

Linux, Open Source The not so silent revolution

Jacky Baltes

Outline

- What is Linux? Who is Linus?
- History of Linux
- The open source software model
- The future of Linux
- Linux at the University of Auckland

History of UNIX

- UNIX is an Operating System
 - similar to Win95, DOS, MacOS
 - layer between hardware and application
 - device drivers, file, memory, and process management
- Multi-tasking, multi-user
- Mid 1960's: AT&T developed Multics (canceled 1969)
- C (Kernigham and Ritchie) developed to implement UNIX
- became popular at AT&T (Text processing, speed)

History of UNIX

- AT&T was not allowed to sell computer systems
- Licenced to universities
- 1977 first commercial version of UNIX (SVR3.2 and SVR4.2)
- University of Berkeley
 - Berkeley Software Distribution
- Standardization
 - POSIX.1 C library (printf, open, ...)
 - POSIX.2 Commands
- X Windows (MIT): graphical user interface, networked

What is Linux?

- Freely dist. (open source) UNIX like OS developed by Linus Torvalds
- Implementation of the POSIX standards
- Independent implementation (No AT&T, BSD code)
- Uses a lot of the Free Software Foundations tools
 - gcc, emacs, ...
- Should be called Linux/GNU
- Multi-user, multi-tasking
- Supports X-windows, networking, ...
- Linux (kernel) + libraries + applications => Distribution
 - RedHat, Debian, Slackware, Suse, ...

What comes standard with Linux?

- Development:
 - compilers (c, c++, java, tcl/tk, python, pascal, basic, lisp, bison, perl, fortran, scheme)
 - version control (rcs, cvs)
 - debuggers (gdb, xgdb)
- Text editors and formatting
 - vi, emacs, pico, xedit,
 - TeX, Lyx
 - lout
 - SGML
- Usenet news and email
 - 8 email clients
 - 3 news readers

What comes standard with Linux

- [WWW](#) Development, browsers and servers
 - browser: netscape, arena, chimera
 - apache
- Graphics
 - gimp (photoshop clone)
 - xfig
 - ghostscript
 - ImageMagick
 - POV trace
- Engineering
 - spice (circuit simulation)
 - gnuplot
 - octave (mathematica clone)

Other applications for Linux

- KDE/qt (and GNOME/gtk)
 - Drag and Drop Desktop environment
 - Built in [WWW](#) browser
 - Transparent network access
- StarOffice
 - provides Office suit (Word, Excel, Access, and Powerpoint)
 - commercial but free for academic institutions
 - starts slow, but then very useable (Pentium 200, 32 MB Ram)
 - Ver 5.0 (17 Aug) can read/write Office 97 files
- Scilab: Mathematical package, simulation
 - Toolkits: hidden markov models, Fuzzy Logic, ...
 - Simulators of IAV cars

Other applications for Linux

- DDD: nice graphical debugger
- DosEmu: dos emulator
- Wine: Windows Win95 emulator (beta)

History of Linux

- Late 1980's: several free versions of UNIX
- Minix (Andrew Tannenbaum)
- 386BSD based on BSD
- Linux (Linus Torvalds)
 - University of Helsinki, BSc.
 - started as pet project
- Oct 5th 1991: Usenet released version 0.0.2

Linux Announcement

Do you pine for the nice days of Minix-1.1? when men were men and wrote their own device drivers? Are you without a nice project and just dying to cut your teeth on a OS you can try to modify for your needs? Are you finding it frustrating when everything works on Minix? No more all-nighters to get a nifty program working? Then this post might be just for you.

As I mentioned a month ago, I'm working on a free version of a Minix-lookalike for AT-386 computers. It has finally reached the stage where it's even usable (though may not be depending on what you want), and I am willing to put out the sources for wider distribution. It is just version 0.02...but I've successfully run bash, gcc, gnu-make, gnu-sed, compress, etc. under it.

Linux timeline

- 1991: 100, version 0.0.2
 - 10 programmers took up the call (Internet)
- 1992: 1000, 0.96
 - X windows
- 1994: 100000, 1.0
 - Networking
- 1996: 1,5 million, 2.0
 - several ports
 - multi-processing
- 1997: 3.5 million, 2.1 (every week)
 - monthly linux magazines in a number of languages
- 1998: 7.5 million, 2.1.117
 - 10000 programmers

Linux news '98

- Estimated 4 – 10.5 million users worldwide (7.5)
- Digital Domain: Titanic scenes rendered on 150 Alphas
- Linux Supercomputer: 68 DEC Alpha (\$150k) makes Top500
- Cranfield Uni. replaces their CRAY supercomputer with a network of PIIs
- Linux community receives "Best technical support" price from InfoWorld
- VSync Technology (Tokyo) introduces Internet refrigerator

Datapro Study

- 829 people, Senior IT managers
- Win NT, Win95, Linux, AIX, SCO, BSD, Solaris, ...
- Growth 96–97: only Win NT (40%) and Linux (25%)
- Satisfaction: Linux wins, Solaris, ... Win NT middle
- Performance: Digital UNIX, Linux, ... Win NT last
- Functionality: Digital UNIX, Linux, ... Win NT last
- Price, flexibility, Java support, cost of ownership, ease of management, technical support, ...

Linus quotes

- "World domination", a joke?
- "I would work for Microsoft if they had an intellectual challenging problem to solve ..."
- "I must be stupid, this bug took me five minutes to find"
- "How should I know whether it works. I just code it"
- Exchange with Andrew Tanenbaum
 - Linux is monolithic, not a microkernel architecture
- I don't dislike Microsoft, they just make a crappy OS

The Bazaar vs. the Cathedral (Eric S. Raymond)

- "The mythical man month" (Fred Brooks)
 - Programmer time is not fungible (<20)
 - ◆ Adding programmers to a late project makes it later
 - ◆ Brooks' s Law
 - Communication grows quadratically
- Linux: 201 people mentioned in the credits
- UNIX small tools, rapid prototyping, evolutionary programming for small software
- Large projects require centralized control
- Do not release to public too soon
- Cathedrals: few mages, isolation, then release

Bazaar model

- Linus Torvald's model
 - release often (sometimes multiple versions per day)
 - delegate everything
 - make everything open
- Bubbling bazaar:
 - how come doesn't fall apart
 - became stronger and stronger
- Developed "fetchmail" to test his theory

Lessons learned from "fetchmail"

- Motivated programmers
- Good programmers know what to write, great ones know what to reuse
- Plan to throw one away, you will anyhow (Fred Brooks)
 - don't really understand problem until 2nd time
- Interesting problems will find you
- Your last duty is to hand off a project to a successor
- Users as Co-developers
 - quick release—test—improve iterations

More lessons

- Release early, release often AND listen to your customers
 - keep your co-developers stimulated
- Given enough eyeballs all bugs are shallow
 - Cathedral: bugs are tricky, deep
 - Bazaar: Most bugs are shallow or become shallow with enough people trying to find them
- Linus's law
- Sociology (Delphi effect):
- Debugging is parallelizable

More lessons

- Smart data structures and dumb code work much better than the other way around
- Treat your beta testers well
- The next best thing to good ideas is to recognize good ideas
- Often the most striking and innovative solutions come from realizing that your concept of the problem was wrong
- Perfection in design is when there is nothing more to take away

The Open Source revolution

- FSF: Richard Stallman (70's)
- Jan 22nd: Netscape announces release of source code
- Feb 5th: Brain storming
- Tim O'Reilly: Freeware summit
- May: Corel announces Netwinder, and WP for Linux
- IBM: sell and support Apache ([WWW](#) server)
- July: Oracle and Informix port databases to Linux
- Aug: Linux is on the cover of Forbes' Magazine
- Aug 21st: IEEE call for paper for special issue on Linux

Mac Developers want Open Source

- July '98: Don Yacktmann w/ Apple engineers
- release source code for part of X server (Rhapsody)
- Mach, BSD kernel
- Device driver kit
- Hazard: loss of programmer's resources. Programmers write applications for at most 2 operating systems
- Advantages:
 - possible to adopt the software -> more applications
 - peer review -> more robust, efficient software

Linux SMP

- Example of cutting edge technology
 - Dual Pentium II systems are cheap (< \$6000)
- Example of deep bug/ major change
- How does it compare to NT
- 1.3 realized that current kernel does not support SMP well, rewrite adapt
- 2.0: compromise: supports SMP (4 processors), but
 - kernel access is locked, only one processor can access
 - IO are delayed
- 2.1: Signal, interrupts, some IO have their own locks

Future of Linux

- The way to world domination (Linus' .signature file)
- July '98, Santa Clara: 1000 people
- Future looks bright! (gotta wear shades)
- Oracle announces release of Oracle 8 for Linux
- Estimate 20-25% of all Intel processors will run Linux

Linux vs. commercial OS

- **Jeremy Allison (Samba)**
 - Lacks: 64 bit file system support, Access control lists, asynchronous I/O, NFS locking
- **Larry Augustin (VA research)**
 - Datapro survey
 - Linux rates best over all, and wins all but two categories
- **Sumil Saxena (Intel)**
 - Intel support Linux
 - > 4 way SMP
 - high end drivers
 - direct server control (remote administration)
- **Linus (Linux)**
 - runs from supercomputer to PalmPilot

Future of Linux

- **Sumil Saxena:**
 - Major increase in Intra/Internets, ISPs
 - Electronic commerce
 - Internet appliances, wearable computers
 - early access to Intel specs
- **Linus**
 - kernel is just a vessel
 - easy to use applications
 - non-traditional UNIX applications
- **Jeremy Allison**
 - killer server platform
 - Linux computers (Corel)
 - 20–25% of all Intel systems

Future of Linux

- **1000 systems, need high end CAD support?**
 - 500 people requested ports of Synopsis, Cadence tools at June '98 design automation conference
 - must let vendors know
- **Intel and NDA, Merced**
 - Linus: done deal, 64 bit clean (Sparc, DEC)
 - Sumil Saxena: issues can be resolved (engineer)
- **Difference between Linux and FreeBSD**
 - Linus: not all that much
 - Linus: I call the shots
 - Linux started from scratch, threw out some old stuff
 - Example: No real SMP support in FreeBSD
 - lighter, faster, more rapid development

Future of Linux

- **What if Linux would cost money**
 - Datapro shows that Linux wins also in reliability and support
- **Patent issues**
 - danger to open source software
 - biggest problem in the US
 - exporting jobs to other parts of the world
- **Re-engineering**
 - proposed change to US state laws
 - does not allow to reverse engineer software etc.

Linux vs Win NT

- Reduced costs as compared to Win NT (\$4636)
 - No quotas (NT5), no MTA, no POP/IMAP server
- University of Nebraska, Press Information System
 - CATS (Order fulfillment and inventory system)
 - NT was a nightmare
 - System crashed two to three times a day
 - Applied patches, \$1500 phone support
 - System crashes twice a week
 - Now we are running Linux as our server

Linux at the University of Auckland

- City: EE run Root–NFS setup, some staff in CS, EE
- Tamaki: Paul Bonnington, Suad Musovich, and me
- Tamaki undergraduate labs: Root NFS boot for all PCs, running Linux RedHat 5.1
- Linux Installfests (2/year)
 - Aug '98: installed Linux on about 25 machines
 - Linux helpers
 - advertisement and scans
- nix.tmk.auckland.ac.nz: RedHat, KDE, StarOffice, ...
- Linux CDs:
 - Tamaki library (8 times since June)
 - for sale at ComTech in Pannure

Web resources

- Local
 - [http://nix.tmk.auckland.ac.nz/\\$AL](http://nix.tmk.auckland.ac.nz/$AL)
 - <http://www.tcs.auckland.ac.nz/~jacky/linux/tips> and Tricks)
 - [ftp://ftp.auckland.ac.nz\(old\)](ftp://ftp.auckland.ac.nz(old))
- NZ:
 - ClearNet
- World:
 - <http://www.redhat.com>
 - <http://www.linuxresources.com>
 - <http://www.linux.org>

Implications for UofA

- Students have access to high quality tools
- Most applications in 3rd/4th year CS use UNIX tools
- Encourages active learning
 - Device driver
 - Man pages
 - 122 MB of doc
- Software engineering course
 - Theory: large projects, > 10 programmers
 - Success of open source is undeniable
 - Excellent opportunity to get students involved
 - University of Auckland Robotics toolkit, VHDL bench, ...
 - Students do contribute to these during their studies
 - Trial: 114 students, Towers of Hanoi, RoboCar controller