



財團法人國家實驗研究院

國家高速網路與計算中心

NATIONAL CENTER FOR HIGH-PERFORMANCE COMPUTING

自由軟體與 DRBL/Clonezilla 簡介

蕭志槐 孫振凱 蔡育欽

<http://drbl.nchc.org.tw>, <http://drbl.org>

<http://clonezilla.nchc.org.tw>, <http://clonezilla.org>

國家高速網路與計算中心

Q2, 2015



自由軟體與 DRBL/Clonezilla 簡介

- 自由軟體簡介
- DRBL 與 Clonezilla 簡介
 - 關於 DRBL/Clonezilla
 - 台灣與世界上的使用者
 - 相關活動
 - 成功案例
 - 見證
- 展示
 - DRBL, Clonezilla 等



Question ?

- 自由軟體 / 開放原始碼軟體 / 免費軟體的差別？
- 使用過 Linux / BSD 系統？
- 使用 Linux / BSD 當 Server ？
- 使用 Linux 教學、研究或辦公？

觀念與理念的接受最重要
擁抱自由永遠不嫌晚



講師簡介

- 國家高速網路與計算中心 軟體發展組組副組長 2013 ~ 至今
- 國家高速網路與計算中心 軟體技術組組長 2010 ~ 2013
- 中華民國軟體自由協會理事長 2011 ~ 2015
- 中華民國開放系統協會理事 2005 ~ 2015
- 法國自由軟體組織 OFSET 副主席 2006 ~ 至今
- 從 1993 年開始接觸 GNU/Linux
- 2002 年開始開發與發行自由軟體
- 2008 年行政院傑出科技貢獻獎得主

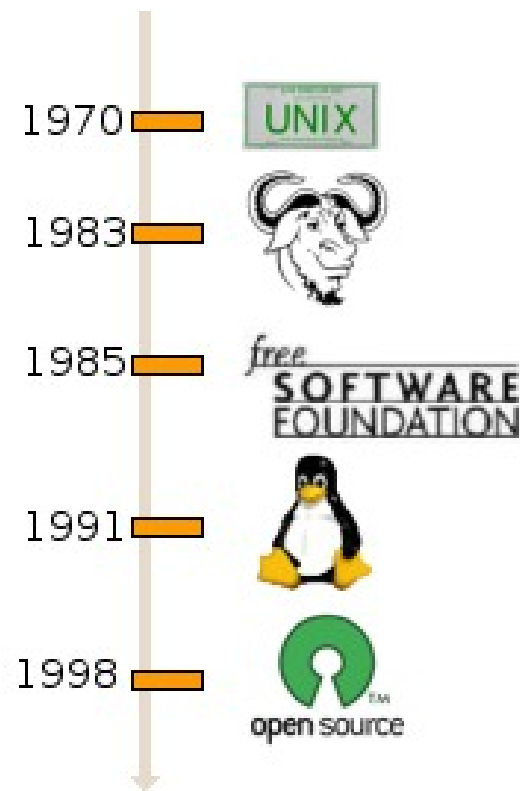


自由軟體與開放原始碼簡介



Free Software & Open Source

- 'Free Software' term author – Richard Stallman
- 'Open Source' term author – Eric Raymond
- 'Open Source Definition' (OSD) – Bruce Perens
- Richard Stallman 等 Free Software 的擁護者並不同意由 Open Source 這個名詞來取代 Free Software
 - Free 比 Open Source 條件更為嚴格
 - Free Software 可視為 OSS 的部分集合
- 自由軟體的四大自由 - 使用，複製，修改，再散播 (Freedom to Use, Copy, Modify and Distribute (UCMD))



不是創新的創新

- Freedom to use, copy, modify and distribute 自由地使用，複製，修改與散播
- Legal 合法
- Software almost free of charge 軟體幾乎免費
- Charge service 服務才收費



自由軟體 / 開放原始碼的作業系統能做？ 以 Ubuntu Linux 為例



Figure source: <http://www.pcworld.com/>

自由軟體 (Free Software)

站在巨人的肩膀上，是自由軟體發展的理念。其靈活、**可自由複製、分享**的價值，將有效解決資訊教育的管理成本及商業軟體高成本負擔的問題。

Freedom to **Use, Copy, Modify and Distribute (UCMD)**



Copyleft vs. Copyright

- Copyright
 - 保護智慧財產權
- Copyleft
 - 基於互惠原則
 - 保護智慧財產權，更保護公共使用權
 - 開發者與使用者能夠自由的 **U**、**C**、**M**、**D**



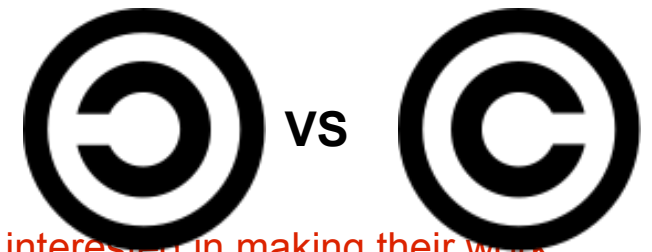
From Martin Fink, "The Business and Economics of Linux and Open Source", Prentice Hall PTR

Lawrence Liang

What is copyright? What is copyleft?

How can we share culture in a world where everything has a license?

Scientists, writers, designers, artists, musicians and others are increasingly interested in making their work available in 'the public domain'. This booklet is an overview of the ways in which this has been done and a guide to the growing area of Open Content Licenses through which people design and safeguard access to their work.



<http://www.gnu.org/copyleft/copyleft.html>

http://pzwart.wdka.hro.nl/mdr/research/liang/open_content_guide



Some Open Source Licenses

- Copyleft or not ?
 - Apache Software License - No
 - BSD License – No
 - GNU General Public License (GPL) - Yes
 - GNU Lesser General Public License (LGPL) – Yes
 - IBM Public License – Yes
 - Mozilla Public License (MPL) – Yes
 - MIT License – No
 - Python License – No
 - Qt Public License (QPL) – Yes
 - ...



Question

為何會有人要開發自由軟體讓別人自由，乃至於免費使用？

Unix History

- Multics – MIT, GE
- Bell Labs, AT&T, early 1970's
 - Unix, C Programming Language
 - Ken Thompson 、 Dennis Ritchie
 - 主要概念
 - 所有程式都是檔案 - (最具創意的概念)。
 - 不論是建構編輯器還是附屬檔案，所寫的程式只有一個目的，且要能有效完成目標。
 - 任何人可以由小到大，模組化建構系統。
- BSD – Berkeley Software Distribution
 - Billy Joy(em), Marshall Kirk McKusick



Unix Wars

- **UNIX variants**

- AT&T, Bell Labs (1956~197x)
- UC, Berkeley – Berkeley Software Distribution (1977)
- SCO Unix
- Sun – SunOS, Solaris
- IBM – AIX
- SGI – Irix
- HP – HP-UX

- **SYSV, BSD, POSIX**

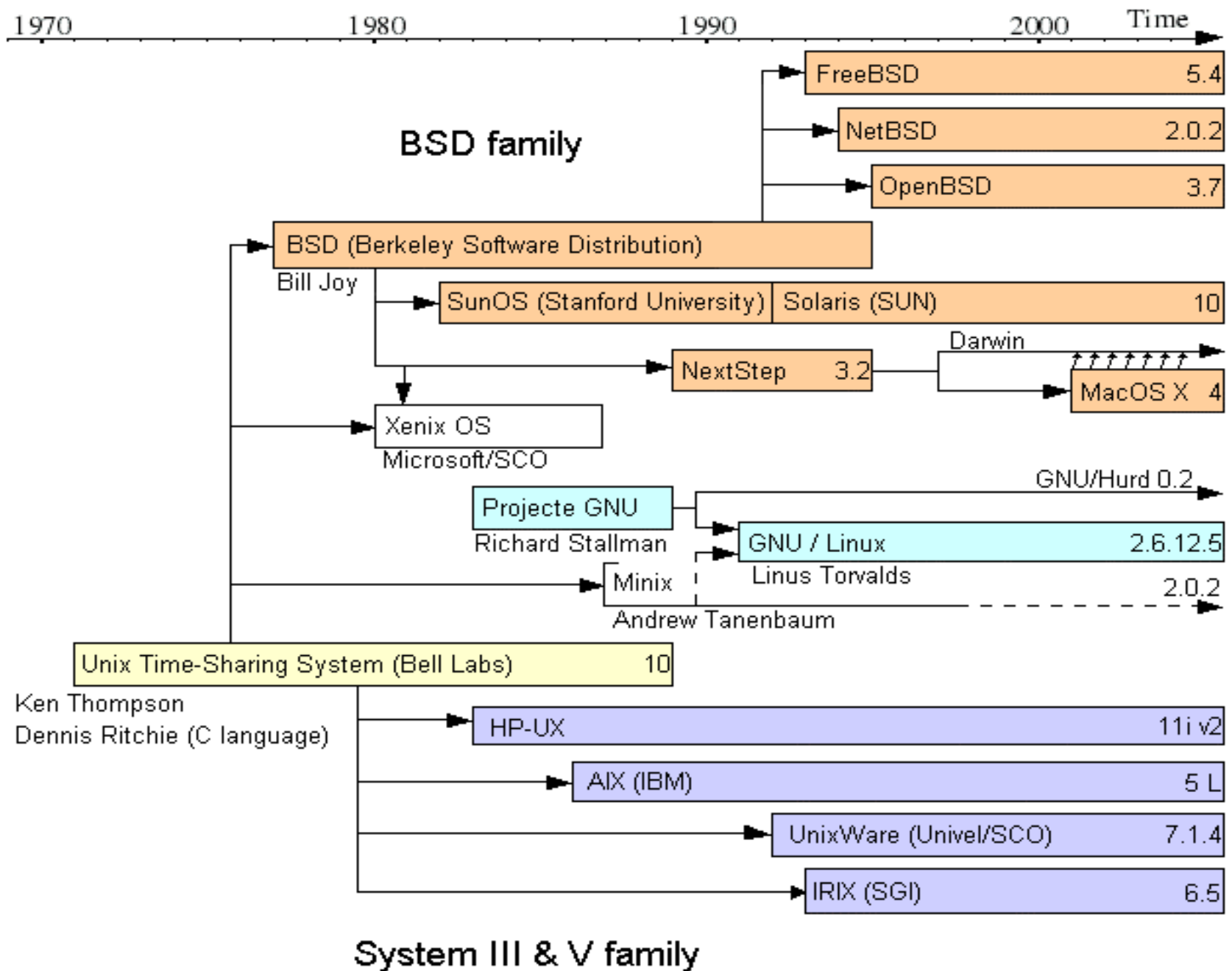


Opensource UNIX-like OS

- Minix
- Linux
- BSD series, OpenBSD, FreeBSD, NetBSD
- Darwin, BSD4.4 + Mach Microkernel, Apple
- More...



Unix-like history



Question

目前世界上佔有率最高的 Unix 系統是？



GNU – Gnu is Not Unix!



- 1983/9/27
- 教主 :Richard Stallman
<http://www.stallman.org/>
- Free software manifesto
<http://www.gnu.org/gnu/manifesto.html>
- Free means freedom!
- Free Software Foundation – FSF
- 軟體應該是人類的共同智能，屬於公共財！



GNU – Richard Stallman

- 試想，如果有人跟你說：只要你保證不拷貝給其他人使用的話，我就把這些寶貝拷貝給你用。其實這樣的人才是魔鬼；而誘人當魔鬼的，則是賣高價軟體的人 - Stallman
- Stallman: 「我要做出一系列亂棒的自由軟體，好到讓廠家們只要不用他就會倒店的程度。」



探討『Free』：免費 or 自由？

- 是自由，不是免費，但是因為可以 U. C. M. D. 所以費用趨近於零，免費只是邊際效應
- Free beer ? No...
- Free speech - By Richard Stallman. (公共財 ,Public good)
- 天下沒有白吃的午餐 ？
- 洛陽紙貴，食譜等例子
- “Free software is free as limestone, wood and silicon. Those are all elemental substances, freely produced by nature.... Free software is produced by human nature” - By Doc Searls (Linux Journal 的資深編輯).
- 自由軟體是建在互惠的基礎上
- 自由軟體還是可以收費，不過不能阻止買者再自由傳播散佈自由軟體
- GPL 軟體可與私有軟體合併，但要所有作者同意

註：

- ♦ 公共財產，在經濟學的解釋裡，是一種財貨；從消費方面的觀點上，具有「非敵對性，或稱非獨享性、共享性」；從供給方面的觀點上，具有「無法排他性」。



Free Software Definition

- Free software is a matter of the users' freedom to run, copy, distribute, study, change and improve the software. More precisely, it refers to four kinds of freedom, for the users of the software:
 - The freedom to run the program, for any purpose (freedom 0).
 - The freedom to study how the program works, and adapt it to your needs (freedom 1). Access to the source code is a precondition for this.
 - The freedom to redistribute copies so you can help your neighbor (freedom 2).
 - The freedom to improve the program, and release your improvements to the public, so that the whole community benefits (freedom 3). Access to the source code is a precondition for this.
- 其他規範 ...



Question

你認為自由軟體的四大自由，哪個最重要？



Legal Issues

- <http://www.gnu.org/licenses/>
- GPL – General Public License
- LGPL – Lesser General Public License
- 非官方中文翻譯
 - <http://www.gnu.org/licenses/licenses.zh-tw.html>



Opensource



Source: The movie - Revolution OS

- 傳教士 Eric S. Raymond
 - <http://www.tuxedo.org/~esr>
 - Opensource 一詞的發明人
 - 著作
 - The Cathedral & The Bazaar
 - The Art of UNIX Programming
 - A Brief History of Hackerdom
 - Netscape 對 Navigator 原始碼的開放



The Open Source Definition

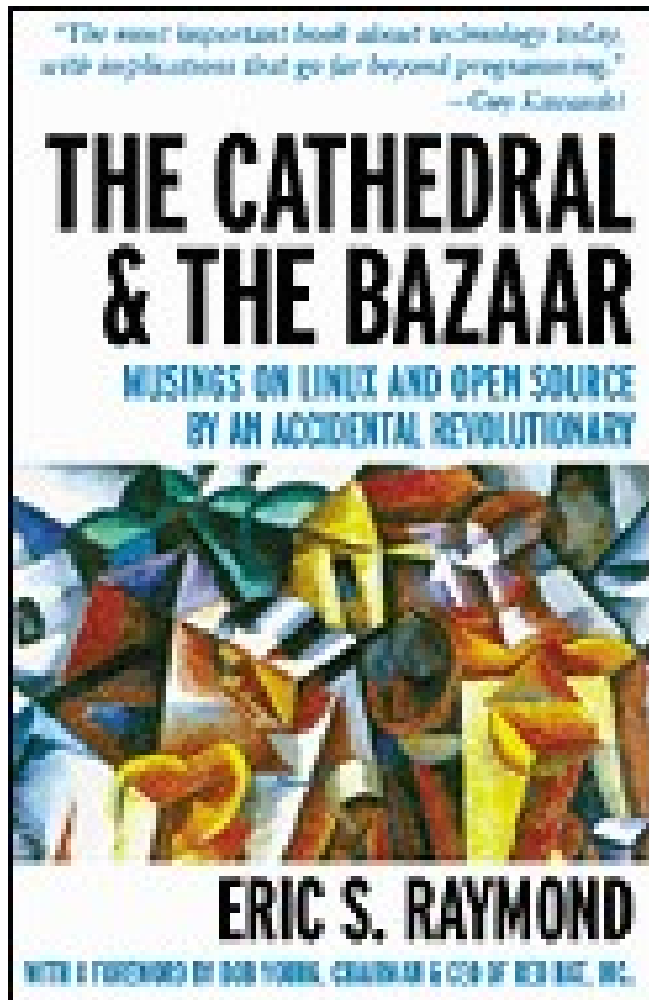
- Free Redistribution - 自由再散布
- Source code - 原始碼
- Derived works - 衍生著作
- Integrity of the author's source code - 原創作者程式原始碼的完整性
- No discrimination against person or groups - 不得對任何人或團體有差別待遇
- No discrimination against fields of endeavor - 對程式在任何領域內的利用不得有差別待遇
- Distribution of license - 散布授權條款
- License must not be specific to a product - 授權條款不得專屬於特定產品
- License must not contaminate other software - 授權條款不得限制其他軟體
- License Must Be Technology-Neutral - 授權條款必須技術中立

<http://www.opensource.org/docs/definition.php>

<http://www.openfoundry.org/>



The Cathedral & The Bazaar



- Case study
 - Linus Torvalds' Linux
 - ESR's fetchmail
 - Netscape, Mozilla
 - Many many more!
- 把你的使用者視為協同發展人，可以讓你傷最少的腦筋，但做到原始碼的快速改善，程式的除錯有績效。
- 中文翻譯版：
 - <http://www.linux.org.tw/CLDP/doc/Cathedral-Bazaar.html>



The Cathedral & The Bazaar

- [格言 1] 好軟體都是起源於程式發展者要解決切身之痛 .
- [格言 2] 優秀的程式師知道要寫程式 , 偉大的程式師知道要改寫 (和重覆利用) 程式 .
- [格言 5] 當你對一個問題不再感興趣時 , 你最後的責任就是找位能勝任的接棒人 .
- [格言 7] 儘早 , 經常發表新版本 , 並且傾聽使用者的意見 .
- [格言 8] 足夠多的人來看程式 , 所有的錯誤都變得淺顯 -
Linux 定律



Question

除了 ' 站在巨人的肩膀上 '， ' 不要重複發明輪子 '，還有哪些格言跟自由軟體，開放原始碼軟體的精神是一致的？

Linux History



- Linus Torvalds, Finland
- Just for fun!
- Related to Minix
- Newsgroup flame
- Opensource
- Internet effect

Source: http://en.wikipedia.org/wiki/Linus_Torvalds



Linus 改變歷史的一篇 post

From: torvalds@klaava.Helsinki.FI (Linus Benedict Torvalds)

Newsgroups: comp.os.minix

Subject: What would you like to see most in minix?

Summary: small poll for my new operating system

Message-ID: <1991Aug25.205708.9541@klaava.Helsinki.FI>

Date: 25 Aug 91 20:57:08 GMT

Organization: University of Helsinki

Hello everybody out there using minix -

I'm doing a (free) operating system (just a hobby, won't be big and professional like gnu) for 386(486) AT clones. This has been brewing since april, and is starting to get ready. I'd like any feedback on



Linus 改變歷史的一篇 post(續)

things people like/dislike in minix, as my OS resembles it somewhat (same physical layout of the file-system (due to practical reasons) among other things).

I've currently ported bash(1.08) and gcc(1.40), and things seem to work. This implies that I'll get something practical within a few months, and I'd like to know what features most people would want. Any suggestions are welcome, but I won't promise I'll implement them :-)

Linus (torvalds@kruuna.helsinki.fi)

PS. Yes - it's free of any minix code, and it has a multi-threaded fs. It is NOT portable (uses 386 task switching etc), and it probably never will support anything other than AT-harddisks, as that's all I have :-).



Question

Linus Torvalds 說他有些後悔 post 這篇文章, why?

Linus 名言

- 人類進化演進的過程 - Linus 三定律
 - 為求生存
 - 為求社會地位
 - 為娛樂 , Just for fun!
 - Examples: Sex 、戰爭、電視、手機、 Linux
- Software is like sex, it's better when it's free.
- 全球性的團隊遊戲 (for developer)
- 詳見書本 just for fun



What's Linux?

- Linux 是一套自由的多人多工 Unix-like 作業系統，同時相容於 System V 與 BSD 並且符合 POSIX 標準。
- It's GPLed!
- Ported to other platforms: i386, X86-64, ARM, IA64, DEC's Alpha, Sun SPARC, PowerPC, VAX, SGI MIPS etc.



Linux Features

- Totally Free!
- Opensource
- Cross platform
- 多人多工
- 具網路功能
- 上千種 GNU 軟體
- 可與其他作業系統並存



Linux & distribution

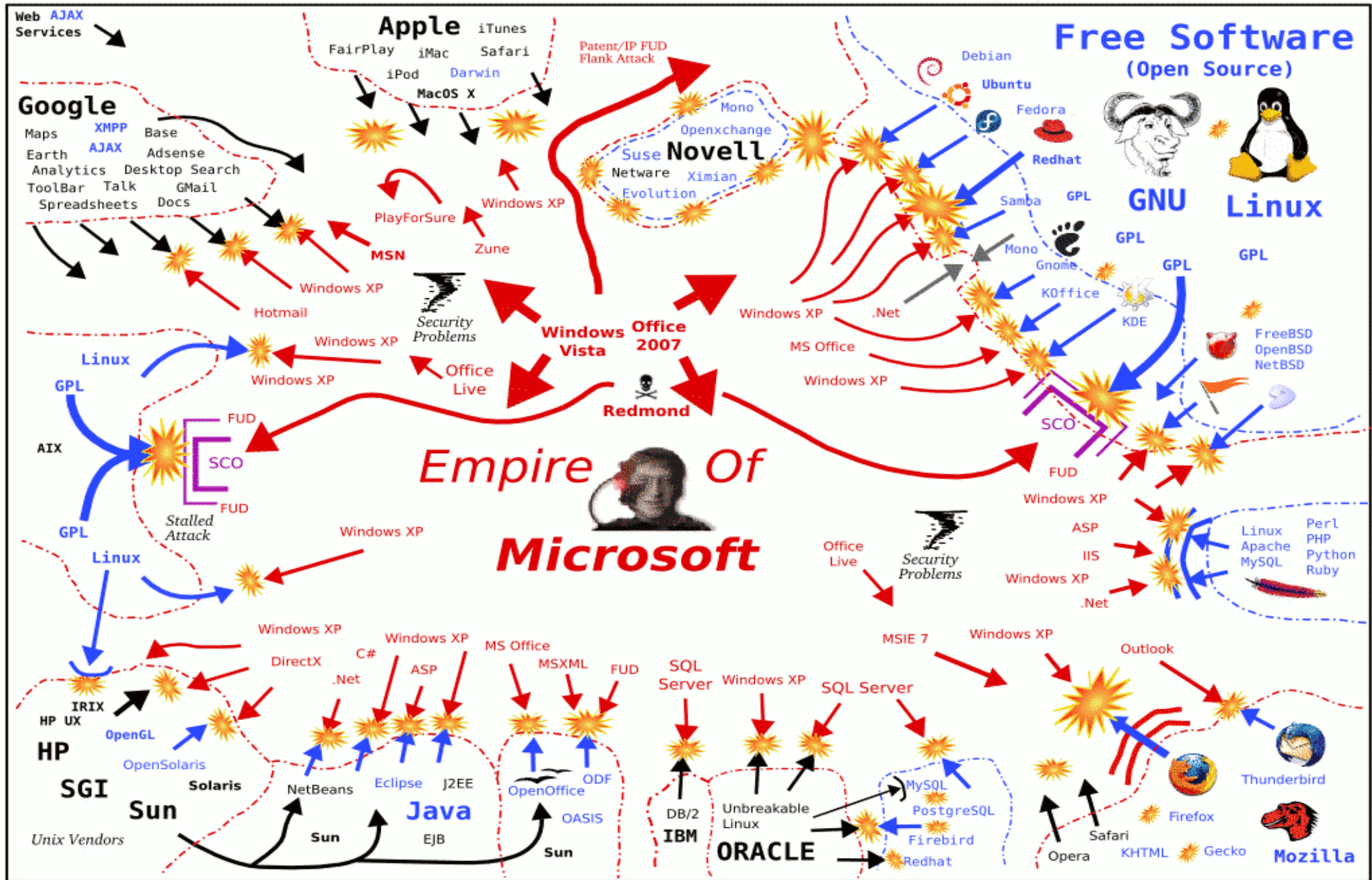
- Linux 是 kernel ！
- A distribution = Linux kernel + software packages
- Linux kernel + 基本的 libc utilities + X Window system
- 最重要的工具集：GNU tools!
- 嚴格來講、叫做 GNU/Linux



Software Wars

Software Wars

http://mshiltonj.com/software_wars/ All trademarks are property of their respective owners. Inspired by Andy Tai <http://atai.org/>
2006-12-28 Copyright 2006 - Steven Hilton <mshiltonj@gmail.com> Permission to copy is granted if copyright notice is preserved.



Linux Distributions

- Debian <http://www.debian.org/>
- Fedora <http://fedora.redhat.com>
- Gentoo <http://www.gentoo.org/>
- Mandriva <http://www.mandriva.com>
- Redhat <http://www.redhat.com/>
- Slackware <http://www.slackware.org/>
- Suse <http://www.suse.com/>
- Ubuntu <http://www.ubuntu.com/>
- Linux Mint <http://linuxmint.com/>
- CentOS <http://centos.org/>
- ...



<http://distrowatch.com/>



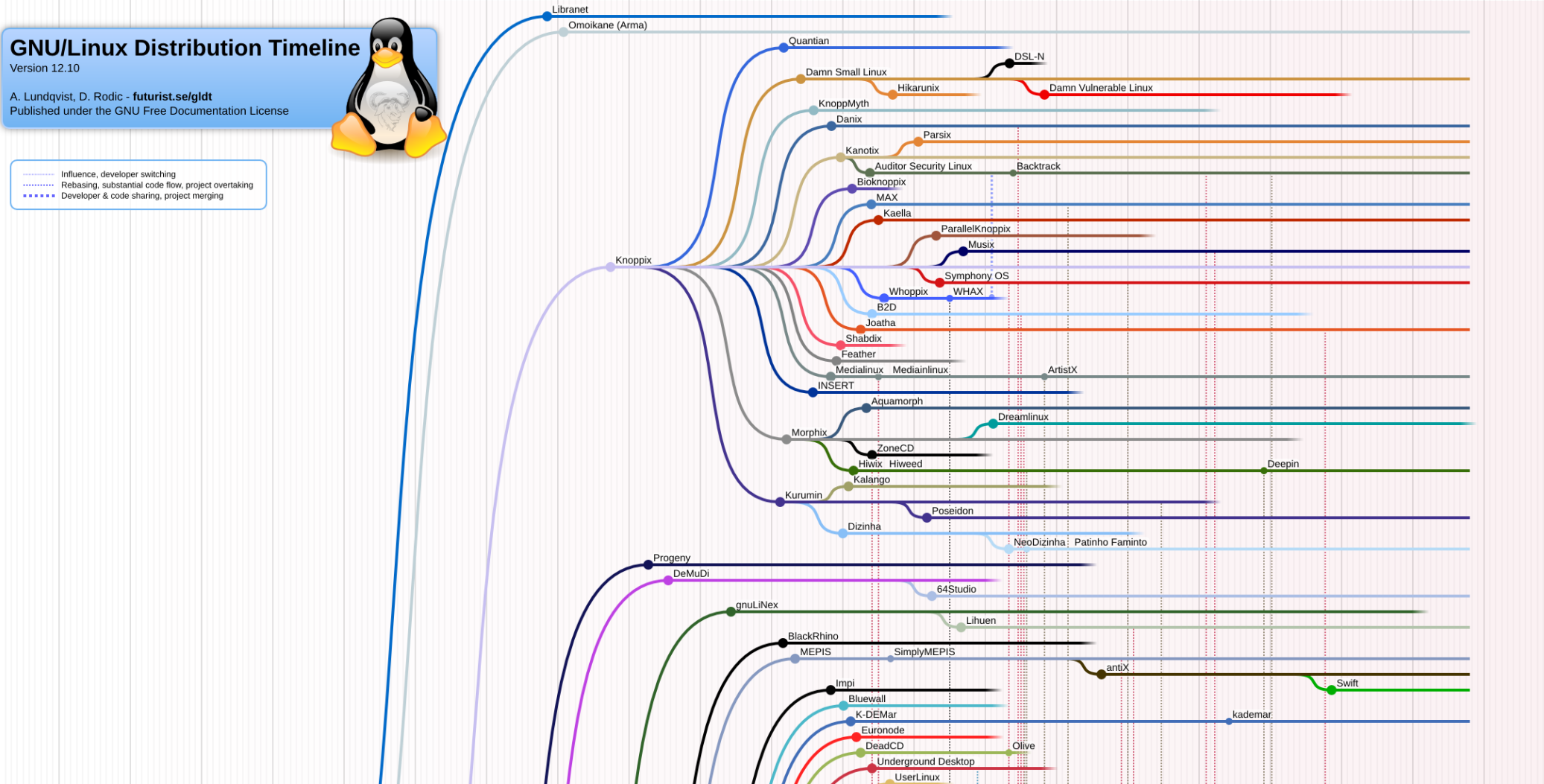
GNU/Linux Distribution Timeline

1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013

GNU/Linux Distribution Timeline

Version 12.10

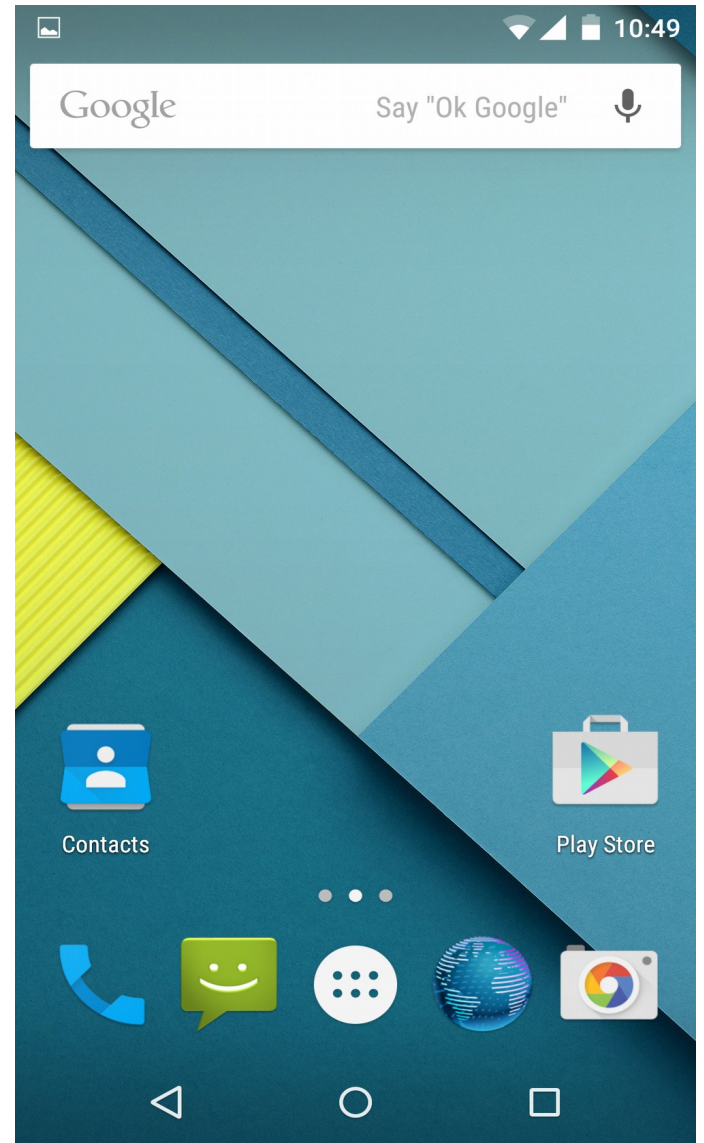
A. Lundqvist, D. Rodic - futurist.se/gldt
Published under the GNU Free Documentation License



<http://futurist.se/gldt/>

Android

- Android's mobile operating system is based on a modified version of the Linux kernel
- 授權條款：Apache 2.0 + GPLv2
- 目前世界上智慧型手機所使用的作業系統中 Android 佔有率第一



資料與圖片來源：http://en.wikipedia.org/wiki/Android_operating_system



Linux Distributions

TurboLinux
OpenLinux
UnitedLinux
...

- 版本眾多
 - 好處
 - 不是單一系統 (monoculture) ,
降低大規模被入侵或是中毒的的機率
 - 在相同的基礎上互相競爭
 - 缺點
 - 一致性較低
 - 程式發展較費時



Debian GNU/Linux



- 非商業化、最自由的套件
- 由全世界數千個志願者共同維護
- <http://www.debian.org/>
- 安裝難度略高
- 但容易控制管理



- Ubuntu – Debian based

國網中心發展與推廣自由軟體的背景

2002 年 5 月 NCHC 在立法院公聽會提出國家型開放原始碼計畫的構想，計畫雖未成立，但我們秉持

- ▶ 理念

- ▶ 自由

- ▶ 經費

- ✓ 鼓勵創新，培植本土軟體資訊人材
- ✓ 建立資訊工業自主實力
- ✓ 節省政府支出，每年省下二十億以上
- ✓ 促進資料交換格式開放，確保資訊自由



NCHC 發展與推廣自由軟體的背景

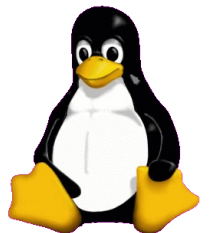
2002 年 5 月 NCHC 在立法院公聽會提出國家型開放原始碼計畫的構想，計畫雖未成立，但我們秉持

▶ 理念

▶ 自由

▶ 經費

- ✓ 鼓勵創新，培植本土軟體資訊人材
- ✓ 建立資訊工業自主實力
- ✓ 節省政府支出，每年省下二十億以上
- ✓ 促進資料交換格式開放，確保資訊自由



國網中心自由軟體實驗室

- 台灣，大部分個人電腦的作業系統與辦公室軟體均為少數外商的產品
- 至民國 89 年底，**政府機關**與**學校單位**設置的個人電腦總數為 1,229,276 部，估計支付外商公司軟體授權費超過新台幣七十億元以上
- 合法，不管使用商業獨家軟體或是自由軟體。不要把盜版當作理所當然
- 教育之所以為教育就是要學生學習能組合與創造的工具，例如數學和英文課程
- 我們的教育，如果只是整天教小孩子昂貴的軟體與作業系統，那學生只有兩條路，不是非常有錢來買軟體，就是作罪犯來盜版。
- 如果我們的老師永遠睜一眼閉一眼，小孩子從小就受這樣的教育，惡小為之，人格必定扭曲。為何要讓學生生活在那樣的環境中？
- 政府機構所採購的電腦，內裝的軟體可能只使用 20%~30% ，卻需付 100% 的軟體費用，最重要的是沒有 U.C.M.D 的自由
- 身為政府成立的法人機構，若有能力卻不做，有違我們的認知與良心



平衡商業獨家軟體與知識教育

知識和軟體都需要讓孩子「帶著走」！



☒ 商業獨家軟體授權高成本

在校學習，也需回家複習

學校每台 (平均) 約 6 千至 1 萬

學生家用 (平均) 約 1 至 2 萬

☒ 知識與法治的學習

教育知識，也需教育尊重

尊重智財權觀念



FLOSS-Free Open Source Software

- ✓ 免費只是自由的一個要素，只看到『免費』太短視
- ✓ 亞洲地區盜版率台灣居第三低，根據 BSA 統計，2011 年約在 37% 左右，略高於日本與新加坡。
- ✓ 建議政府應該盡量花錢請人寫自由軟體，而不是買封閉或是獨家的軟體
- ✓ 自由就是你可以任意 copy，任意傳播散佈
- ✓ 台灣人這麼愛 copy，為何不發展一個東西讓大家來 copy，被 copy 的人很爽，copy 的人也拷貝的很爽 ... 自由軟體的精神，很符合人性



使用自由、開放原始碼軟體可能遇到的問題與解決方式

- ✓ 遇到的問題 - 封閉格式檔案
 - ✓ 網頁只針對微軟 IE 撰寫，其他瀏覽器無法開啟
 - ✓ 檔案只有微軟獨家的程式可以完整的開啟、編輯或執行，例如 .doc, .exe 檔
- ✓ 解決方式 - 我們的主張
 - ✓ 無障礙的網頁，請遵循 W3C 標準撰寫網頁
 - ✓ 公開空間，提供開放格式的檔案是人人的責任，尤其政府單位與學校更是有責任與義務做到。這不是技術問題，是公德心問題
 - ✓ 不是反微軟，而是反壟斷 - 自由軟體、不自由軟體在開放格式的共通標準下和平共存與公平競爭。這樣社會才有正義，世界才能進步
 - ✓ 舉微軟在歐盟的例子 - 微軟反駁說是類似汽車加新配備，事實是 ...



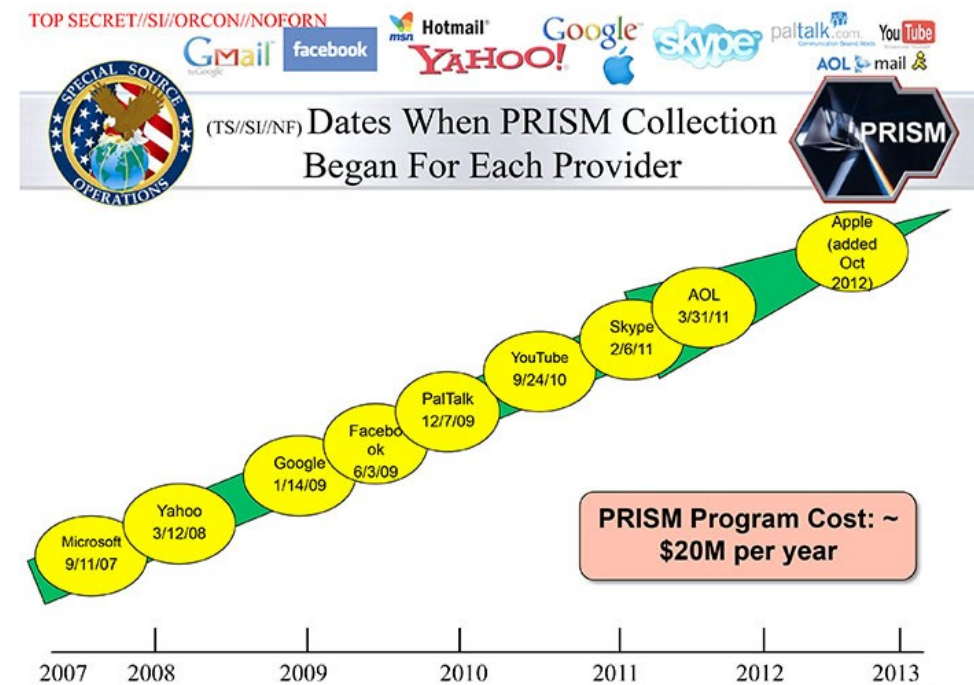
雲端？

- ✓ Lock-in 的問題？想像你要把 yahoo 上的所有服務轉換到 google 上？
- ✓ IEEE 打算建立雲端運算標準 – 2011-04-07 IThome
 - ✓ IEEE 的說明，P2301 希望雲端供應商、服務供應商與使用者在應用程式介面、可攜式介面、管理介面、互動性介面、檔案格式與操作習慣上都能夠有標準化的選擇。P2302 則是負責定義拓樸（ Topological ）、功能、互動性管理與聯盟等各方面的標準。
- ✓ Open standard, open protocol 為基本要素
- ✓ 自由，開放原始碼軟體才能被大部份的使用者接受
- ✓ 就像電源線、插頭等，不會只有「**台電牌**」獨家的電源線或是插頭才能用，而是只要符合規範的，都能使用。如果你不滿意現有的，你也可以依照規格自己製作。



雲端的疑慮

- ✓ Lock-in 的問題
- ✓ 完全掌控在他人手裡
- ✓ 隱私的問題
- ✓ 極權老大哥的最愛
 - ✓ NSA, PRISM, Snowden,
- ✓ 一般較能接受的是私有雲 (Private cloud)



Question

自由軟體之父 Richard Stallman 對雲端的看法？

駭客的倫理

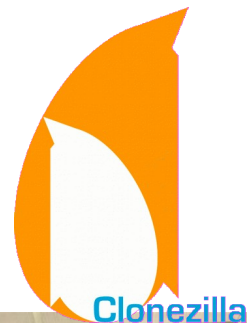


- 這裡講的駭客 (hacker) 是 RMS, ESR, Linus 之類的人，不是鬼客 (cracker)
- 工作倫理
 - 對工作擁有**熱情與積極**的態度
- 金錢倫理
 - **知識的擁有才是富足**，才是賺錢之道。知識的擁有不是為了賺錢，而是為了創造對社群有意義的發明
- 網路倫理
 - **方便資訊與電腦資源的取得**。網路上的言論自由與網路資源的自由取得



Free Software Smart Classroom, FSSC

- Free software projects developed by NCHC Free Software Labs
- Our goal
 - FSSC (Free Software Smart Classroom)
 - DRBL, Clonezilla, DRBL-winroll, Tux2live, Partclone, Tuxboot, Cloudboot
 - Multicast VNC
 - Access Grid, E-learning
 - Cluster computing
 - Grid computing
 - Cloud computing



國網中心自由軟體開發

高速計算技術及經驗發展之核心技術



企鵝龍 DRBL

(Diskless Remote Boot in Linux)

無碟環境，適合將整個電腦
教室轉換成純自由軟體環境



再生龍 Clonezilla

適用完整系統備份、裸機還原
或災難復原

是自由！不僅是免費...

使用、複製、修改與再散播軟體的自由。免費是附加價值。人人皆可自由享用。



DRBL 與 Clonezilla 開發大事紀

- ✓ 2002/05 商業軟體聯盟大規模掃蕩盜版
- ✓ 2002/06/17 輔仁大學毛慶禎教授在福營國中，主持「會診 LTSP 會議」，NCHC 在該會議中第一次提出 DRBL 的想法
- ✓ 2002/06/20 DRBL 雛形完成
- ✓ 2002/07/15 新店大豐國小研習，DRBL 第一次上線面對使用者測試。
- ✓ 2004/01/01 Clonezilla (OCS 的程式名稱) 雛形問世，Clonezilla 正式整合到 DRBL 中
- ✓ 2005/11/28 發行大一統版本，一個版本適用所有支援的 GNU/Linux 套件



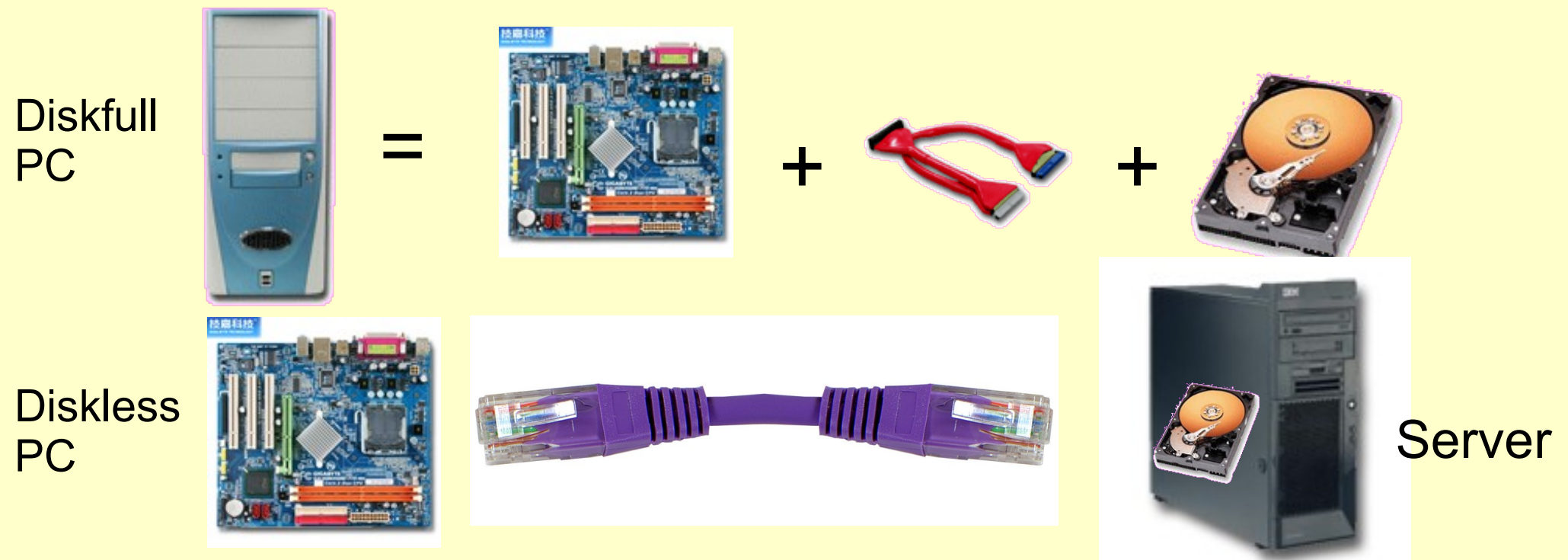
DRBL 與 Clonezilla 開發大事紀

- ✓ 2006/05/08 新增 DRBL Single System Image (SSI) 與 Clonezilla box 模式。這些模式，理論上 server 一張網卡可以支援 253 台 client
- ✓ 2007/03/14 首次發行 Clonezilla live
- ✓ 2007/12/04 DRBL 榮獲在法國所舉辦的第四屆國際自由軟體比賽 " 公部門 " 類別 (public sector software) 的第一名
- ✓ 2008/07/15 DRBL 與 Clonezilla 榮獲國家實驗研究院科技貢獻獎技術發展類玉山獎 (第一名)
- ✓ 2009/03/11 DRBL 與 Clonezilla 榮獲 2008 年行政院傑出科技貢獻獎
- ✓ 2010/01 Clonezilla 榮獲 sourceforge 2010 年 1 月份的最佳專案 (Project Of The Month)
- ✓ 2011/04 Clonezilla 獲選為國際知名雜誌 PC Magazine—2011 年最佳備份軟體之一
- ✓ 2012/04 Clonezilla 連續兩年獲選為國際知名雜誌 PC Magazine— 最佳備份軟體之一
- ✓ 2013/12 Linux Journal 讀者票選為最佳備份軟體



DRBL

- Network is everywhere, cheap, and fast
- In DRBL
 - The harddrive bus cable is replaced by network cable
 - All DRBL clients share 1 harddrive in the server

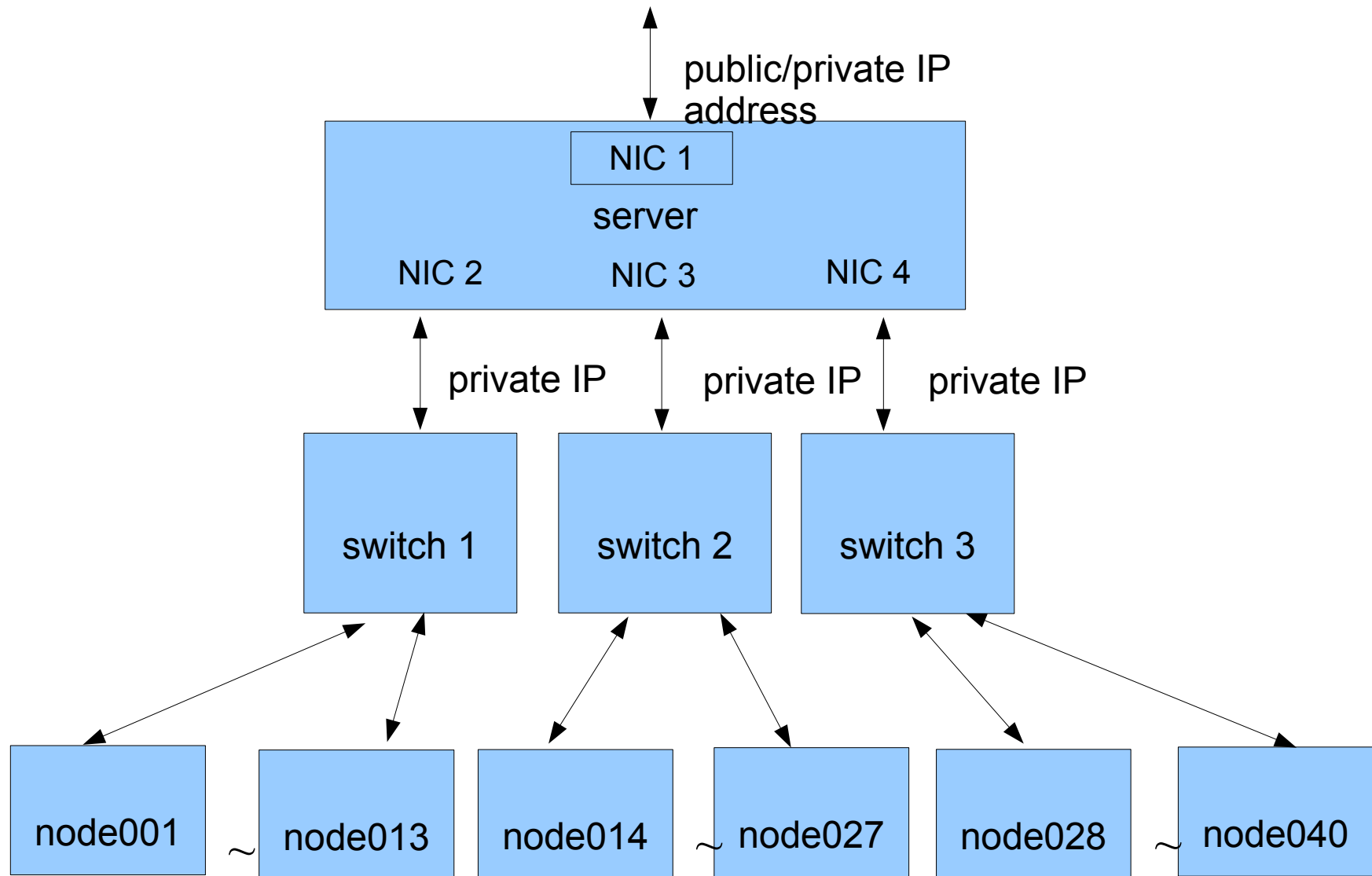


既有 LTSP , 何要 DRBL ?

- 中央集權 vs. 地方分權
- 精簡型電腦 (Thin client) vs. 功能強大電腦 (powerful client)
- 有些人需要在用戶端能玩 3D 遊戲, 播放電影, 或者需要用戶端的計算資源
- DRBL 的特別功能
 - Clonezilla
 - 單一指令切換所有用戶端電腦的環境
 - DRBL, FreeDOS, 硬碟中的 OS, memtest...
 - 網路安裝 GNU/Linux 套件
- DRBL 不適用於老舊電腦使用
- 因地制宜, 取己所需



DRBL Environment



DRBL



server



switch



client nodes



DHCP — IP →

pxe/etherboot

192.168.0.1

pxe/etherboot

172.16.100.10

TFTP — kernel →

boot

boot

NFS — file system →

/, /usr, /home ...

/, /usr, /home ...

NIS — account →

user login

user login



DRBL 的建議規格

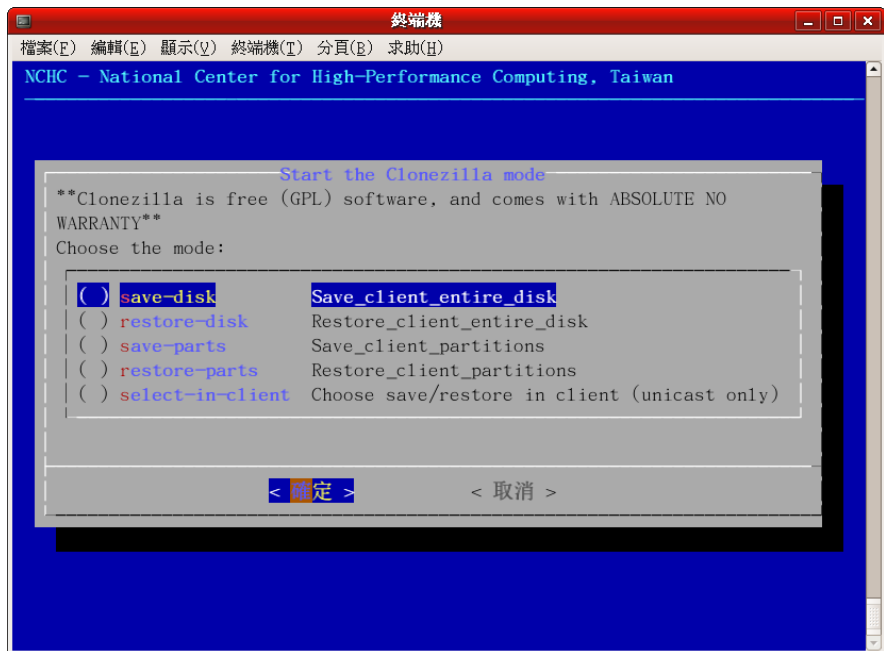
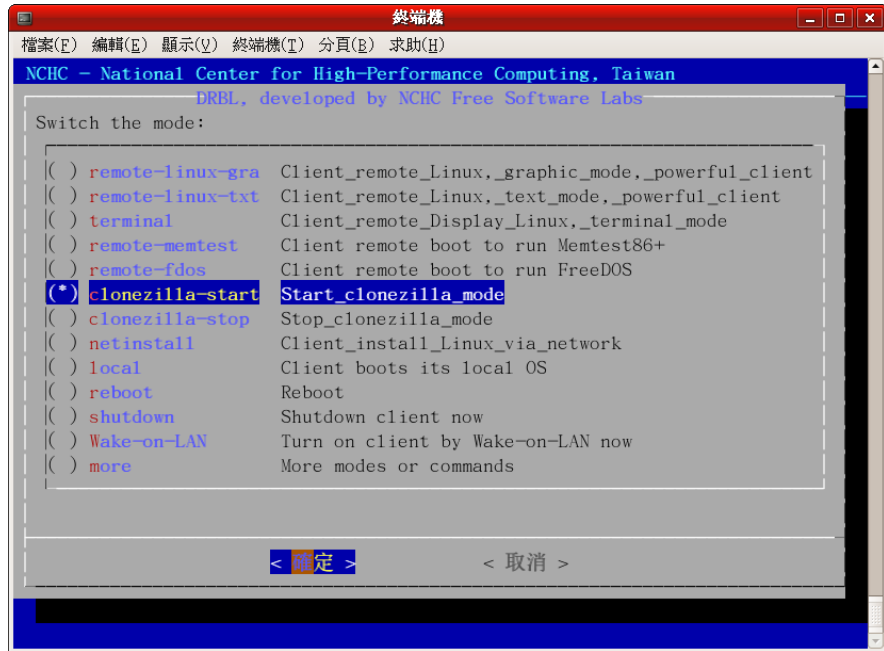
- ✓ 以下所列的規格僅供參考，採購時可依據經費與當時最佳的設備來採購，中央政府各機關、學校委託的中央信託局集中採購案中有符合使用的設備
- ✓ 高效能計算 (HPC) 的需求是永無止境的
 - ✓ **伺服器**
 - ✓ 最低規格 :CPU 450 MHz ，記憶體 256 MB ， fast ethernet(100Mbps) 網路卡多張。
 - ✓ 建議規格 :CPU 2.6 GHz ，記憶體 1 GB ， Gigabits 網路卡 4 張。
 - ✓ **客戶端**
 - ✓ 最低規格 :CPU 300 MHz ，記憶體 128 MB ， 100Mbps 網路卡，若是新購電腦的話建議直接買有支援網路開機 (PXE) 的網卡或是內建 PXE 功能網卡的主機板。
 - ✓ **網路連接設備**
 - ✓ 最低需求 :100Mbps 的交換器。
 - ✓ 建議規格 : 以 40 人的電腦教室為例，兩台 24 埠 100Mbps 的交換器，每台上另外個別有 2 個 Gigabits ports 。



DRBL

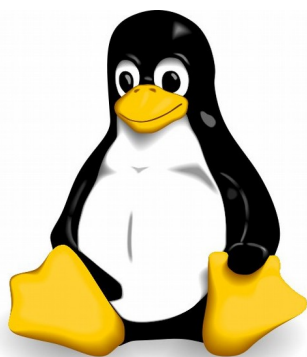
- <http://drbl.nchc.org.tw>, <http://drbl.sf.net>
- 標準 GNU/Linux 套件 – 持續連接模式
 - i386/X86-64 platform
 - Debian, Ubuntu, B2D, RedHat, Fedora, Mandriva, CentOS, OpenSuSE, SuSE
- 小型 GNU/Linux 套件 – 射後不理模式
 - DSL, PuppyLinux, INSERT, PLD, GeeXbox
- 4 大安裝步驟
 - 安裝 GNU/Linux
 - 安裝 DRBL 程式
 - 設定伺服器
 - 設定用戶端

DRBL



What is Clonezilla?

- A partition and disk imaging/cloning utility similar to True image® or Ghost®
- GPL license
- A bare metal recovery tool for



*1



*2



*3



*4

VMFS

VMware
ESX/ESXi

*5



MINIX

*6



*7

*Logo source: (1) Larry Ewing, Simon Budig and Anja Gerwinski, (2) Apple, (3) Microsoft, (4) Mars hall Kirk McKusick, (5) VMWare (6) Distrowatch.com (7) Google



Clonezilla

- ✓ Clonezilla [OCS (Opensource Clone System)]
 - 整合 partimage (<http://www.partimage.org>), ntfsclone 與 udpcast (<http://udpcast.linux.lu/>), Clonezilla 是一完整的硬碟資料複製的工具, 類似 Symantec Ghost 或是 True image
 - 以 NCHC 的 cluster 為例, 40 台 clients clone 2.5 GB 的 Debian Linux 環境, 使用 multicast 方式傳輸速率達 8 GB/min
- ✓ 可以儲存與還原不同作業系統
 - ✓ GNU/Linux, MS windows
 - ✓ File system: ext2/3/4, xfs, jfs, reiserfs, ntfs, fat. UFS, VMFS, Minix
 - ✓ Supports LVM2
- ✓ DRBL-winRoll
 - ✓ DRBL 在 MS windows 中的擴充功能 (1) 還原後自動修改 M\$ Windows 的機器名稱, SID, 群組 (2) 接受來至 DRBL server 的指令



Bare Metal Recover Tools

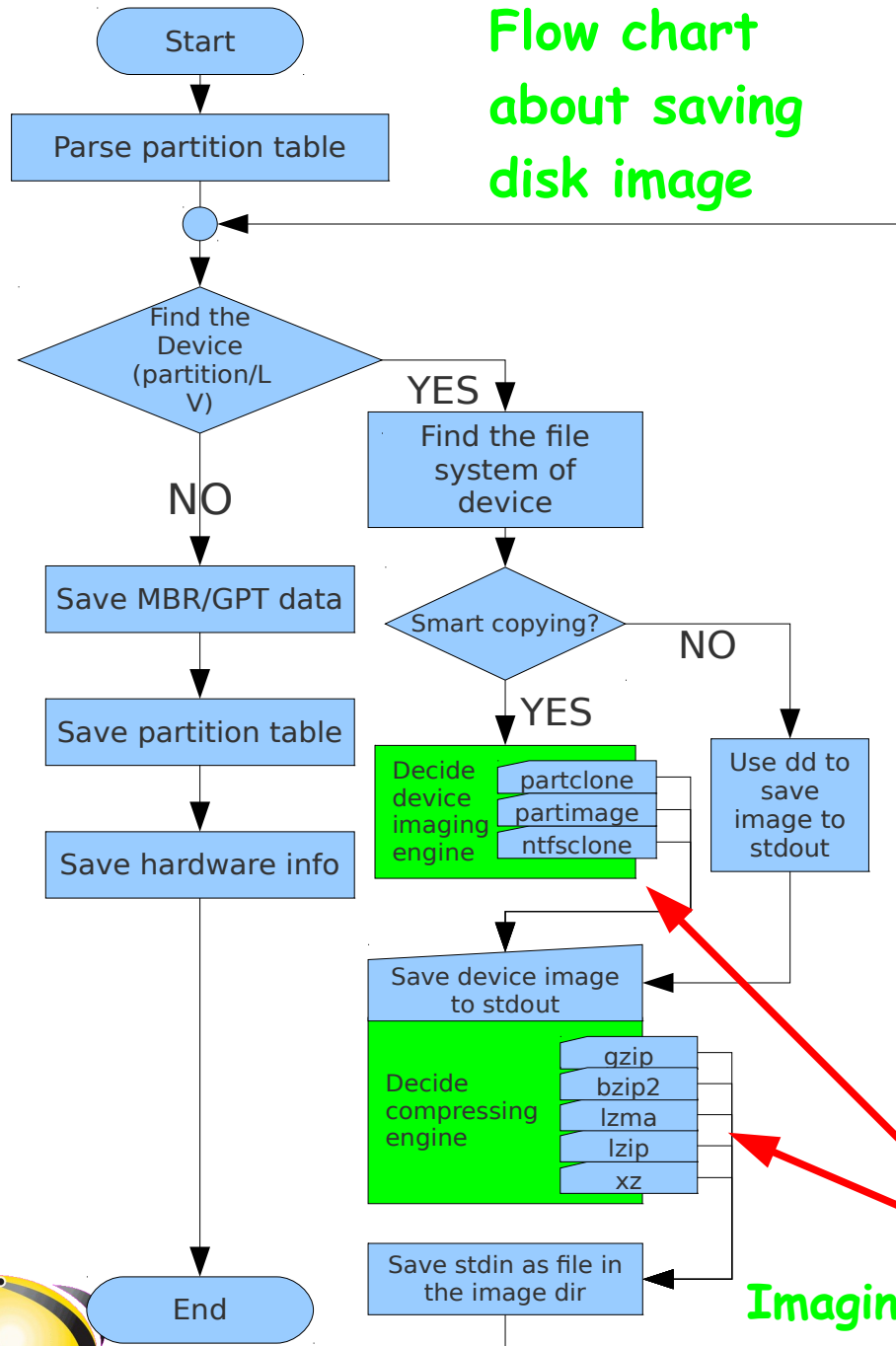
	URL	Version
Clonezilla live	clonezilla.org	1.2.6-40
FOG	www.fogproject.org	0.29
Fsarchiver	fsarchive.org	0.6.10
G4L	g4l.sourceforge.net	0.34
Mondo Rescue	www.mondorescue.org	2.2.9.4
Partimage	partimage.org	0.6.9
Acronis® True Image	www.acronis.com	2011
Norton Ghost™	www.symantec.com	15.0

Open Source Software

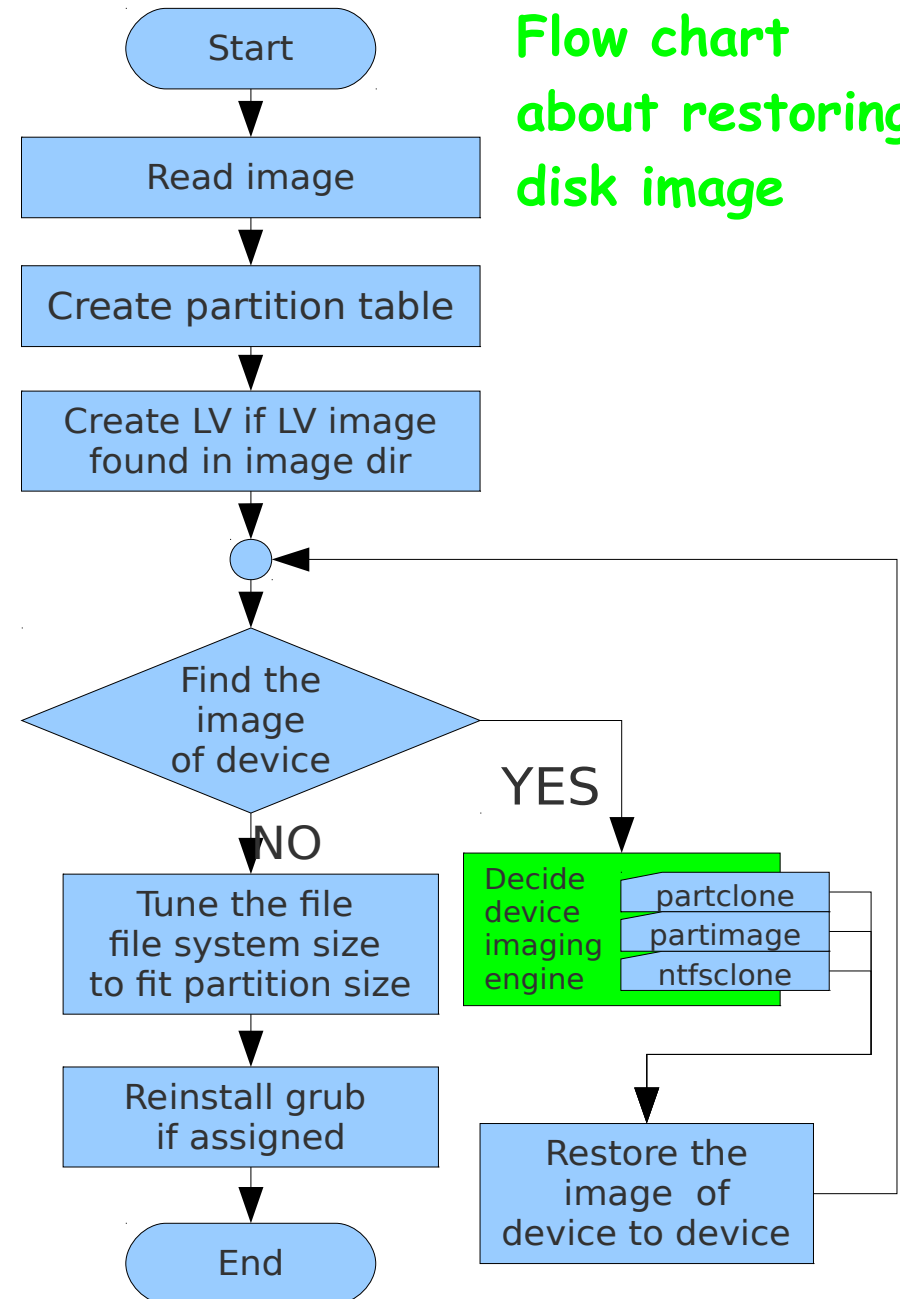
Proprietary Software

Open and Flexible Architecture of Clonezilla

Flow chart
about saving
disk image



Flow chart
about restoring
disk image



Imaging and compressing engines can be easily added

Open and Flexible Architecture of Clonezilla – Image format

```
root@debian:~# ls -alFh /home/partimag/lucid-2010-07-28-07-img/
```

```
total 220M
```

```
drwxr-xr-x 2 root root 512 07:12 ./
```

```
drwxr-xr-x 7 root root 168 07:12 ../
```

```
-rw-r--r-- 1 root root 420 07:12 disk
```

```
-rw-r--r-- 1 root root 34K 07:12 Info-dmi.txt
```

```
-rw-r--r-- 1 root root 18K 07:12 Info-lshw.txt
```

```
-rw-r--r-- 1 root root 1.4K 07:12 Info-lspci.txt
```

```
-rw-r--r-- 1 root root 260 07:12 Info-packages.txt
```

```
-rw-r--r-- 1 root root 10 07:12 parts
```

```
-rw----- 1 root root 216M 07:12 sda1.ext4-ptcl-img.gz.aa
```

```
-rw----- 1 root root 2.3M 07:12 sda5.ext4-ptcl-img.gz.aa
```

```
-rw-r--r-- 1 root root 36 07:11 sda-chs.sf
```

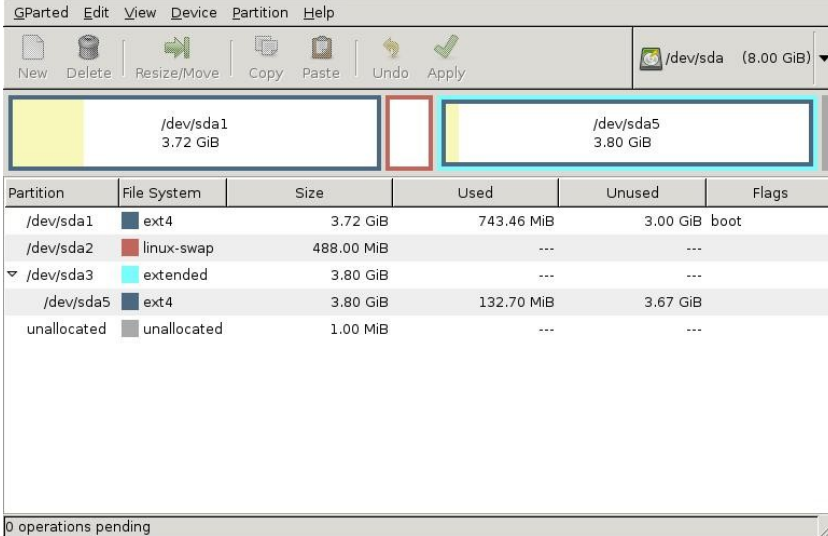
```
-rw-r--r-- 1 root root 1.0M 07:11 sda-hidden-data-after-mbr
```

```
-rw-r--r-- 1 root root 512 07:11 sda-mbr
```

```
-rw-r--r-- 1 root root 434 07:11 sda-pt.parted
```

```
-rw-r--r-- 1 root root 310 07:11 sda-pt.sf
```

```
-rw-r--r-- 1 root root 53 07:12 swappt-sda2.info
```



Partition	File System	Size	Used	Unused	Flags
/dev/sda1	ext4	3.72 GiB	743.46 MiB	3.00 GiB	boot
/dev/sda2	linux-swap	488.00 MiB	---	---	
▼ /dev/sda3	extended	3.80 GiB	---	---	
/dev/sda5	ext4	3.80 GiB	132.70 MiB	3.67 GiB	
unallocated	unallocated	1.00 MiB	---	---	

0 operations pending

Terminology

- Raw copying*

- A possibility to perform sector-by-sector copying of a whole **partition**

- Smart copying*

- A possibility to distinguish which portions of the **partition** really contain data and to copy these only

- Live copying*

- A drive or volume can be copied/imaged while it is in use, avoiding the need for booting into a separate operating system or Live CD.

- Smart copy full disk

- A possibility to distinguish which portions of the **disk** really contain data and to copy these only

* The descriptions are from http://en.wikipedia.org/wiki/Comparison_of_disk_cloning_software

Comparison – General Info

	Interface	Provides Live USB	Provides Live CD	Live copying	Differen- tial backup	Based on	License
Clonezilla	TUI	Y	Y	N	N	partclone	GPL
FOG	GUI	N	N	N	N	partimage	GPL
Fsarchiver	CML	Y	Y	Y	Y		GPL
G4L	TUI	Y	Y	N	N	g4u, dd, partimage, ntfsclone	GPL
Mondo Rescue	TUI	Y	Y	Y	Y	afio, mondi	GPL
Partimage	TUI	Y	Y	N	N		GPL
True Image	GUI	Y	Y	Y	Y	Proprietary	Proprietary
Ghost	GUI	Y	Y	Y	Y	Proprietary	Proprietary

Comparison – General Info

	Smart copy full disk (No LVM2, no firmware RAID)	Smart copy full disk with LVM2	Smart copy full disk with firmware RAID	Raw copying	Without server	Server/client
Clonezilla	Y	Y	N	Y	Y	Y
FOG	Y	N	N	Y	N	Y
Fsarchiver	N	N	N	N	Y	N
G4L	N	N	N	Y	N	Y
Mondo Rescue	Y	Y	N	Y	Y	N
Partimage	N	N	N	N	Y	Y
True Image	Y	Y	N	Y	Y	Y
Ghost	Y	N	N	Y	Y	Y

Comparison – **Smart** Copying File Systems of Linux



	ext2/3	ext4	reiserfs	reser4	xfs	jfs	btrfs
Clonezilla	Y	Y	Y	Y	Y	Y	Y
FOG	Y	N	Y	N	Y	Y	N
Fsarchiver	Y	Y	Y	Y	Y	Y	Y
G4L	Y	N	Y	N	Y	Y	N
Mondo Rescue	Y	Y	Y	Y	Y	Y	Y
Partimage	Y	N	Y	N	Y	Y	N
True Image	Y	Y	N	N	N	N	N
Ghost	Y	N	N	N	N	N	N

Comparison – **Smart** Copying File systems of Other Oses



	HFS+ (Mac)	FAT (MS Win)	NTFS (MS Win)	UFS+ (*BSD)	VMFS (Vmware Esx(i))
Clonezilla	Y	Y	Y	Y	Y
FOG	N	Y	Y	N	N
Fsarchiver	N	N	Y	N	N
G4L	N	Y	Y	N	N
Mondo Rescue	N	Y	N	N	N
Partimage	N	Y	Y	N	N
True Image	N	Y	Y	N	Y
Ghost	N	Y	Y	N	N

Proprietary Software vs. Free Software

■ Pros and Cons for using Proprietary Software

■ Pros

- You know WHOM you **pay**, so you can ask for support from them
- Average good quality in the QC and the GUI

■ Cons

- Cost
- Normally no good support for non-mainstream Oses



- **No freedom** to use, copy, modify and redistribute



■ Clonezilla is a good choice, because of its

- **open** and **flexible** architecture
- support for **a wide variety of file systems**



國際自由軟體競賽

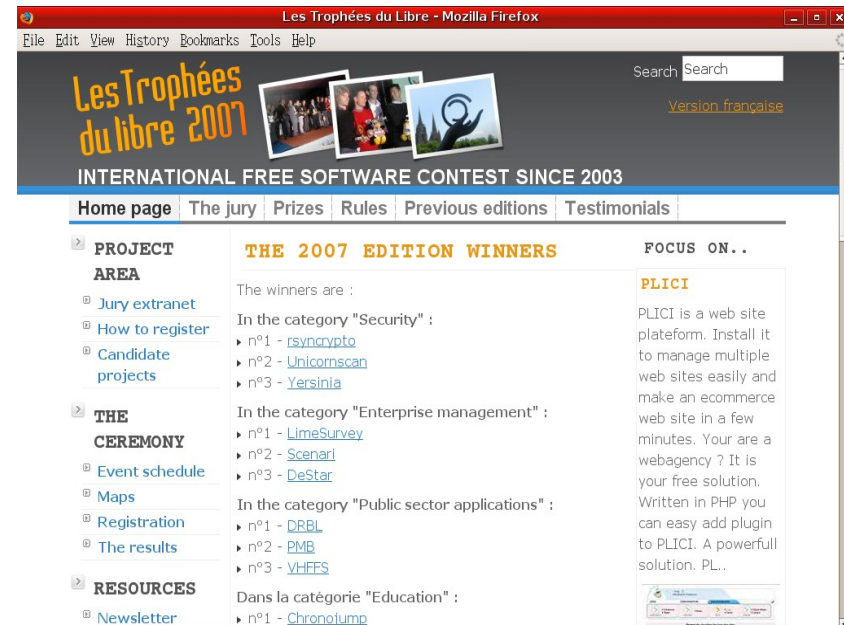
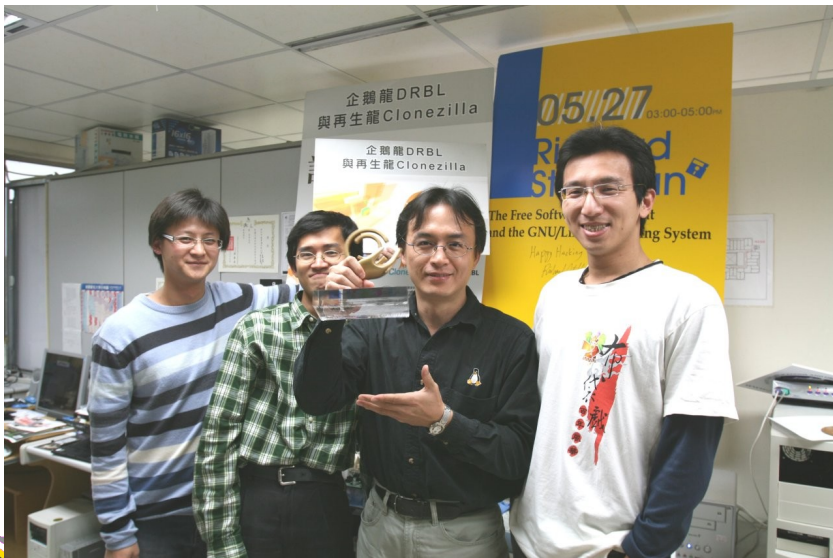


- 2007 年 11 月 29 日，Centri 協會在法國 Soissons 所舉辦的國際自由軟體競賽中 (Les Trophées du libre)，DRBL 贏得 'public sector software' 分類的首獎
 - <http://www.freesoftwareawards.com> or <http://tropheesdulibre.org/?lang=fr>



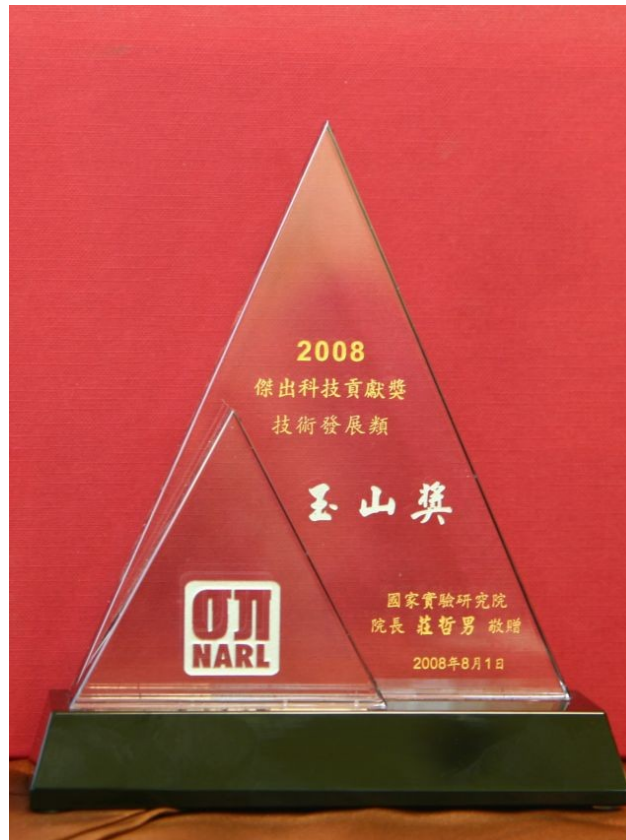
International Free Software Contest

Soissons, France, Nov 07



2008 年國家實驗研究院 傑出科技貢獻獎

DRBL/Clonezilla 團隊獲得「技術發展」類的「玉山獎」(第一名)



2008 年行政院傑出科技貢獻獎

名稱：『高效能計算平台 DRBL 與 Clonezilla 軟體的技術發展
與推廣應用』

頒獎典禮：2009 年 3 月 11 日





Project of the Month, January 2010

sourceforge FIND AND DEVELOP OPEN SOURCE SOFTWARE

Welcome, Guest! [Log In](#) | [Create Account](#)

[Find Software](#) | [Develop](#) | [Create Project](#) | [Blog](#) | [Site Support](#) | [About](#)

Search

[SourceForge.net](#) > Blog
Project of the Month, January 2010

Clonezilla

Clonezilla is a partition or disk clone tool similar to Norton Ghost. It saves and restores only the used blocks in the hard drive. Two types of Clonezilla are available, Clonezilla live and Clonezilla SE (Server Edition). The filesystem supported by Clonezilla are: ext2, ext3, ext4, reiserfs, xfs, jfs of GNU/Linux, FAT, NTFS of MS Windows, and HFS+ of Mac OS. Therefore you can clone GNU/Linux, MS windows and Intel-based Mac OS whether they be 32-bit (x86) or 64-bit (x86-64) OS. For these file systems, only the used blocks in the partition are saved and restored. For unsupported file systems, a sector-to-sector copy is done by dd in Clonezilla.

Why and how did you get started?

On the 29th of March, 2003, the computers in the computer classrooms at the National Center for High-Performance Computing (NCHC, <http://www.nchc.org.tw>) were all upgraded. However, the deployment software did not support the new hardware. That's why we started the Clonezilla project. In the beginning, we started the Clonezilla server edition first, then, in 2007, Clonezilla live was created.

Who is the software's intended audience?

System administrators, that being, PC cluster administrators, computer classroom administrators, and of course anyone who needs a tool to clone or image his/her computer.

What are a couple of notable examples of how people are using your software?

* The National Computer Centre Wonen, Netherlands, used Clonezilla to, "clone a 3 GB image to 27 machines with an average speed was 2.4 GB/min."

* Cisco Systems used DRBL, "...in the design of our Cisco Computational Cloud cluster to multicast a 5 GB disk image to 64 machines simultaneously."

* Information Systems Security, Southbridge, Massachusetts, USA, said, "So far, I have cloned 1,084 systems using DRBL. By carefully following the instructions on the DRBL website, and using multicasting and dividing the number of systems into groups of 80-100 PCs at the time, it took me somewhere between 16-38 minutes for each group of PCs, using images of various operating systems that averaged 1 GB in size. DRBL has reduced the recovery/cloning factor by more than 500% as compared with the previous commercial solution [we were] using"

Project name: Clonezilla

Date founded: July 2004

Project page: <https://sourceforge.net/projects/clonezilla/>

Project Leader

Steven Shiau

Occupation: Researcher at the NCHC, Taiwan

Location: Hsinchu, Taiwan

Education: M. S. (Nuclear Engineering), National Tsing Hua University, Taiwan



Key Developers

Blake, Kuo-Lien Huang

Occupation: Open source hobbyist

Education: M. S.

Location: Hsinchu, Taiwan



Chenkai (Ceasar) Sun

Occupation: Associate Researcher at the NCHC, Taiwan

Education: M. S. (Department of Management Information System) National Sun Yat-Sen University, Kaohsiung, Taiwan

Location: Hsinchu, Taiwan



Yao-Tsung (Jazz) Wang

Occupation: Associate Researcher at the NCHC, Taiwan





Clonezilla

2011 年 1 月份的 Linux Journal 有 5 頁的 Clonezilla 報導，內文特別提到臺灣與 NCHC，封面並寫上：

**Clonezilla –
High Performance Open-Source Cloning**



2013 年 12 月份 Linux Journal 讀者票選 最佳備份軟體為 Clonezilla

Linux Journal 於 1994 年在美國德州休士頓成立，專注在 Linux 與 OpenSource 的內容。與 Linux Magazine 以及 Linux Format 並列為世界上三大專注於 Linux 的期刊雜誌。

FEATURE Readers' Choice Awards 2013

BEST CLOUD-BASED FILE STORAGE

Dropbox is still the favorite cloud-based storage option, but it's great to see ownCloud nipping at its heels. No, not because I have anything against Dropbox (I use it myself), but because I love to see open-source alternatives whenever possible.

35.5% Dropbox

16.3%	ownCloud	4.8%	Amazon S3
16.2%	Google Drive	4.6%	SpiderOak
7.1%	Ubuntu One	1.7%	Copy
6.8%	rsync	1.4%	Box
5.2%	Other*	.4%	AjaXplorer



.1% Norton Zone
*Popular write-ins:
BitTorrent Sync, MEGA, Skydrive
and Wuala.

BEST LINUX GAME

Okay, true confession, it's been a couple years now, and I still don't understand the popularity of *Minecraft*. I just don't get it. That's okay, however, because most of you obviously do! *Minecraft* takes more than 20% of the vote this year. Will Steam's Linux support change things up next year? We'll have to wait and see.

21.2% Minecraft

20.9%	Other*	3.3%	Warzone 2100	.8%	Glest
18.5%	Half-Life	1.8%	FreeOrion	.6%	Elite
11.1%	Frozen Bubble	1.6%	Hedgewars	.4%	BurgerSpace
7.1%	Trine 2	1.4%	Scorched 3D		
5.2%	OpenTTD	1.2%	Darwinia		
4.2%	Battle Field	.9%	KGolddrunner		

*Popular write-ins:
0 AD, Battle for Wesnoth, Dota 2
and FTL: Faster Than Light.

BEST BRAND OF VIDEO CHIPSET

51.6% NVIDIA

26.3%	Intel	21.3%	AMD	.8%	Other
-------	-------	-------	-----	-----	-------



BEST SQL DATABASE

Databases may not be the most exciting topic of discussion, but as someone who spent the past year working in the database department of a university, I can assure you, they are important. The numbers are very close this year, but it's neat to see MariaDB topple PostgreSQL.

29.7% MySQL

28.5%	MariaDB	8.8%	SQLite	1.8%	Other
26.8%	PostgreSQL	4.4%	Oracle		



BEST NOSQL DATABASE

43.6% MongoDB

15.3%	Apache HBase	13.2%	CouchDB	4.5%	Redis RethinkDB
13.2%	Cassandra	7.7%	Other	2.6%	Neo4j

BEST BACKUP SOLUTION

The short version of our results: I don't care which option you use, just back up! Now! Seriously though, it's interesting to see Dropbox as a backup solution. Yes, it does versioning, but I guess I've never considered it a backup. Perhaps I'm too old.

19.6% Clonezilla

19.3%	Dropbox	4.5%	Amanda
19.1%	Other*	4.1%	luckyBackup
8.8%	Bacula	1.8%	Tivoli Storage Manager
7.7%	rdiff-backup	1.4%	Symantec Backup Exec
7.5%	CrashPlan	.5%	Storix
5.4%	Back In Time	.4%	Areca-Backup

*Popular write-ins:
BackupPC, Deja Dup,
SpiderOak, duplicity and rsync +
tar/btrfs/ftp/cron/and so on.

DRBL/Clonezilla Use In Taiwan

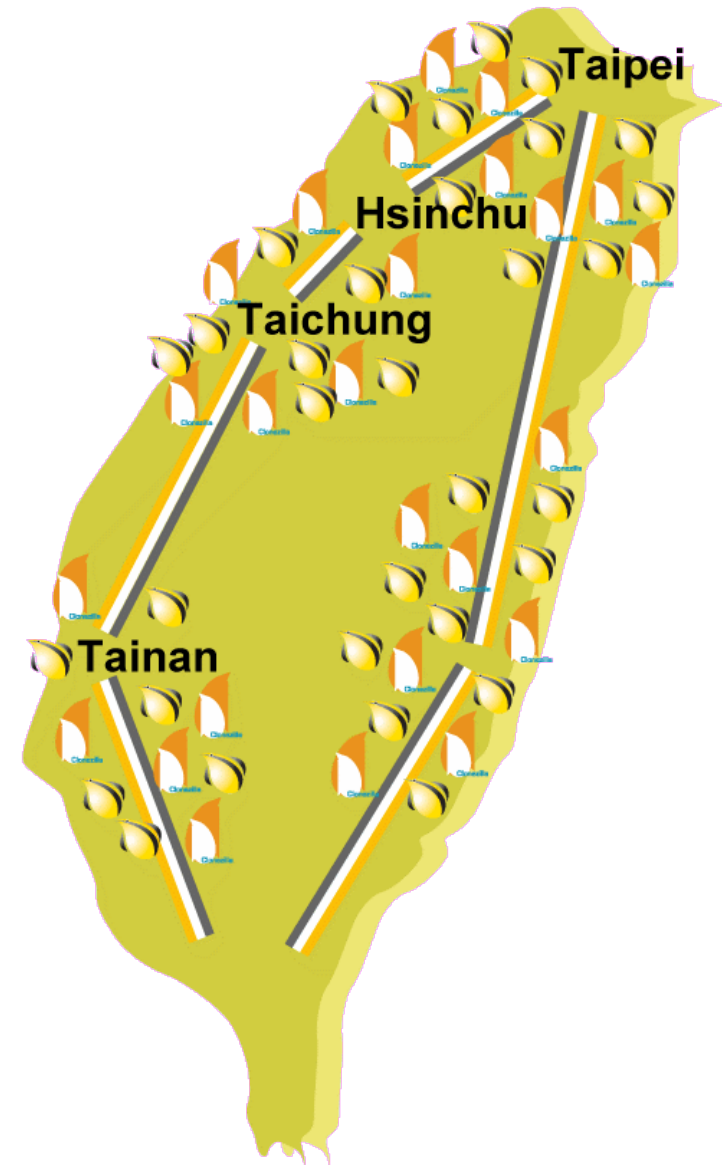
✓ **Public Sector:**

Primary/High schools	295
Universities	95
Local governments	35
Hospitals	3
TV stations	1

✓ **SMBs** 124

✓ **Misc.** 2

Known sites > **500!!!**

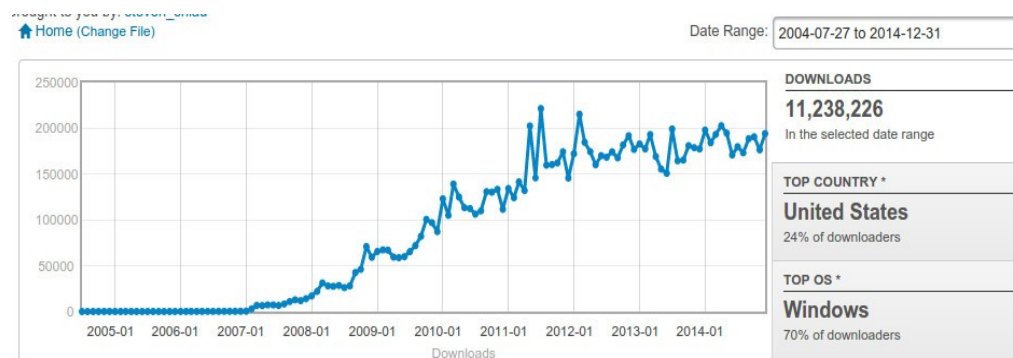




Clonezilla Users Worldwide



ca_ES.UTF-8 Catalan | Català
de_DE.UTF-8 German | Deutsch
en_US.UTF-8 English
es_ES.UTF-8 Spanish | Español
fr_FR.UTF-8 French | Français
it_IT.UTF-8 Italian | Italiano
ja_JP.UTF-8 Japanese | 日本語
pt_BR.UTF-8 Brazilian Portuguese | Português do Brasil
ru_RU.UTF-8 Russian | Русский
zh_CN.UTF-8 Chinese (Simplified) | 简体中文
zh_TW.UTF-8 Chinese (Traditional) | 正體中文 - 臺灣



使用者使用之主要情境：

- 單機之系統備份與還原
- 為使用者提供客製化還原光碟 / 隨身碟
- 多機系統之大量佈署

2014 年度達 224 萬下載人次
2004 至 2014 累積超過 1100 萬下載人次

Testimonials

- Kristian Hermansen
- Cisco Systems, Boston, MA, USA, Sept. '07
- Cloned a 5GB image to 64 machines in 5 under minutes!!!
 - "I used Clonezilla in the design of our Cisco Computational Cloud Cluster to multicast a 5GB disk image to 64 machines simultaneously and all in under five minutes! Amazing! Thanks Clonezilla!"

Testimonials

- Barny Sanchez
- Information Systems Security, Southbridge, Massachusetts, USA
- Cloned 1,084 systems using DRBL (Clonezilla SE)
 - "I've used DRBL to clone 1,084 systems so far! It was simple! All I had to do was divide each system into groups of 80-100 PCs and then use multicasting to do the cloning. It took anywhere from 16-38 minutes to clone each system. The images of various operating systems averaged 1GB in size. DRBL has reduced the recovery/cloning factor by more than 500% as compared to the commercial solution I used previously! You can imagine how happy my project managers are!"

Testimonials

- Alvin Su
- Shen-Mei Elementary School, Taiwan
- Cloned more than 100 USB flash drives , each with 3 GB OS and data. Every batch 8 USB flash drives, ~ 30 mins



Testimonials

- Juergen Chiu
- Canonical Ltd. Taipei, Taiwan
- Clonezilla helps me a lot in system backup, recovery and ISO image creating
 - "In my job, I need to handle different type of system and create the ISO image for customers. Your great tool, Clonezilla, helps me a lot in system backup, recovery and ISO image creating. I only need to download the Clonezilla zip file, and create the bootable usb key in few easy steps, then I can use that key to backup the systems and create the ISO image by the same key. And the key is just the recovery partition as I need. All procedures take me only about 1 hour to finish all stuffs. I love your tool and that is really cover all functions what I need to have in Linux system recovery scope. Clonezilla is the best all-in-one tool that I have never seen before."

Use case in enterprise

- Nagappan Alagappan from VMware
- Palo Alto, CA, USA
 - Before Clonezilla we were using Symantec Altiris, but it worked fine only for Windows and RedHat, it doesn't work for Ubuntu / SUSE
 - As a product company, we need to test our product in all popular operating system, when exploring different opportunity, we found Clonezilla appropriate, Reason: It support all the Linux distribution (RedHat, SUSE, Ubuntu, Mandriva) and different file system, which we use (ext3, ext4, reiserfs)

Use case in enterprise

- Initially evaluated Clonezilla live and found a very good performance, Windows XP image restoration 7 minutes, Ubuntu 3 minutes, SUSE / RHEL 5 minutes from a NFS server
- Later we (in VMware) have implemented a service, which will automate the Clonezilla reimaging part, without any manual intervention, which have saved our life and ofcourse money, as Clonezilla is Free Software !

Use case in enterprise

- When a new (internal) build is released (at least **one build a day**), **Basic Acceptance Test** (BATS in short) will be executed. The process is: Install a new OS image in a single test machine (pool of 70 machines), download the latest build, download the test scripts to execute, start the test, publish the result and release the machine back to pool, if all the tests in BATS are passed
- VMware has proudly **contributed back the code to Clonezilla team** and will be happy to support anyone who wants to use in their environment

Question

為何公司大如 **Cisco** 或 **Vmware** 等要採用 **Clonezilla**，而不是直接使用 **Norton Ghost**, **True image** 等有名的商業獨家軟體？



DRBL 實機展示

- 無碟用戶端 (NFS-based)
- 無碟用戶端 (Memory-based, small Linux)
 - DSL
 - PuppyLinux
 - Gparted Live
 - Clonezilla Live
- MS windows 無碟 (SAN-based)
 - AoE boot: MS windows XP



Clonezilla 實機展示

- 單機版 Clonezilla live
 - 儲存印象檔
 - 還原印象檔
 - 製作單鍵還原光碟
 - 客製化還原
 - 硬碟對拷
- 伺服器版 Clonezilla SE
 - 群播還原

其他參考文件

- DRBL/Clonezilla 進階使用
 - <http://drbl.nchc.org.tw/advanced>
- Clonezilla Live 文件集
 - <http://clonezilla.nchc.org.tw/clonezilla-live/doc/>
- Clonezilla 相關文章與報導
 - http://clonezilla.nchc.org.tw/related_article/

