Allgäu-Gymnasium Kempten Kollegstufenjahrgang 2001/03

**Facharbeit**

aus dem Fach

**Englisch**

# Linux, the Open Source Movement and Microsoft


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Leistungskurs : Englisch

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Abgabetermin : 03.02.2003

Bewertung : Note (Punkte) .....

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Unterschrift des Kursleiters

# Linux,
# the Open Source Movement
# and Microsoft

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# 1 Ideological aspects of software

*"I am firmly of the opinion that the Macintosh is Catholic and that DOS is Protestant"*[1], Umberto Eco once wrote. Living in the 'Information Age', the choice of the operating system is, even with a global player in a monopoly position, comparable to a religious confession. Since several years, another alternative to the omnipresent Microsoft products exists and the bad blood between these two sides rose even more. Steve Ballmer, CEO of Microsoft Inc. said that Linux has *"characteristics of communism"*[2]. With the US anti communism campagnes in the late 1950s in mind, the significance of this statement gets clearer. The other side, often represented by prejudiced enthusiasts start *"mindless flaming of any article that puts Linux in less then the best possible light"*[3]. In this research paper, I will discuss the choice of Linux as an alternative desktop operating system based on rational aspects and work out the mutual influence of the Open Source movement and Microsoft.

# 2 Linux, the Open Source Movement and Microsoft

## 2.1 Historical outline of operating systems

In 1969, programmers at Bell Labs invented a new kind of operating system named Unix. As a fundamental difference to all existing types he designed it to be flexible and easily portable with the help of a new programming language called *C*[4]. The fact that the operating system itself was no longer bound to specific hardware soon made it very popular and it was ported to various different hardware architectures. Like computers in general at that time, Unix was very expensive and therefore it was only purchased by institutions like universities or research laboratories. This partly changed with the invention of the personal computer which was small and relatively cheap in comparison to

1 http://www.simongrant.org/web/eco.html
2 http://www.theregister.co.uk/content/1/12266.html
3 http://linuxtoday.com/news_story.php3?ltsn=2000-03-16-004-04-NW
4 http://www.cs.bell-labs.com/who/dmr/

→mainframes. In 1984 Richard Stallman, a programmer from the Berkeley Labs, started to create the free Unix clone →GNU[5] in order to *"give computer users the freedom that most of them have lost"*[6] and developed many basic applications except for a suitable →kernel. Intels 80-x86 based microchip made the Personal Computer available to the public, and this was the time when Microsoft appeared with its easy-to-use graphical top part for MS-DOS, Windows. Although Windows was set on a *"shockingly inferior technology"*[7], it soon became very popular, not exclusively a result of MS's aggressive marketing tactic. Nearly unnoticed by the PC market, a student at the Helsinki University named Linus Torvalds began in 1991 to develop a Unix kernel with the help of the GNU toolkit for the 386 Intel processor and released it free of charge under the conditions of GNU's *General Public License (→GPL)* on the Internet. Soon he received comments, suggestions and bug fixes from other →hackers that searched for a customizable operating system based on the approved Unix system. Basic features like network capabilities, the grapical user interface →*X Window System,* were added and in 1993 the project, now labled Linux, could *"compete on stability and reliability with many commercial Unixes"*[8]. Mostly applied by computer experts, Linux was especially used as the software base for network servers while Microsoft expanded its market share on desktop computers up to over 95% in 2002[9] by using the *"FUD-strategy"*[10] (Fear, Uncertainty and Doubt) to eliminate competitors like IBM with its *OS/2* or Apple with its *AppleOS*.

## *2.2 Differences between Linux and Windows*

### 2.2.1 Basic technical concepts of Unix and Windows

In order to work out the main differences in their design, the analysis

5 http://www.gnu.org/gnu/thegnuproject.html
6 http://www.stallman.org/#serious
7 Raymond, E., *The Cathedral and the Bazaar*, p.15
8 Raymond, E., *The Cathedral and the Bazaar*, p.16
9 Sietmann, R., *Das Microsoft-Monopol,* p. 96
10 http://www.geocities.com/SiliconValley/Hills/9267/fuddef.html

candidates must be reduced and their technical development must be contemplated. The basis of the comparison is the latest desktop OS from Microsoft, Windows XP Home Edition and the german Linux distribution SuSE Linux Personal 8.1.

#### *2.2.1.1 User Management*

Unlike its previous Windows 9x versions, Windows XP was extended with the ability to manage multiple users although they can neither be divided into different groups nor set permissions on their own files. By default, user accounts, *"im Windows-Jargon 'Profil' genannt"*[11] have unrestricted abilities to change system settings, e.g. Software installation.

Right from the start, Unix – and as a derivation Linux – provides the tools required for this and also the basic implementations for managing several users on one system. This could be extended by network technology transparently, i.e. without notification by the user, on several computers, no matter where they are. The users are tied to groups e.g. such that work on different projects and need to have files together. On every kind of Unix system you can locate the system administrator called 'root' who is the only one allowed to change system files that – by default – belong to him.

#### *2.2.1.2 Process Handling*

DOS, namely MS-DOS, was originially designed to run only one program at a time. Based on this rudimentary system, Microsoft made a graphical frontend, firstly on 16 bit calculation mode (Windows Version 1.0-3.11) and in 1995 they released the *"major milestone in personal computing"*[12] Windows 95 with the faculty to run 32-bit applications, but like in Windows 3.x the operating system did not prevent programs from writing into memory areas of co-resident applications. At the same time MS worked on a technically improved professional OS that corrected the grave mistakes of Win9x, but without multimedia extensions and at a much higher price, namely Windows NT (*'Network Technology'*).

11 Siering, P., *Ein Windows für alle,* p. 113
12 http://www.alliance-computer.com/6reasons.htm

#### *2.2.1.3 File Systems*

For a better archiving system of the data stored, an operating system nowadays uses a method that became known as a *"hierarchal storage"*[13] . The Files on data mediums are separated into files and directories/folders. Windows XP uses *NTFS* as standart file system, a much more reliable and capable filesystem, originally designed for its predecessor Windows NT, the Linux kernel is able to read and write various file systems, from *Minix* to *NTFS*[14], but this paper mainly focuses on *ReiserFS*[15]. Both OS's can restrict file access to users, with the limitation that XP Home Edition can only mark files as '*private*' without being able to share them among different groups of users[16]. To gain a more precise insight in the differences of their file management, their arrangement of the system files needs to be looked at closely. XP uses the method already known from Windows 9x with which the tree is seperated into the different harddisk partitions titled with letters, e.g. C:, D: The Operating System is normally located on the first partition which has to contain all of the system files. Linux uses a hierarchical structure, beginning with the 'root filesystem', abbreviated '/'. From this point on, the tree expands into several directories described in the Unix *"Filesystem Hierarchy Standard"*[17]. New storage mediums can be made accessible by *mounting* them into an existing directory, which means that the root of the new partition, CD-ROM etc. appears in the directories of your choice. Like this, you are able to split the system onto various partitions reducing failures when disks are full, etc.

#### *2.2.1.4 Software management*

Helping in everyday-life tasks, a computer needs to run programs for e.g. multimedia, communication etc.. The choice of programs should be the user's decision. Installing software in windows means downloading or buying an executable file on CD-ROM, starting it and thus copying all the

13 http://www.lowendmac.com/myturn/01/0820.html
14 http://tldp.org/HOWTO/Filesystems-HOWTO.html
15 http://www.namesys.com/
16 Schulz, H., Siering, P., *Installations-eXPerimente,* p.136
17 http://www.pathname.com/fhs/

data needed in your prefered place (by default c:\programs\<*programname*>). It also writes information in the registry[18], a kind of database for the programs and the operating system. The missing features of the registry are central managment and a clear structure. Deinstallation of software normally leads to remaining data on the system and in the registry. The ratio of the number of files remaining after the deinstallation of the office-suite MS-Office compared to Applixware Office: 166:0[19] is very significant.

Most Linux distributions take advantage of a package management system. The prevalent system in this context is *RPM* (*RPM Package Manager*, [20]), originally shipped with *Red Hat Linux*[21], today more than 20 distributions use this database format ensuring a consistent system, including SuSE Linux personal. Software packages are distributed not as executable binaries, but as archives with information like a general description, the name of the packager, the version and the dependencies among other programs and libraries. They are installed with the help of the program rpm and a central database in a specific format. This is useful in getting a survey over installed applications and removing unused ones without any remains.

### 2.2.2 The Software Development

In this section, I will analyze and compare the fundamentally different methods used to develop software by both sides. The fact that Microsoft didn't publish as much information on this internal process as the Open Source community leads to a more precise view on the *Bazaar Model.*

#### *2.2.2.1 The Cathedral Model*

Conventional software, known by most companies, is being developed by a specific group of programmers for fixed salaries. They work together in a team on a program that is intended for a specific purpose which was

18 Schulz, H., *Schaltwerk,* p. 112
19 Hüskes, R., *Megapacks*, p. 111
20 Http://www.rpm.org
21 Http://redhat.com

determined at the beginning of the project. Mostly, the project is forked into different parts and after the general discussion of interfaces, each employee writes his allocated part. Although there are test runs, it's impossible to fix every fault, *"[→]bugs and development problems are tricky, insidious, deep phenomena"*[22].

#### *2.2.2.2 The Bazaar Model*

In his book "*The Cathedral and the Bazaar: Musings on Linux and Open Source by an Accidental Revolutionary*", Eric S. Raymond, a participant in the Internet hacker culture, describes the efforts required for the creation of a succesful Open Source project: Started most of the time by the "*developer's personal itch*"[23], there are several preconditions like a solid design idea, fast release cycles and an open ear for the customers. Once you are in the position of having a widely spread user community, you have *"many eyeballs [that] tame complexity"*[24], report bugs, provide feature requests and usability improvements. As a communication medium most projects involve both users and developers in mailing lists. Larger projects like the Linux kernel are seperated into two branches, a *'stable'* one used in a productive environment being steadily bugfixed and one named *'unstable'* with new features but less stability tested by enthusiasts and developers. *"The fact that either choice is available makes both more attractive"*[25].

### 2.2.3 Desktop computer operating systems

Operating Systems are working in a lot of devices that people, unfamiliar with technical devices, often do not regard as such, for example in embedded devices like *Palm* handhelds, helping us in our everyday life. In this paper I will focus on the most obvious application field of a computer in the Information Age, the desktop computer.

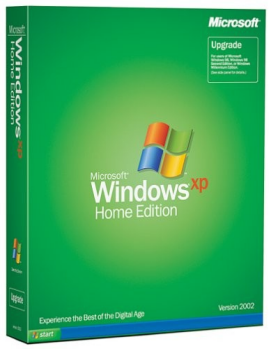
I will compare two desktop OSs, building the base for the work with the computer: Microsoft Windows XP Home Edition and SuSE Linux 8.1

22 Raymond, E., *The Cathedral and The Bazaar*, p. 31
23 Raymond, E., *The Cathedral and The Bazaar*, p. 23
24 Raymond, E., *The Cathedral and The Bazaar*, p. 33
25 Raymond, E., *The Cathedral and The Bazaar*, p. 33

Personal. Criterias in the comparison contain mutimedia functionality, office applications, stability and costs.

#### *2.2.3.1 Windows XP Home Edition*

For a price of about 199$ the customer receives Microsoft's most modern desktop system in a full version[[26], Img. 1]. The most obvious changes compared to its predecessors highlighted by Microsoft in [[27]] are usability enhancements as well as a better system structure, *"Dramatically reduced reboot scenarios"*. Included software, expect for the system itself, is the *Internet Explorer*, the *Windows Media Player*, some small utilities like a notepad, calculator, etc.. The license you get with the package is valid for an installation on one PC. You are compelled to register your copy after two weeks time, otherwise you can't do anything with it. Support is provided only if you buy it preinstalled with a computer, MS itself offers some additional fee required services. Screenshots of the system can be found in Appendix B.

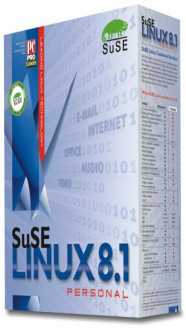



*Img. 1 Windows XP Home Edition Box*

26 http://microsoft.com/windowsxp/home/howtobuy/pricing.asp
27 http://microsoft.com/windowsxp/shared/evaluation/RevGuide.pdf

#### 2.2.3.2 SuSE Linux 8.1 Personal

SuSE, Germany's most successful Linux distribution, ships its package [Img. 2] with 3 CDs, a "quickinstall Poster", a printed manual and 60 days installation support. For 49,90€ the costumer recieves about 1000 programs, covering every purview of normal computer users. As →GUI of their choice, SuSE installs KDE3 (see page 13 and screenshot in Appendix B). The *Personal Edition* also includes everything in order to integrate the computer into a heterogeneous network. You are allowed to make several copies of the CD's and distribute them among your friends/family, there are no limitations how often to install one package. If you want to make a draft on support, you have to register[28].




*Img. 2SuSE Linux 8.1 Personal Box*

## 2.3 Mutual Influences

Although Microsoft made its first statements on Linux by releasing the Halloween Papers, it has already profited earlier in its history from Open Source. The first Windows-implementation of the Internet Protokoll was originally under the FreeBSD license. After a long gap, MS had the great success at the consumer market and Linux was almost beyond the eyes of the public in the relatively small cyberspace developed. Linux was on the way gaining more and more market share in the server area by the adaption of the OSS Apache web server to Linux. OSS attracted in May 1997 the public computer world when Eric Raymond released his memorandum leading Netscape, competitor of MS and ex-leader with internet browsers[29], to the decision to make their browser available for free including the sources. Bill Gates commented Linux at PC Week in June 1998 as follows:

*"Like a lot of products that are free, you get a loyal following even though it's small. I've never had a customer mention Linux to me."*

A few months later, MS induced an internal investigation how to stand

28 http://suse.de/de/private/products/suse_linux/i386/prices.html
29 Kossel, A., Schmidt, J., *Webstreit,* p. 192

against this new type of competitor. These papers were leaked to Eric S. Raymond, completed over the Halloween weekend and released by them afterwards to the press[30]. To all appearances the document, later called *"Halloween Paper"*, explains the OSS success adopting Raymond's theories and possible counterattacks for the leading staff of the MS Coorporation. Linux is described by them as an actual threat which can't be defeated as a company rather then a process, *"FUD tactics can not be used to combat it"*[31]. Raymond responded to this with the following statement:

*"This could be both good and bad news. The good news is that Microsoft would give up attack marketing, a weapon which in the past has been much more powerful than its distinctly inferior technology. The bad news is that, against us, giving it up would actually be better strategy; they wouldn't be wasting energy any more and might actually evolve some effective response."*[32]

Around that time Linux enthusiasts were about to start several projects on an easy-to-use graphical frontend.

In march 2001 even MS felt impelled to make concessions to the OpenSource Community after international coorporations like IBM and HewlettPackard announced support for the operating system. The sound slowly changed from a *"Krebsgeschwür, das in Bezug auf geistiges Eigentum alles befällt, was es berührt."*[33], stated by MS-CEO Steve Ballmer, to a more moderate approach claiming that OSS leads to a lack of innovation. Representatives of the OS Community harshly zinged these predications and blamed MS for trying the FUD strategy once more[34].

In 1996 a student at the university of Tübingen started a GUI for Unix in order to *"to fill the need for an easy to use desktop for Unix workstations, similar to the desktop environments found under the MacOS or Microsoft Windows"*[35]. Despite some controversial discussions about the licensing scheme of the basic framework QT, that was not released under the

30 http://www.opensource.org/halloween/
31 http://www.opensource.org/halloween/halloween1.php
32 http://www.opensource.org/halloween/halloween1.php
33 http://www.heise.de/newsticker/data/ju-04.06.01-001/
34 Dr. Oliver Diedrich, Microsoft lästert über Open Source, c't 11/2001
35 http://www.kde.org/whatiskde/index.html

terms of the GPL[36], its most significant task that "All parts must fit together and work together"[37] was soon achieved. One year later, *KDE e.V.*, a non-profit organization, was founded to shield core members from legal and financial liabilities. Inspired by Microsoft's idea that a professional toolkit must provide commercial support for companies, the norwegian software company Trolltech was, among the fact that is was easy to write programs with it, choosen with its product QT. With QT, KDE soon retrieved many awards, e.g. *'"Innovation of the Year 1998/99" in the category "Software"'*[38] at the CeBIT in 1999. Trolltech decided to revise its licensing scheme and released QT in accordance to the GPL when the second main release in 2000 appeared, ending discussions of legal distribution. This increased KDE's competitive edge while other projects with a similar purpose, e.g. GNOME[39], were in decline. Nowadays KDE is the favourite desktop for about 70% of all Unix users[40], replacing the traditonal Unix command line interface and becoming more colorful like Windows XP. Integrating the Internet into the desktop was also an idea originally created by Microsoft.
The following text is an extract of release announcement of KDE 3.0 in april 2002:

*"KDE 3.0 is available in 50 languages and ships with the core KDE libraries, the base desktop environment, an integrated development environment, and hundreds of applications and other desktop enhancements from the other KDE base packages (administration, artwork, development, edutainment, development, games, multimedia, PIM, utilities, and more). A KDE 3 port of the KDE office suite is available. Consistent with KDE's rapid and disciplined development pace, the release of KDE 3.0 includes an impressive catalog of bug fixes, performance enhancements and feature additions."*[41]

Special distributions soon appeared in order to be an alternative for desktop systems. Lindows for instance provides *"everything you need for*

36 http://www.kde.org/whatiskde/qt.html
37 http://www.kde.org/documentation/posting.txt
38 http://www.kde.org/announcements/ZD-Innov-CeBIT99.html
39 http://gnome.org/intro/findout.html
40 http://people.mandrakesoft.com/~david/IST2001/html/slide_3.html
41 http://www.kde.org/announcements/announce-3.0.html

*your computer"*[42], including the ability to run programs build for MS Windows. This goal was achived by the use of the emulator WINE[43], which is a kind of rebuild of the Windows architecture. Now it is possible to start many of the Windows programs directly in Linux. Microsoft felt the upcoming threat of their monopoly position and accused Lindows of missusing a registred trademark by using of a similar name for their product in december 2001. Lindows countered with the argument that 'Windows' is a commonly used name for a graphical user interface. The court in the end denied the motion with the following statement:

*"Although Lindows.com certainly made a conscious decision to play with fire by choosing a product and a company name that differs by only one letter from the world's leading computer software program, one could just as easily conclude that in 1983 Microsoft made an equally risky decision to name its product after a term commonly used in the trade."*[44]

Meanwhile, Lindows.com sued Microsoft and the trial is still running. The CEO of Lindows, Michael Robertson paid 100.000$ at the 19. Chaos Communication Congress in january 2003 to a group of programmers that won the contest in hacking Microsoft's game console Xbox, inducing it to run under Linux[45].

Microsoft didn't sleep either and came up with a serie of far reaching changes in his new desktop OS, *Windows XP*. The technical base was extracted from *Windows NT*, the professional Server OS. With the help of this improvements, *Windows XP* is said to be *"an operating system that can go for weeks without crashing"*[46]. When a single application crashes caused by a bug, you were offered without engagement to send a report to Microsoft. KDE used this kind of 'bugtracking' already in its first version.

Whether the decision to combine the two branches of the Windows

42 http://www.lindows.com/lindows_sales_intro.php
43 http://winehq.com/about/
44 http://info.lindows.com/lindows/
45 http://www.heise.de/newsticker/data/em-01.01.03-002/
46 http://www.pcworld.com/features/article/0,aid,97429,pg,4,00.asp

development was caused by the success of Linux, is speculation. But another important change concerning the license policy was surely triggered by the discussion about free source code of computer programs. In march 2001, Microsoft announced the *Shared Source Initiative* providing 63 european institutions – Universities, governments and others - the possibility to analyze large parts of their source code in a read-only environment. Jason Matusow, representative of MS in this initiative, was harshly criticized. The really critical parts were excluded, no one is willing to look at aproximately 100.000.000 lines of source code and this is just a PR action[47].

# 3 A Glimpse into the Future

A statistic by the *c't magazine* showed the main areas of usage on the Linux desktop: Beside usual tasks like Internet and office applications, Linux users tend to develop software and adminstrate networks. The survey also showed that missing professional software for e.g. *Computer Assisted Design* and missing games were the major reasons for discontent, which is in the desktop area at about 77%, compared to those unhappy with Linux as a server at about 96%[48].

Future considerations of Microsoft are for many people an impulse to think about an alternative. Especially the conception of TCPA/Palladium, a combination of a operating system with cryptographic abilities and a secure chip on the computer, is a thread for everyone who cares about data privacy. With the system, it should be possible to install only certified device drivers and "secure content" according to Microsoft. Co-

47 Krempl, S., *Von Linux lernen*, p. 62
48 Diedrich, O., *Und was machen Sie mit Linux?,* p. 188

developed with the *Recording Industries Assosiation of Amerika* (RIAA), the main target are illegal copies of music and videos. Technically, this could be arranged by authenticating every media file by a server located at Microsoft.

Beside the fact that Microsoft managed it to bring the computer to the masses, I think it is time to renew the competition.

# **Appendix A.** Glossary

| | |
|---|---|
| GNU | GNU's Not Unix, <body, project> /g*noo/ 1. A recursive acronym: "GNU's Not Unix!". The Free Software Foundation's project to provide a freely distributable replacement for Unix. The GNU Manifesto was published in the March 1985 issue of Dr. Dobb's Journal but the GNU project started a year and a half earlier when Richard Stallman was trying to get funding to work on his freely distributable editor, Emacs.<br><br>Emacs and the GNU C compiler, gcc, two tools designed for this project, have become very popular. GNU software is available from many GNU archive sites. |
| kernel | <operating system> The essential part of Unix or other operating systems, responsible for resource allocation, low-level hardware interfaces, security etc. |
| hacker | [..] The term "hacker" also tends to connote membership in the global community defined by the net (see The Network and Internet address). It also implies that the person described is seen to subscribe to some version of the hacker ethic.<br><br>It is better to be described as a hacker by others than to describe oneself that way. Hackers consider themselves something of an elite (a meritocracy based on ability), though one to which new members are gladly welcome. Thus while it is gratifying to be called a hacker, false claimants to the title are quickly labelled as "bogus" or a "wannabee". |
| X Window System | <operating system, graphics> A specification for device-independent windowing operations on bitmap display devices, developed initially by MIT's Project Athena and now a de facto standard supported by the X Consortium. X was named after an earlier window system called "W". It is a window system called "X", not a system called "X Windows". |
| bug | <programming> An unwanted and unintended property of a program or piece of hardware, especially one that causes it to malfunction. [...] |
| GUI | a user interface based on graphics (icons and pictures and menus) instead of text; uses a mouse as well as a keyboard as an input device [syn: graphical user interface] |
| GPL | <legal> (GPL, note US spelling) The licence applied to most software from the Free Software Foundation and the GNU project and other authors who choose to use it. The licences for most software are designed to prevent users from sharing or changing it. By contrast, the GNU General Public License is intended to guarantee the freedom to share and change free software - to make sure the software is free for all its users. The GPL is designed to make sure that anyone can distribute copies of free software (and charge for this service if they wish); that they receive source code or can get it if they want; that they can change the software or use pieces of it in new free programs; and that they know they can do these things. The GPL forbids anyone to deny others these rights or to ask them to surrender the rights. These restrictions translate to certain responsibilities for those who distribute copies of the software or modify it. |
| mainframe | <computer> A term originally referring to the cabinet containing the central processor unit or "main frame" of a room-filling Stone Age batch machine. After the emergence of smaller "minicomputer" designs in the early 1970s, the traditional big iron machines were described as "mainframe computers" and eventually just as mainframes. The term carries the connotation of a machine designed for batch rather than interactive use, though possibly with an interactive time-sharing operating system retrofitted onto it; it is especially used of machines built by IBM, Unisys and the other great dinosaurs surviving from computing's Stone Age. |

**[The Free On-line Dictionary of Computing (09 FEB 02) ]**

**[Homepage: http://wombat.doc.ic.ac.uk/foldoc/]**

## **Appendix B.** Software Licenses[49]

| Software Type | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Commercial | | | | | | | |
| | Trial Software | X[1] | X | | | | | |
| | Non-Commercial Use | X[2] | X | | | | | |
| | Shareware | X[3] | X | | | | | |
| | Royalty-free binaries ("Freeware") | X | X | X | | | | |
| | Royalty-free libraries | X | X | X | X | | | |
| | Open Source (BSD-Style) | X | X | X | X | X | | |
| | Open Source (Apache Style) | X | X | X | X | X | X | |
| | Open Source (Linux/GNU style) | X | X | X | X | X | X | X |
| | | Zero Price Avenue | Redistributable | Unlimited Usage | Source Code Available | Source Code Modifiable | Public "Check-ins" to core codebase | All derivatives must be free |
| | **License feature** | | | | | | | |

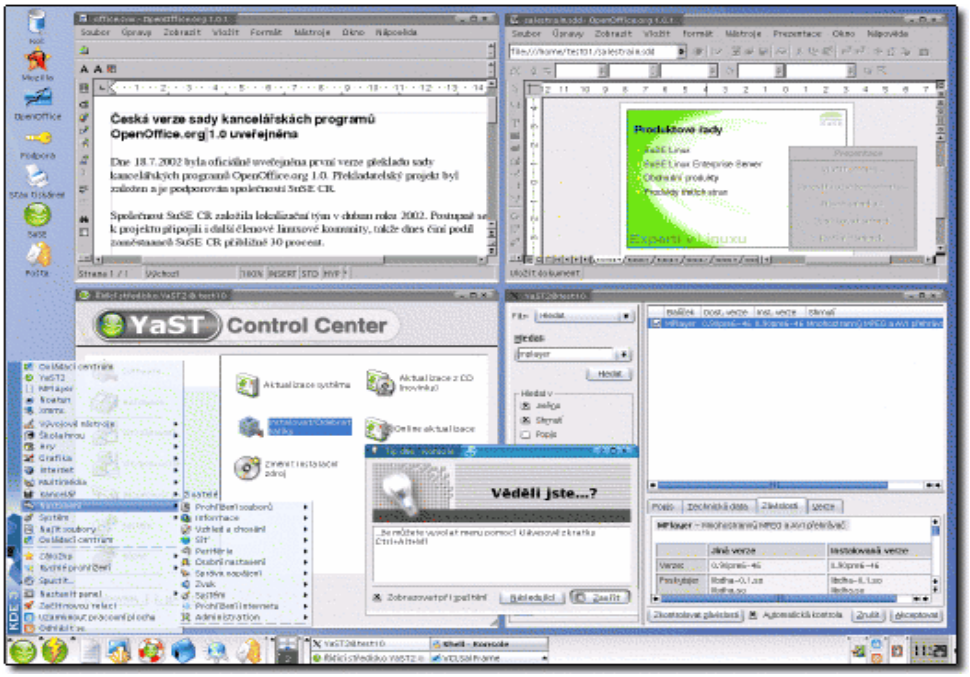
[1] Non-full featured

[2] Usage dependent

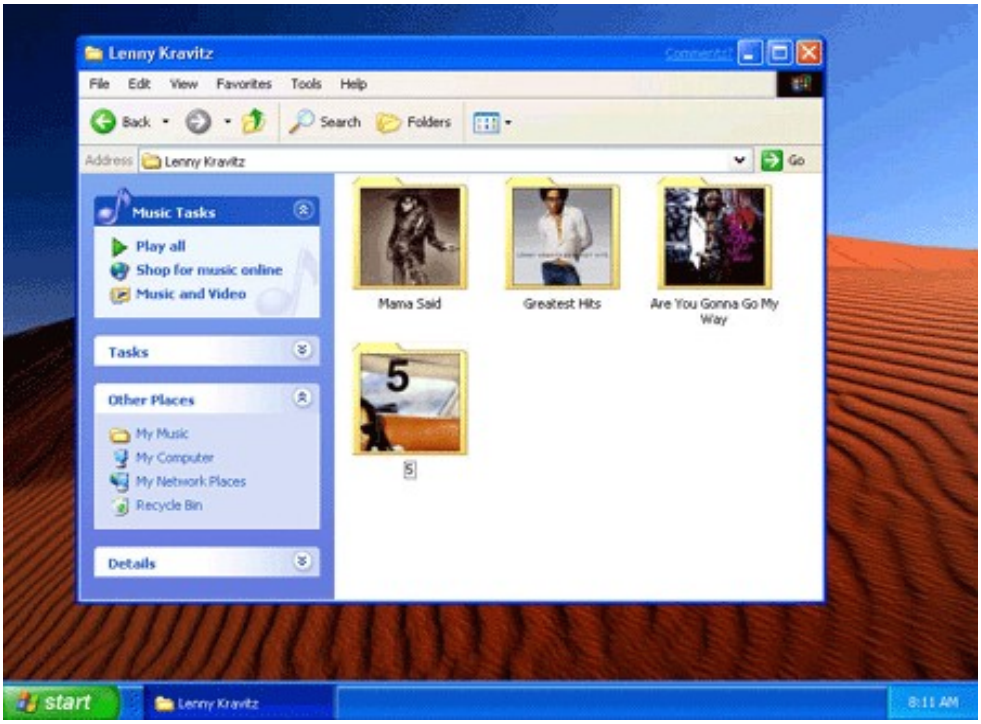
[3] Unenforced Licensing

49 http://www.opensource.org/halloween/halloween1.php (revised)

# **Appendix C.** Screenshots




*Img. 3 SuSE Linux 8.1 Personal screenshot. Open Office, YaST control centre and KDE3 desktop*




*Img. 4Windows XP Home Edition desktop. Explorer-folder 'MyMusic'*

## **Appendix D.** Knoppix CD-ROM

This CD-ROM contains a modified version of KNOPPIX.

*"KNOPPIX is a bootable CD with a collection of GNU/Linux software, automatic hardware detection, and support for many graphics cards, sound cards, SCSI devices, and other peripherals. It can be used as a Linux demo, educational CD, rescue system, etc. It is not necessary to install anything on a harddisk due to on-the-fly decompression."*[50]

Additional, this research paper and the Internet sites used for it were added as desktop icons.

Insert this CD before the boot process and ensure your computer is configured with 'Boot from CD'.

50 http://www.knopper.net/knoppix/index-en.html

# Bibliography

## Monographies

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# Statement

Ich erkläre hiermit, dass ich die Facharbeit ohne fremde Hilfe angefertigt und nur die im Literaturverzeichnis angeführten Quellen und Hilfsmittel benützt habe.

....., den .....  .....

Ort  Datum  Christian Mayr