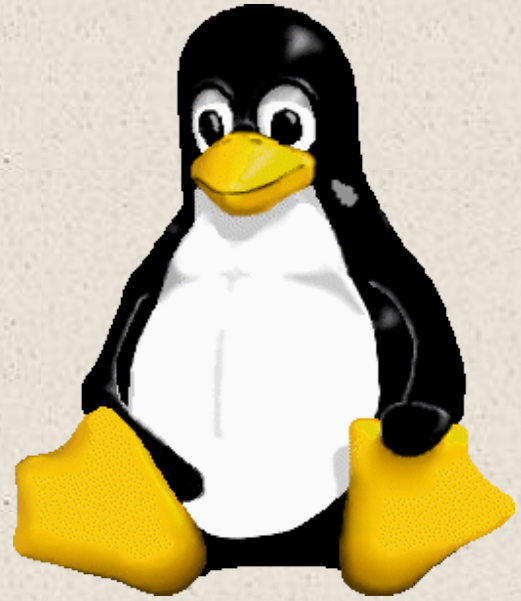


The (R)Evolution of an OS

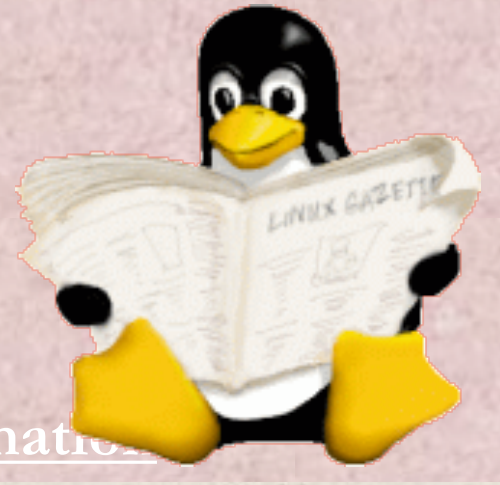
An Introduction to the Development, Features, and Usability of the GNU/Linux Operating System

Version 1.4, August 2002. First Released: May 2001.
Deepak, VII Semester BE (CSE), Bangalore INDIA

Linux is pronounced as *luh-nuhks* or *ly-nuhks*. Some even say *lee-nooks*.

A Brief Overview

- History of Linux
- Features Supported Under Linux
- A Few Myths About Linux
- Unresolved Issues in Linux
- Major Supporters of Linux
- Some Reasons to Use Linux
- Online Resources and Contact Information



The Origins of Linux

The Beginning

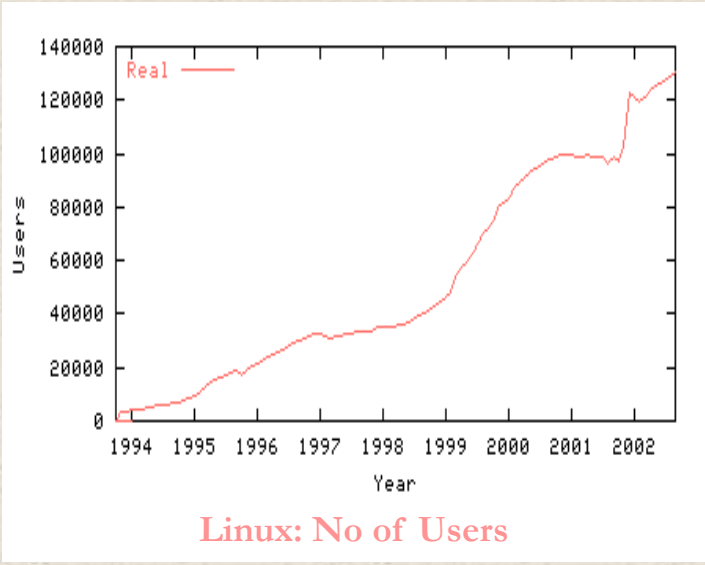
The core of the Linux operating system was coded by a Finnish programmer called **Linus Benedict Torvalds** in 1991, when he was just 21! He had got a new 386, and he found the existing DOS and UNIX too expensive and inadequate.

In those days, a UNIX-like tiny, free OS called **Minix** was extensively used for academic purposes. Since its source code was available, Linus decided to take Minix as a model. In his own words, 'I wanted to write a better Minix than Minix.'

More stats are at the Linux Counter. If you run Linux, you can also add your machine there.

Growing and Growing...

In order to encourage wide dissemination of his OS, Linus made the source code open to public. At the end of 1992 there were about a hundred Linux developers. Next year there were 1000. And the numbers multiplied every year.



Linux: No of Users

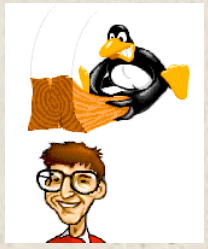
Source: The Linux Counter

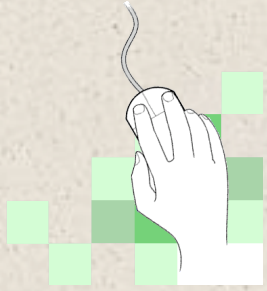
Recent estimates say about 18 million people use Linux worldwide. This doesn't include non-personal computers, such as server machines on the Internet and other networks.

Red Hat has over 30 million lines of source code, mostly in C. Source: David Wheeler

Linux Today

Though Linus never imagined it, Linux quickly became a general tool for computing. People stopped looking at Linux as a toy, and began to think about it seriously. Today there are thousands of applications that can be run on Linux, from Office Suites to 3D games. Hundreds of *Linux User Groups* the world over discuss ways to make Linux work better. Umpteen number of web sites, and thousands of *newsgroups* and *mailing lists* talk about Linux. Bangalore hosts a Linux convention every year, called Bang!linux.





Distributions of Linux

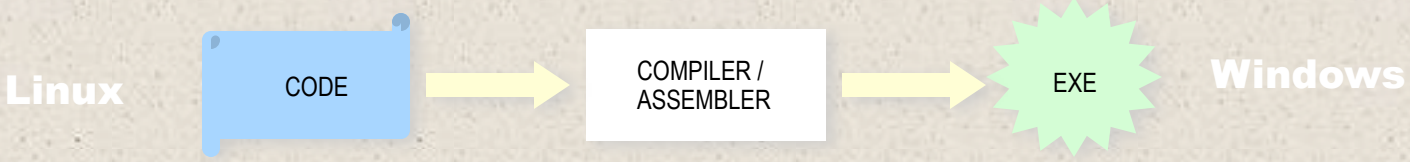
In tune with the power-of-choice tradition of Linux, many companies and communities now offer it along with lots of applications. Though the OS is the same, the bundled software do vary from one distribution to another. **Red Hat**, **SuSE**, **Mandrake**, and many other firms sell Linux this way, and their CDs are called distributions. Usually the distributors charge a nominal fee for the media and for technical support in the future. **Debian** is a high-quality non-commercial distribution of Linux, funded and run by about 900 volunteers.

Open-source: What does it mean?

Any software, at heart, contains binary instructions -- a continuous stream of 0's and 1's -- to the processor so that it works the way it is supposed to. Encoding software directly in binary is no doubt a tedious, if not impossible, proposition.

So a programmer uses an English-like higher-level language to write software. This program text is the source code; it is *compiled* or *assembled* to obtain the final executable.

Microsoft give away only the executable; Linux also gives you the source code -- hence it is *open-source*. Does this matter? A lot. Buying closed-source software is much like buying a car with its hood welded shut.



Google, Amazon, CNN and Yahoo all run UNIX based operating systems. Source: NetCraft

Features of Linux

Why Linux is Built Upon UNIX

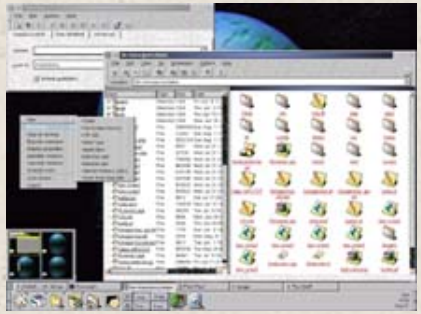
- UNIX has been time-tested for 30+ years, which is eons by computer age
- The basic **design** of UNIX is *elegant*, being the brain-child of two master programmers: Thompson and Ritchie. Ritchie also co-invented the C language.

Thompson and Ritchie, the creators of UNIX, working on a PDP-11 machine.

- UNIX developed with contributions from many different sources; today it hosts a huge collection of excellent software
- UNIX is very well-documented, and source code is available for much of the system -- unlike MS Windows, for example.

Features Supported in Linux: True Multitasking

• All applications in Linux are **preemptively multitasked**. The OS handles all scheduling of processes (and kernel threads). No application can hog the resources unless the system administrator specifically defines it as high-priority. This leads to smoother performance and better load-balancing

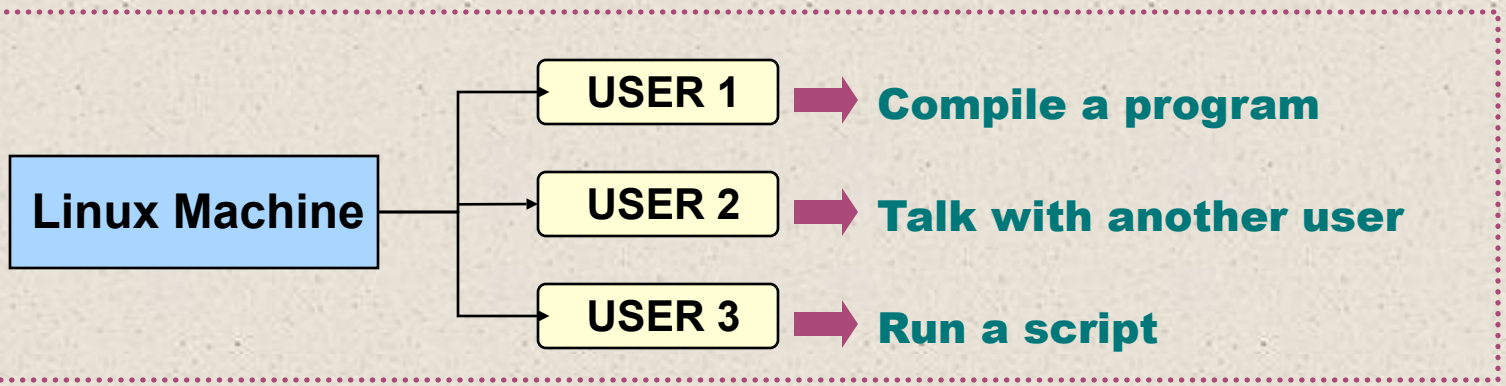


Multitasking under Linux: *The number of apps you can run is limited only by the memory you have.*

• All applications in Linux run in their own **private memory space**. This means that a poorly-written application cannot tamper with the memory of another application (or the kernel). If an application does try to access memory it doesn't own, it is immediately halted by the operating system, without disturbing any other process on the system

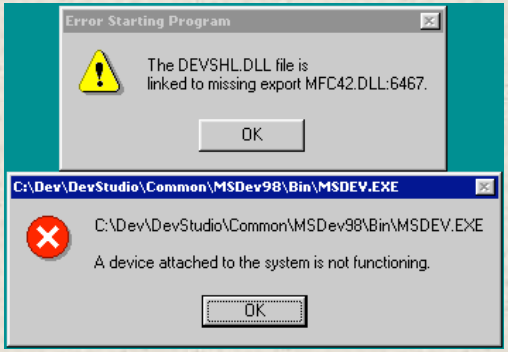
Multi-User and Customisable

UNIX was designed with the notion that multiple people would be sharing use of the system at the same time. Several people can log into a Linux machine and each of them can run whatever programs he likes. UNIX applications are written from scratch with the idea that multiple people will be using them, and each may have entirely different preferences. Many people can use the *same application* at the *same time* according to *their liking!*



Easy Remote Administration and DLL Handling

- Because of the fundamental design of UNIX, every application can *run* on one machine and *display* its interface on another. This is extremely useful for **remote administration**
- Windows allows the use of **DLLs** (Dynamic Linker Libraries) to modularise applications and reuse code. But *version conflicts* often arise, which might make some applications or the whole OS useless. Linux also handles DLLs (called *shared objects*), but it checks the version of DLL each app is asking, and then links the correct version. In Windows, the program may simply crash



A DLL Goof-up in Windows

Efficient Memory Management

• Linux is outstanding in the area of memory management. It will use every scrap of memory in a system to its full potential. The Linux kernel occupies just 2 MB, whereas NT takes 16 MB!

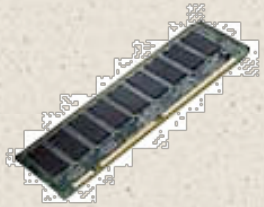
How shall I get 64 MB AGAIN for Win 2000?

• Linux uses a **copy-on-write** scheme. If two or more programs are using the same block of memory, only one copy is actually in RAM, and all the programs read the same block. If one program writes to that block, then a copy is made for just that program. All other programs still share the same memory. When loading DLLs, this is a major memory saver

Efficient Memory Management (Contd.)

Demand-loading is very useful as well. Linux only loads into RAM the portions of a program that are *actually* being used, which reduces overall RAM requirements significantly. At the same time, when swapping is necessary, only *portions* of programs are swapped out to disc, not entire processes. This helps to greatly enhance *multiprocessing* performance.

Finally, any RAM not being used by the kernel or applications is automatically used as a *disc cache*. This speeds access to the disc so long as there is unused memory. On the other hand, memory management is poorest in Windows!



Why waste money on upgrades when you can use it with Linux?

GNU, FSF and Linux

Richard Stallman is the founding father of the GNU Project and the *Free Software Foundation* (estd. 1985), which aim to code software which give *freedom* to the user -- freedom to share, modify and distribute -- which no proprietary software does.

This goat is the logo of GNU

Stallman liked UNIX so much that he wanted to make a free alternative to it. The GNU [guh'-noo] project, started in 1984, has developed thousands of software which do all that the original UNIX tools did, but with a difference: you can modify them, share with your friends, and use however you want.

Images: gnu.org

GNU and Linux share a symbiotic relationship. While the Linux kernel still lies at the core, GNU software make the system much more functional. Hence the awkward but accurate: *GNU/Linux*

Powerful File System

- Linux normally uses its own **high-performance file system**, which uses disc space much more efficiently, optimises for speed on reading and writing, and automatically prevents fragmentation. The Linux file-system literally does not need a defragmenter, though one is available. It also sees when programs make errors writing to the disc and automatically prevents them, so there is usually no need to run a disc checker unless you notice a problem

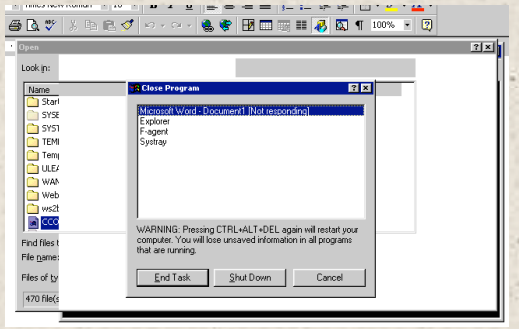
- Linux can also read and write all FAT variants (FAT12, FAT32), Windows NT's NTFS, OS/2's HPFS, and many others you've never heard of. Often it can use them faster than their native operating system can!

Linux can use your hard disc better

Linux has the Unmatched Stability of UNIX

- Linux enforces a strict *separation* between the kernel and other applications. Most services like mail, file and print serving, web serving and so on are applications, and can usually be changed dynamically. At worst, a specific application may need to be restarted, and not the whole system. Reboots are only for kernel updates and hardware changes.UNIX systems have uptimes in terms of *years!*

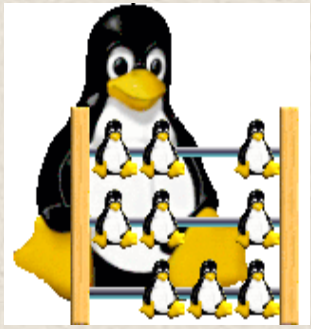
- Linux also provides the ability to *dynamically increase* **swap space** and then *reduce* it later without a reboot, unlike Windows, where it grows and grows until a restart



MS Word has frozen

Inbuilt Networking Support

TCP/IP networking and the Internet was originally developed on UNIX systems, and most of the high-power networking in the world is done on UNIX. About **75%** of the web servers on the Net run a version of UNIX.



Linux is network ready

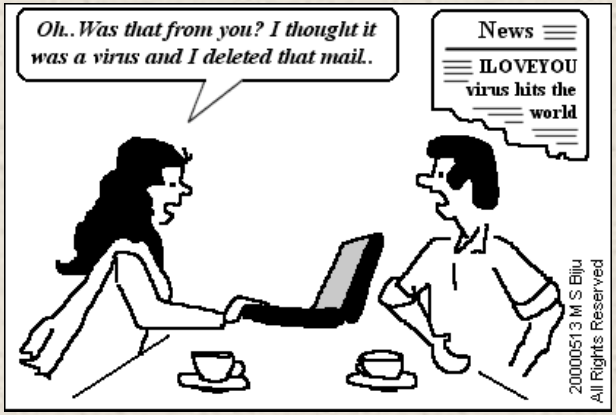
In fact, Linux has the *largest market share* for the entire Internet, running 25.7% of the **news servers**, 26.9% of the **web servers**, and 33.7% of the **FTP servers** in the world. Apart from extremely fast and reliable networking, dozens of major and minor network services are usually provided when you get Linux. *Web servers, file and print servers, ftp servers, NIS servers, IRC servers, news servers*, and more are available for free or very little cost.

High Level of Security

Linux is a very secure operating system, much better than Windows 9x and even Windows NT.

- As each application runs in its own protected memory space, it is not possible for a *virus* to infect another application running in memory. Linux also has file permission structure which greatly limits the damage a virus can do

Source: toonshome.com



Oh, was that you? I thought it was a virus and I deleted the mail.

- Linux is less prone to *hacker attacks* than most OSes. This is partly because of its design and its open-source nature. Security bugs are fixed very quickly, often within hours!

Linux vs. Windows NT

Linux is emerging as a strong competitor to NT. It has given enough scare to Microsoft, that it circulated a memo on the damaging effects of Open-Source revolution! This table, built by a Microsoft certified NT professional, shows a feature by feature comparison of Linux and Windows NT.

Component	Linux 2.x	Windows NT Server 4.0
Operating System	Free, about $49 for a CDROM	Depends on no. of users: $899 to $3999
Kernel Source Code	Yes	No
Web Server	Apache	IIS
Telnet Server	Yes	No
POP3 / SMTP Server	Yes	No
X-Window Server	Yes	No
C / C++ Compilers	Yes	No
No. of file systems supported	32	4
Disk quotas support	Yes	No
No. of GUIs	4	1
Free Online Technical Support	Yes	No
Platforms	x86, SPARC, PowerPC, StrongARM	Intel x86, Alpha
SMP Support	Upto 16. Beowulf supported	2 in Workstation, 4 in Server. No Beowulf

Source: www.unix-vs-nt.org/kirch

Bugtraq reported only 20 vulnerabilities in Debian Linux for 2000, while Windows NT had as many as 85.

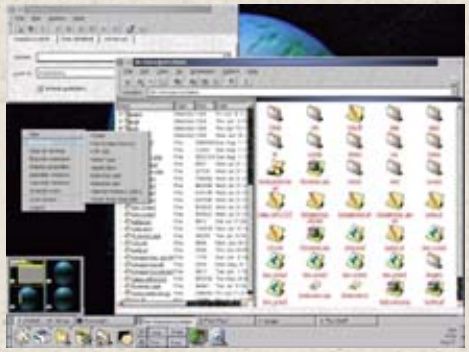
A Few Myths About Linux

⊗ Linux is open, so insecure

√ This might be a valid argument, but thankfully, our world is still a very good place. When programmers find a piece of bug in the source, they quickly try to *fix* it, rather than capitalise on it. If you hack into a system based on a bug you found in Linux, it is only so long as another guy finds out the bug and fixes it

⊗ Linux is not as nice as Windows

√ KDE 2.2 was rated by *PC Magazine* as the most user-friendly GUI, beating WinXP!



⊗ There are not many applications for Linux

√ As of today, there are about 15,000 applications built for the Linux platform. You can code in C, C++, Java etc.; listen to music; browse the Web; play an action game; watch a movie; and even modify this slideshow with OpenOffice!

You can do everything in Linux as in Windows

⊗ Linux does not have a centralized authority

√ Linux might be coded by programmers around the world, but there *is* a group of people headed by Linus who have the ultimate say on it. They decide on the next version of Linux

⊗ The various UNIXes are fragmenting into a plethora of incompatible versions

√ This was the trend sometime back, but since the past ten years, they all are *converging*. UNIX systems now broadly adhere to ANSI and POSIX standards, that allow software to be **source-compatible** across different platforms, ranging from embedded micro-controllers to supercomputers. The X/OPEN standard allows a common desktop across all platforms. On the Intel x86 platform, for example, Linux can run SCO UNIX binaries, and FreeBSD can run Linux binaries. In a nutshell, there is as little a difference as among, say, Windows 3.1, Windows 9x, and Windows NT.

Some UNIXes

- Caldera UnixWare
- DEC Digital UNIX
- FreeBSD
- HP-UX
- IBM AIX
- Linux
- SGI IRIX
- Sun Solaris

Some Issues in Linux

Linux is not very beginner-friendly

Linux can be overwhelming for a new user from Windows. Stop comparing Linux with Windows every once in a while, and you will gradually appreciate Linux.

Installing Linux is difficult

Installing Linux is an adventure for a novice accustomed only to Windows. Ever heard of swap partitions and mount points?

It is sometimes hard to work with Linux software

To quote Stallman, 'Freedom is much more important than technical superiority or ease of use.' Patience!

There is a lack of user-friendly help in Linux

Be prepared to read long technical manuals, and subscribe yourself to your local Linux user-group mailing lists!

Linux is still heavily command-dependent

Though KDE and GNOME are great GUIs, you still cannot forgo commands. Sooner or later, you will use the prompt.

```
Red Hat Linux release 6.2 (Zoot)
Kernel 2.2.14-5.0 on an i686
geekshome login: dpuck
Password:
Last login: Sun May 13 11:10:59 on tty1
[dpuck@geekshome dpuck]$ _
```

Linux is choosy on hardware

Most hardware work well in Linux, but a few, especially win-modems and certain brands of video- and sound-cards, can be notoriously uncooperative. As more firms realise the power of Linux, getting drivers won't be a problem.

Major Supporters of Linux

In spite of all these setbacks, Linux has found a large following, from a broad spectrum of organisations. Here is a short list of major supporters and users of Linux.

Click on any logo to visit the company's Web-site. Full list.

Why Use Linux?

- Linux has *legendary stability*. Blue screens are unknown; crashes, very rare.
- Linux is *ideal for networking*: You can freely set up a functional and stable router, firewall, Web server, mail server, or FTP server right out of the box.
- Linux can *talk with many other systems*, including NT, NetWare and Sun. It supports *multiple-processes* and *-processors*, and a variety of *file systems*.
- *Low resource requirements* of Linux means you can bring even a 386 to glory
- Linux *gives you choice* from GUIs and shells to everything. The *range* of applications is *huge*, and *powerful package management systems* exist.
- Linux is *reliable*, *secure*, *easily upgradeable*, and has an *open design*, *logical file system layout* and *supportive community*, which make it a *zero-maintenance system*
- Linux comes with the *world's best compilers* and *development tools*, complete with *version control software*. It is a *programmer's heaven*.
- And finally, the best part: *Linux is free*. You can share it with everyone.

Online Resources and Contact Information

www.linux.org	The Linux portal
www.kernel.org	The official Linux kernel Web site
www.linuxdoc.org	The Linux documentation project
www.ssc.com/lj	Linux Journal is a fine Linux periodical
www.linuxapps.com	Download Linux softwarehere
www.slashdot.org	Slashdot mirrors the Linux community
www.sourceforge.net	SourceForge is *the* place for Linux projects
www.cheapbytes.com	CheapBytes sells cheap Linux CDs
www.oreilly.com	O'Reilly sells the best books on Linux
www.gnu.org	The official GNU Web site
www.linuxlinks.com	Links to many Linux-related Web sites
comp.os.linux	The Linux USENET newsgroup
symonds.net/~deep/stuff/linux	My Linux advocacy page
deepak@despammed.com	My e-mail address: comments/feedback