UNIX, Linux and BSD: a re-examination of my of 09/00 BLU “A Short UNIX History” talk

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Biography: Clem Cole

- an old school hacker and “Open Sourcer” with more than 30 years of free and open source system development experience.
- has held most every position in the computer field from operator, programmer, designer to VP of Eng and CTO and startup founder
- first encountered the early editions of UNIX while a university student, writing a variety of device drivers, kernel enhancements, and microprocessor support tools for the early 4- and 8-bit CPUs
- has been designing and developing Operating Systems and Technical Computing Systems ever since
- currently @ Intel leading an international team of engineers building super computers and super computer systems
- degrees in EE, Math, & CS from CMU and UCB, with the usual multi-page list of publications and talks to his credit
- helped to write one of the original TCP/IP implementations in the late 1970’s
- is also known as one of the authors of the precursor to IM, the UNIX talk program, as well as other more humorous and notorious hacks
- is honored to be the current President of the USENIX Association

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- These slide were produced from material found in many places, including but not limited to
  - My brain, notes, texts,
  - My education at CMU and UCB,
  - My professional mentors,
  - IEEE and USENIX Associations
  - Larry Lessing “Free Culture”

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Agenda

- Quick Review
- UNIX Market Update
- BSD Market Update
- Linux Market Update
- The New name for UNIX Market is OSS
“The reason *closed [source]* software forks into incompatible versions is so that one company can differentiate its version from everyone else’s.”

*Eric S Raymond, Business Week, April 27, 1999.*
Themes from Sept 2000

- Something new is really something old
- The Open Source Culture predates UNIX and Linux
- Evolution is good
- Fighting is not always bad, but we all need to learn when it’s good enough and stop fighting
Standards are an agreement that it’s time to stop fighting
BSD & Linux both bring much to the table, they are complements
We have a standard (UNIX/POSIX), let’s not create a new one
If Open Source is to succeed, the BSD/Linux rift must stop

*The issues are really elsewhere … let’s all work together*
We are all around the same fire...
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4/14/09
UNIX became the Intellectual High Ground of the CS community.

Dennis M. Ritchie, private communication, 2000.
A UNIX Family History 1st 25 Yrs

Other Players

Research

UCB

PWB

µSoft/SCO

Multics


PWB/UNIX PWB 1.0 PWB 2.0 Sys III Sys V Sys V. 2

Sys III Sys V Sys V. 2

CMU Accent CMU Mach

CMU Mach 2.5 CMU Mach 3.0

SVR3 SVR4 SVR4/ESMP

RIG

BBN Generic TCP/IP

4BSD 4.1A

4.1BSD 4.2BSD 4.3BSD

4.3Tahoe 4.3Reno 4.4BSD

OSF1

Minix

386/BSD Net 1.0 Net 2.0 FreeBSD

FreeBSD

Linux

Linux 1.0 Linux 1.1 Linux 1.2

TRU64

Linux 2.0

NT/OS2 NT/Win

NT/Win

µSoft/SCO µSoft/Xenix SCO/Xenix SCO/UNIX

Linuxware

OSF1

Tru64

Linux

Linux 1.0

Linux 1.1

Linux 1.2

NT/OS2

NT/Win

4/14/09
Where is UNIX in 2009?

- The final commercial UNIX players
  - Sun (Open) Solaris
  - IBM AIX
  - HP UX
  - Apple Mac OSX
Solaris / Open Solaris

◆ Basic Heritage
  ❖ Merge of AT&T System V4 adding in BSD 4.2 plus new IP

◆ Market Reputation
  ❖ Solaris is the “Gold Standard” for Enterprise Computing on SPARC
    □ Just works
    □ Huge ISV base, particularly in commercial applications
    □ Replaced System 360 and family as the “nobody got fired for buying ..”
  ❖ Solaris/386 – huh?
    □ Sun does not convince the market that they were serious about Intel processors
    □ Roadrunner (Sun 386 system) was an extremely short lived product
  ❖ Open Solaris does runs on x86 and INTEL® 64, although only small market penetration of same
    □ Even though Sun now (again) produces Intel based product

◆ The Volvo Truck of the industry

◆ Largest/Lasting Innovation
  ❖ NSF, NIS (aka YP)
  ❖ SMP Enhancements
    □ SMP scaling of enterprise codes
  ❖ Solaris Threading Model used by lots of ISVs
    □ not pthreads

4/14/09
AIX

◆ Basic Heritage
  ❖ System V.3, with lots of BSD

◆ Market Reputation
  ❖ Mainline product is Enterprise class
    □ although sluggish and “less cool” than Solaris
  ❖ The Oldsmobile of the Commercial UNIX Implementations

◆ Largest /Lasting Innovation
  ❖ Commercially available exotic configurations and structures
    □ Clusters and Federations for HPC
      ■ SP2 family
      ■ Cell
    □ TCF – Transparent Computing Facility (SSI clusters on AIX/x86 & AIX/370)
UX

- **Basic Heritage**
  - BSD Kernel, with System V.3 and V.4 APIs added

- **Market Reputation**
  - Rock Solid
  - Not sexy like Solaris
  - Reasonable Scaling
  - The Ford F150 of the Commercial UNIX Implementations

- **Largest /Lasting Innovation**
  - UX + IPF can handle hardware failures
  - Forced SPARC, PPC and Intel® 64 to be better as commercial systems
OSX

◆ **Basic Heritage**
  - Mach 3.0 (OSF uKernel), BSD 4.4, System V & Solaris as needed

◆ **Market Reputation**
  - Best desktop system of any OS
  - Cool
  - Just works, “virus proof” (not actually reality – but is the rep)
  - Even safe for corporate environments, the commercial alternative to Winders
  - BMW M5 of the industry

◆ **Largest/Lasting Innovation**
  - Mainstream Window/GUI admin of a UNIX system
    - Jamie Cameron’s Webmin predates this but was not as wide spread
  - Superb integration of certification and security keys
  - Excellent integration of a “server” system as a desktop
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“BSD 4.2 just like UNIX, only different.”

Henry Spencer, University of Toronto in a net.news posting circa 1982.
A UNIX Family History 1st 25 Yrs

Other Players

UCB

Research

PWB

μSoft/SCO
Where is BSD in 2009?

◆ The final BSD players
  - FreeBSD
  - OpenBSD
  - NetBSD
  - Darwin / Mac OSX
Free BSD

◆ Basic Heritage
  - BSD 4.4 + 386BSD
  - The original “Freely available” UNIX for an x86

◆ Market Reputation
  - Just works
  - Used by large and small ISPs
  - Scales well
  - Best Solaris/SPARC alternative for 32-bit x86 system
    - Gold Standard of traditional BSD on Intel platforms

◆ Largest /Lasting Innovation
  - Simple (PC style) install
  - Free (as in beer) UNIX on x86/PC hardware
Net BSD

◆ Basic Heritage
  ❖ BSD 4.4

◆ Market Reputation
  ❖ University / research tool to explore ideas

◆ Largest /Lasting Innovation
  ❖ Runs on almost any 32-bit hardware platform with a reasonable memory system
  ❖ Was the system Linux had to displace in research community for experimentation
Open BSD

◆ Basic Heritage
  ◆ BSD 4.4 – derivative of NetBSD

◆ Market Reputation
  ◆ Security by design and vigilance
    □ Try to break in .. Really
    □ We bet none of you can
      ■ Anytime anything has been exposed, Open BSD closes it in hours. Most issues are in user space and come from the security conferences when people consider new attacks.

◆ Largest /Lasting Innovation
  ◆ Security by code review of everything
    □ Kernel and user space
  ◆ Very small… if you can not demonstrate why it needs to be there, it’s not
Darwin

- Basic Heritage
  - Mach 3.0 uKernel + some Apple-isms

- Market Reputation
  - What’s Darwin?

- Largest /Lasting Innovation
  - ?? Maybe the Hackintosh
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“Linux is just like UNIX, only names have been changed to protect the guilty.”

_Clem Cole, in an evaluation report on Linux for Locus Computing Corp circa 1991._
“The reason closed software forks … Anybody that does do that will see their product quickly die because there's no reason anyone else would want to use it. ”

Simplified Linux Family Tree, circa ‘09

Kernel.org

- OpenSuSE
- Fedora
- Debian
- Moblin

- Novell/SUSE
- Red Hat
- Pixart
- Ubuntu
- Linspire

- Asianux
- CS2C
- Oracle
- Knoppix
- Bayanihan
- GnuLinEx

- RedFlag
- Miracle
- Haansoft
- Vietsoft

Community Distribution
Product
Consortium

+11 Linux OSVs
Where is Linux in 2009?

- The current main stream Linux Distros
  - RH
  - SuSE
  - Canonical
  - Asianux
  - Moblin
RH

◆ Basic Heritage
  ❖ kernel.org main line, with System V API and applications from GNU, BSD et al.
  ❖ RH added value add, such as RPM, their installer and packaging

◆ Market Reputation
  ❖ In USA, RH = Linux
    ❑ When ISVs talk about porting to Linux, they mean RHEL
    ❑ RHEL is considered the enterprise Linux
  ❖ Excellent market presence but many find working with them difficult
    ❑ MSFT of the Linux world (tries to be just as controlling)
  ❖ Expensive

◆ Largest/Lasting Innovation
  ❖ Linux can work in the enterprise
SuSE

◆ Basic Heritage
  - kernel.org main line, with System V API and applications from GNU, BSD et al.
  - SuSE added value add, first workable Linux installer and packaging

◆ Market Reputation
  - In EMEA, SuSE = Linux
    - Mostly likely mean SLES
  - OK market presence but great engineering team
    - Avis to RH’s Hertz
  - Continues to innovate ahead of RH, and adopts latest technology fastest
  - Willing to sell their soul to Redmond

◆ Largest /Lasting Innovation
  - First and best non-English distro
  - Enterprise wide NDIS/LDAP (much cleaner than Windows)
  - Mail from Novell, that competes favorably with Outlook/Exchange

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Ubuntu/Canonical

◆ Basic Heritage
  ❖ kernel.org main line, with System V API and applications from GNU, BSD et al.
  ❖ Debian - GNU/Linux

◆ Market Reputation
  ❖ Workers of the World Unite
    ❑ Will always be free
  ❖ Closest to the GNU Manifesto of any Linux
  ❖ Excellence in engineering an award winning simplified user experience
    ❑ But questionable if they can survive
  ❖ A desktop that can compete with Windows/Home
    ❑ Thank the Lord that Sun continues to invest in OpenOffice
  ❖ Support for >40 languages
  ❖ Unwilling to sell their soul to anyone
  ❖ Some of Kernel Community resent lack of OS or subsystem contributions

◆ Largest /Lasting Innovation
  ❖ Most PC-like install yet
  ❖ Extremely simple update scheme
Asianux

- **Basic Heritage**
  - RH

- **Market Reputation**
  - Don’t enter Asia’s market without it

- **Largest /Lasting Innovation**
  - Extremely good support for Asian character sets
  - Easy to do business, like minded
  - Proved an consortium can work in the Linux market, even after the United Linux failure
Moblin

◆ **Basic Heritage**
  - kernel.org main line, with System V API and applications from all over
  - Integrating lessons-learned from Puppy, DSL, et al
  - Community project with a complete stack
    - Kernel, driver, OS+UI+Apps, Infrastructure ....

◆ **Market Reputation**
  - I’ve heard of it, but I’m not sure what it is
  - It’s not in there
    - Trying to be as light/small as possible
  - Why is Intel behind a distro?
    - It’s not – it’s a community like Fedora, but Intel is shepherding it since its targeted to MIDS, Netbooks, embedded, automotive etc…

◆ **Largest/Lasting Innovation**
  - Linux really aimed at mobile device
    - Optimized for power, performance and footprint
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4/14/09
“...the Linux environment will fork (just as traditional Unix did) if it really becomes a commercial success. The reason is because to be a real business, product differentiation is the key to each firm’s success!”

Clem Cole – BLU talk Sept 2000 on an e-mail exchange I had earlier with ESR
The Great Fork Debate

- If Linux is limited to the kernel.org and what Linus and Alan Cox control, ESR’s prediction is correct
  - We have one basic kernel stream
    - Although the distros are never in sync with it
    - Most commercial SW does not use it

- Since Linux really is more than just the kernel, Linux has forked even more than UNIX ever did … sigh

- This is the observation that Apple and Microsoft are betting their businesses upon
A word on Licenses…

- I Believe, I Believe
- OS is great, so should to GPL everything and life will be good…. Read the Source Luke….

- (Well maybe not….)

4/14/09
Linux & My Code

Community: “It *may* be OK to not be open here”

<table>
<thead>
<tr>
<th>Applications</th>
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</tr>
</thead>
<tbody>
<tr>
<td>System Shared Libraries</td>
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<tr>
<td>The Linux kernel (<em>i.e.</em>, the main part of the OS)</td>
<td></td>
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</tr>
<tr>
<td>Loadable kernel modules (<em>i.e.</em>, drivers)</td>
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</tbody>
</table>

Community: “This *really* should be open under GPL”
Linux & My Code, cont.

Community DOs and DON’Ts for dynamic linking of non-GPL code

- **NO**
  - Applications
  - System Shared Libraries (GPL)
  - The Linux kernel (i.e., the main part of the OS)
  - Loadable kernel modules (i.e., drivers)

- **OK**
  - Applications
  - System Shared Libraries (LGPL)

- **OK** (if the other license allows)
  - Applications
  - System Shared Libraries (Other License)

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“User Space”

“Kernel Space”
<table>
<thead>
<tr>
<th>Feature</th>
<th>GPL</th>
<th>BSD</th>
<th>Apache</th>
<th>EPL, CDDL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copyleft (sources must be released)</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Spreads by linking</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Clear patent license</td>
<td>V2 - No</td>
<td>V3 - Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>“GPL compatible”</td>
<td>V2 &amp; V3 incompatible</td>
<td>Yes</td>
<td>V2 - No</td>
<td>V3 - Yes</td>
</tr>
</tbody>
</table>

Each license has pluses & minuses: your mileage may vary, check with your own legal advisors
Why Does Open Source Work?

- Traditional UNIX was Open Source by ESR’s definition
- Linux is working and has displaced UNIX in many areas
- Why is the “new” model an old one and why does it work?
  - It’s all about how revenue is taken and money is made
The Seeds of Open Source

“If I sell the software, I go in the front door like any other salesman, if I give it away as my research, I get to walk in the backdoor and see their secrets.”

Donald O. Peterson, private communication
Open Source Software

- Donald O. Peterson (a.k.a. dop) father of the EE CAD begets “Open Source”
  - dop et al. are funded by Government and mostly industry, but the university is not in competition with any of them
  - UCB’s job is push out the State-of-the-Art

- In early 1970’s EE already gave away its EE tools: SPICE, SPLICE, MOTIS, etc.

- CS Div. is part of the EE department at UC Berkeley

- The “give away” the open source culture and processes were already in place
  - Mag Tapes (DVDs of the day ;-) were distributed
  - Internet distribution just made this easier
OSS Business Models

- OSS vendors sell any of, or a combination, of the following
  - Standard ISV revenue streams: Subscription based software, Services, Licensed software and/or runtime licenses
    - Some offer a mix of proprietary and OSS
- Each customer that uses code is a lead
  - New product technology risks are reduced because people use the product
  - Web-based lead management becomes the key to sales
- Sales theories for OSS software
  - ~3X price advantage with similar function advantage over competition
  - ~4X sales cycle compression due to rapid market share acquisition via downloads
- As OSS moves from early adopter to mainstream adoption, revenues increase
- OSVs have moved to applications and on-line marketplaces
  - Red Hat announced RHX which hopes to be “Amazon” for OSS

New low cost model = low overhead + scale
### How To Spot A Successful Open Source Project

**A 9-point checklist before considering using open source.**

<table>
<thead>
<tr>
<th><strong>A thriving community</strong></th>
<th><strong>Disruptive goals</strong></th>
<th><strong>A benevolent dictator</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>A handful of lead developers, a large body of contributors, and a substantial—or at least motivated—user group offering ideas.</td>
<td>Does something notably better than commercial code. Free isn't enough.</td>
<td>Leader who can inspire and guide developers, asking the right questions and letting only the right code in.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Transparency</strong></th>
<th><strong>Civility</strong></th>
<th><strong>Documentation</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Decisions are made openly, with threads of discussion, active mailing list, and negative and positive comments aired.</td>
<td>Strong forums police against personal attacks or niggling issues, focus on big goals.</td>
<td>What good’s a project that can’t be implemented by those outside its development?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Employed developers</strong></th>
<th><strong>A clear license</strong></th>
<th><strong>Commercial support</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>The key developers need to work on it full time.</td>
<td>Some are very business friendly, others clear as mud.</td>
<td>Companies need more than e-mail support from volunteers. Is there a solid company employing people you can call?</td>
</tr>
</tbody>
</table>

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From InformationWeek, Feb 2007
“Good programmers write good programs. Great programmers start and build upon other great programmer’s work.”

Unknown origin, often attributed to Fred Brooks.
Conclusion

- UNIX is alive today
- UNIX still looks a lot like it did under the covers
- Lots of new faces and names
- The fight is not over, so let’s work together
Questions?