs entirely from a bootable CD (2 GB compress data)

CentOS - 100 percent compatible rebuild of Red Hat Enterprise Linux

- used by organisations and individuals
  - who do not need commercial support for OS operation
- for people who need an enterprise class OS stability
  - without the cost of certification and support

Top Ten Linux distributions

An overview of today's top distributions

Gentoo Linux

- versatile and fast Linux distribution for developers and network professionals

Knoppix

- is a bootable CD with a collection of GNU/Linux software
- supports many devices and peripherals
- can be used as a Linux demo, educational CD, rescue system
- It is not necessary to install anything on a hard disk

Top Ten Linux distributions

A comparision

Distributions - Very easy to use

- Ubuntu, Linux Mint, PCLinuxOS: easiest for new users
  - to get productive as soon as possible
  - without having to master all its complexities

More advanced distributions - learn first

- require plenty of learning before they can be used effectively
- Slackware Linux, Gentoo Linux, FreeBSD

Middle-road distribution

- openSUSE, Fedora, Debian GNU/Linux and Mandriva Linux

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Structure of Linux

The Kernel

Kernel: the conductor in the OS

- loaded by the boot loader at start of the OS
- managing processes (scheduler)
- managing memory (real and virtual); access to memory
- doing multitasking
- serves the File System
- manages rights and permissions (users, files)
- manages hardware units (I/O, hard disks, equipments, etc.)
- networking

Structure of Linux

Unix Processes

Process - a running program

- started by kernel;
- get CPU time slices (multitasking)
- priority: 0 to 64 (minimal)
- PID (process ID, sequential number)
- first process: kswapd0
  - for virtual memory management
- second process: init, PID=1
  - start and stop the system (i.e. all other processes)
- process state: see ps output
  - running (R) - stopped (T),
  - active (S) - idle (I) (waiting 20sec)

Structure of Linux

The Shell - an overview

Shell

- User Interface to the OS
- it runs in a terminal window
- is a command language interpreter
  - usable as an interactive login shell
  - shell script command processor
- interprets command line inputs; manages display output
  - includes a command-line editor
- included is a programming language (shell script)
  - commands, variables, expressions,
- includes a job control
- lot of built in commands for each specific area
- invokes programs; redirects input/output; makes pipelining

First Steps in Linux - The Login

How to login

Directly

- xdm/kdm: by graphical display managers login prompt
- on the serial console (24x80 character terminal window)

Remotely

- from other computer (through network) from terminal window
  - ssh [-X] host name or host IP

Working Environment

- shell in terminal window; command line input, closed by RETURN
- some simple commands:
  - ls; who; date; wc; passwd; (RISC: yppasswd)

Logout

- shell: exit, logout, etc.; X: use GUI

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The Linux file system

Structure and Components

File System

- tree structure, begins with the root (/) directory
- any number of (nested) subdirectories
- any number of files (file = leaf in the tree structure)

File Types

- ordinary files (text, executable, jpeg, wav, doc, etc.)
- special files (dev files = device description files)
- symbolic link (pointer to another file)
- subdirectories contains any type of files

Linux Root directory structure

```
/bin/ /boot /cdrom  /dev /etc /home /lib
/lost+found /media /proc /root /tmp /usr /var
```

The Linux file system

Linux Root directory structure

Root directory structure in detail

- / (root) is the base directory (Windows C: drive)
- /dev contains the physical devices files
- /etc for system and application configuration files
- /home for the home directories of the users
- /lost+found used by fsck (for lost and found files)
- /media contains the mounted units (/media/cdrom; /media/IOMEGA HDD;)
- /proc contains every information about a running system
- /usr is the second file system
- /var working area (/var/log; /var/spool/mail; /var/run)
- /tmp used for temporary files
- programs are located in /bin, /usr/bin, /usr/sbin, /usr/local/bin

The Linux file system

Some special files and directories: /dev /proc

I/O devices

- acces as/through files: /dev/cdrom, /dev/audio, /dev/hda

Features of the /proc file system

- process information pseudo-file system
- used as an interface to kernel data structures

Quick tour through the /proc hierarchy

- /proc/[number]: subdirectory for each running process
- /proc/cpuinfo: CPU and system architecture dependent items
- /proc/modules: list of modules loaded by the system (lsmod)
- /proc/net: status of some part of the networking layer

The Linux file system

the /proc FS - cpuinfo

cat /proc/cpuinfo

```
processor       : 1
vendor_id       : GenuineIntel
cpu family      : 15
model           : 4
model name      : Intel(R) Pentium(R) 4 CPU 3.00GHz
cpu MHz         : 3000.152
cache size      : 1024 KB
physical id     : 0
fpu             : yes
fpu_exception   : yes
hades:/proc!3>
```

The Linux file system

the /proc FS - meminfo

cat /proc/meminfo

```
gorilla:/proc!21> cat meminfo
MemTotal:       8302188 kB
MemFree:        6628844 kB
Buffers:         322816 kB
Cached:          922404 kB
SwapCached:           0 kB
SwapTotal:      2931852 kB
SwapFree:       2931852 kB
gorilla:/proc!22>
```

The Linux file system

the /proc FS - partitions

cat /proc/partitions. A: IDE hard disk B: two SATA hard disks

```
hades:/proc!12> cat partitions
major minor  #blocks  name
   3     0   39121488 hda
   3     1   14651248 hda1
   3     2    1461915 hda2
   3     3          1 hda3
   3     5   23005048 hda5
hades:/proc!13>

gorilla:sysadmin!3> cat /proc/partitions
major minor  #blocks  name
   8     0  244198584 sda
   8     1   24410736 sda1
   8     2    2931862 sda2
   8     3  216853402 sda3
   8    16  244198584 sdb
   8    17  244196001 sdb1
gorilla:sysadmin!4>
```

The Linux file system

commands to list the /proc FS

Using cat for the /proc

- cat /proc/cpuinfo
- cat /proc/meminfo
- cat /proc/partitions

Using special commands

- free
- sudo fdisk -l ; sudo gparted

The free command

```
gorilla:sysadmin!3> free
             total       used       free     shared    buffers     cached
Mem:       8302188    1682668    6619520          0     323424     927688
-/+ buffers/cache:     431556    7870632
Swap:      2931852          0    2931852
gorilla:sysadmin!4>
```

The Linux file system

Symbolic link, path

Symbolic link:

- only one physical file; any number of symbolic link to it
- delete symlink: the physical file will not be deleted !

```
lrwxrwxrwx 1 ke ke 24 2008-10-21 22:04 oxygen.png -> ../oxy.png
```

Path

- the exact location of an object (file, subdir, etc.)
  - /usr/share/doc/latex-beamer/solutions/generic-talks
- absolute path; relative path (../rlogin-ssh)
- gives shell the directory list to search for executable commands
- commands: pwd - current location; cd - change dir
- echo $PATH

```
/usr/local/bin:/usr/bin:/bin:/usr/bin/X11:/usr/games:/zvol/timer/bi
/home/ke/bin:/usr/NX/bin:/usr/local/Adobe/Acrobat7.0/bin
```

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The user account

Overview

user identification by login:

- Linux: username, passwd
  - similar by gmail account or by XP Professional

further parts of the Linux user account:

- the home directory; the shell; the userś group; other parameters

location of the Linux home directory: /home/username

- (XP: Eigene Dateien, gmail: not visible)
- local /home/username not a usable solution in a networking environment
- problems by backup, by changing the workstation, etc.

LAN-wide home directory

The solution for a computer network

riscwide Home directory

- at RISC the home directories are located on a file server
  - the file server exports them by NFS to all other workstations
- you have always the same home directory
  - independently on which workstation you logged in
- advantage by backup
  - only the file server hard disk has to be backuped
- miscellaneous information must be distributed LAN-wide
  - see later: NIS, YP, etc.

special user in Linux: root (read/write rights for all files)

Parameters of the user account

Files related to accounts:

- /etc/passwd, /etc/group, /etc/shadow, /etc/gshadow
- /etc/passwd:

```
login name:password:UID:GID:real name,,,:home directory: shell
sysadmin:x:1000:1000:sysadmin at risc,,,:/home/sysadmin:/bin/bash
```

- /etc/group

```
sysadmin:x:1000:
```

additional information:

- real name, location (room number)
- work phone number, home phone number,
- shadow: additional information about:
  - password expires, last changed, has to be changed
  - account expires, etc.

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Permissions in Linux file system

Groups and attributes

Groups

- files and users have miscellaneous attributes
- the user belongs to a group in Linux (adm, root, audio, etc.)
- /etc/group file contains the groups

```
root:x:0:                cdrom:x:24:ke
daemon:x:1:              audio:x:29:ke
bin:x:2:                 video:x:44:ke
```

- more users may belong to a group

```
webadmin:*:10019:sysadmin,mkauers,wwindste
sysadmin:*:10017:sysadmin,ke,landerl,kesysadm
```

- the file gets attributes for the grouping: u/g/o
  - u: the user, who owns the file
  - g: all users in a group
  - o: other users not in the files group and not owner (others=world)

Permissions in Linux file system

attributes

Attributes

- files/directories get attributes for the grouping: u/g/o
- file attributes:
  - r: read; w: write; x: execute; -: no rights
  - special permissions: s: execution with rights of the owner
- directory:
  - r: list of files; w: create/delete file; x: change into directory; -: no
- ls -l /etc/passwd /etc/shadow
  - -rw-r–r– 1 root root 119 Nov 02 1999 /etc/passwd
  - -rw-r—— 1 root shadow 1079 2008-01-12 18:48 /etc/shadow
- ls -ld /etc/network
  - drwxr-xr-x 7 root root 4096 2009-05-15 08:43 /etc/network/

1.character:

- - file, d directory, l link, c char device, b block device

Permissions in Linux file system

Using groups

```
atlantis:~> ls -ld /home/doench/  /home/khan
drwxr-x--- 2 doench doench 4096 Oct 29 17:35 /home/doench/
drwxr-x--- 2 khan khan 4096 Oct 29 17:35 /home/khan
atlantis:~>
atlantis:~>  ypcat passwd | grep doench
doench:Fusb8x9TDxDuc:13144:13144:Christian Doench:/home/doench:/bin/tcs
atlantis:~>
atlantis:~>  ypcat group | grep 13144
doench:*:13144:ke
atlantis:~>
atlantis:~> ypcat group | grep khan
khan:*:13134:ke
student:*:10030:ablinger,sinka,tec,rahkooy,khan,ghira,galea,vele,
korporal,korbelar,zaf,velkov,conran,sharkey,doench,wiesinge
atlantis:~>
```

Permissions in Linux file system

Changing permissions by commands

chmod [ugoa]*([-+=]([rwxXst-]*|[ugo]))+

- a: all (u+g+o)
- chmod g-rwx,o-rwx /home/kerdei
- chmod 700 /home/kerdei/private (4: read; 2: write; 1: execute; 0: no right)

default setting for directory: drwxr-xr-x

```
sysadmin!16> mkdir junk
sysadmin!17> ls -ld junk
drwxr-xr-x 2 sysadmin sysadmin 4096 Oct 31 21:20 junk/
sysadmin!18> chmod g-r,o-r junk
sysadmin!19>
sysadmin!19> ls -ld junk
drwx--x--x 2 sysadmin sysadmin 4096 Oct 31 21:20 junk/
sysadmin!21>
```

Permissions in Linux file system

Changing permissions by commands

```
sysadmin!20> touch junk/file1.txt
sysadmin!21>
sysadmin!21> ls -l junk/file1.txt
-rw-r--r-- 1 sysadmin sysadmin 0 Oct 31 21:20 junk/file1.txt
sysadmin!22>
hades:sysadmin!22> sudo su - ke
hades:1> cd /home/sysadmin
hades:2> ls -l junk/fi
junk/ unreadable
hades:2> ls -l junk
ls: cannot open directory junk: Permission denied
hades:3>
hades:3> ls -l junk/file1.txt
-rw-r--r-- 1 sysadmin sysadmin 0 Oct 31 21:20 junk/file1.txt
hades:4> ls -ld junk/
drwx--x--x 2 sysadmin sysadmin 4096 Oct 31 21:20 junk//
hades:5>
```

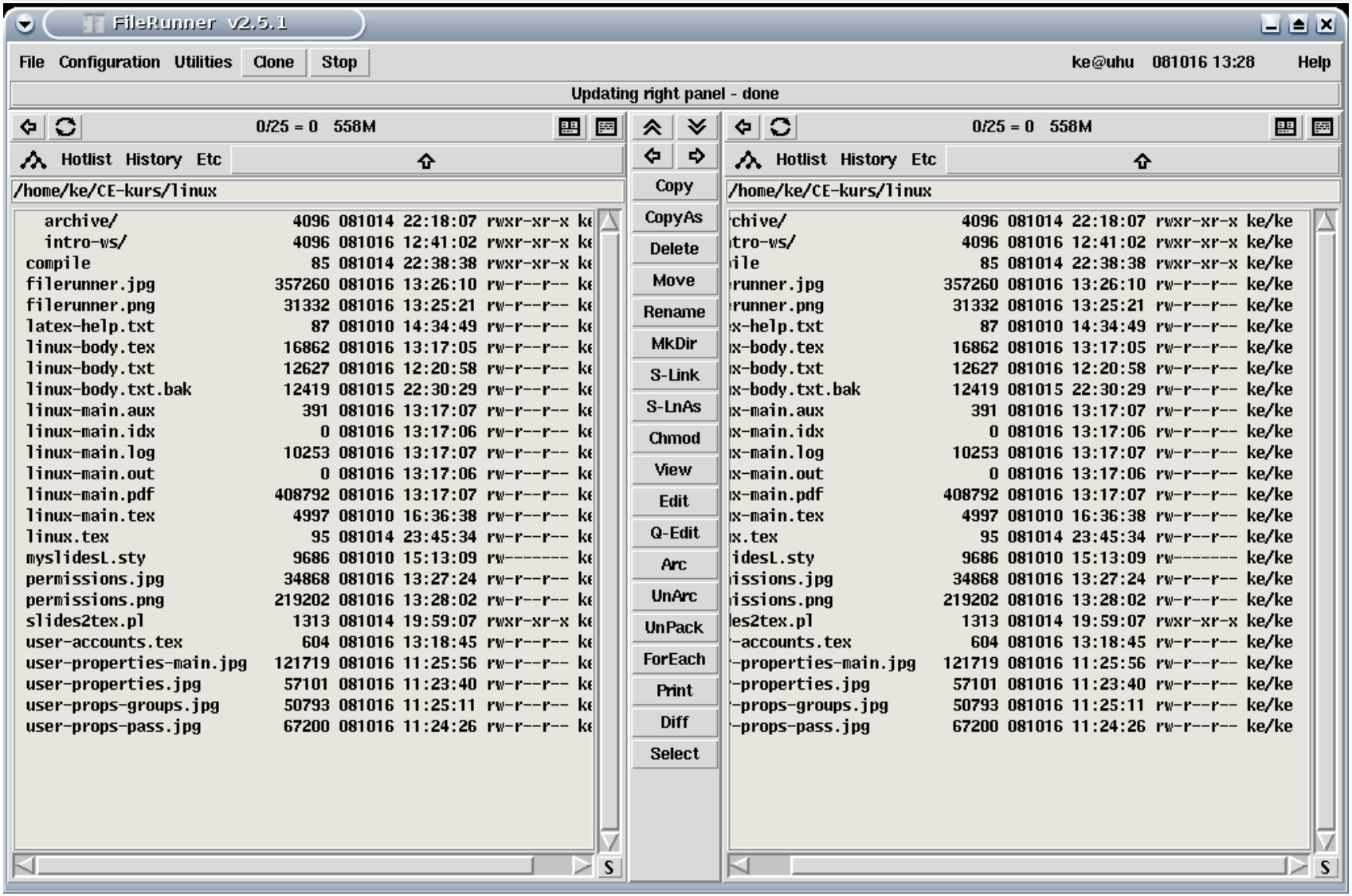
Permissions in Linux file system

umask - user mask

Umask is a shell variable and a function

- defines the default permissions for files and folders
- is calculated by using the bitwise AND and NOT
- Umask is confusing in that it is set up by defining what is not wanted
- Using umask
  - umask (lists the current value)
  - umask 022 (sets new values)
  - 022 means the rights: 755 for dirs, 644 for files
  - 000 means: 777 for directories, 666 for files
- To find the proper permission wanted, subtract the umask
  - Permissions for files = 666 - umask
  - Permissions for directories = 777 - umask

Filerunner - main window



Filerunner - File permissions

Changing attributes in Linux file system

Commands used

learned commands

Working on files

- ls, ls -l; cat, touch, mkdir, grep

Permissions

- chmod

Others

- su, sudo , ypcat, free, gparted

End of Linux Basics

Thanks for your attention !