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# **Why Free-Libre / Open Source Software (FLOSS)? Look at the Numbers!**

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**May 30, 2011**

**<http://www.dwheeler.com/numbers>  
[http://www.dwheeler.com/oss\\_fs\\_why.html](http://www.dwheeler.com/oss_fs_why.html)**

*This presentation contains the views of the author and does not necessarily indicate endorsement by IDA, the U.S. government, or the U.S. DoD.*

# Outline of Quantitative Information on FLOSS\*

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## Quantitative measures justify considering FLOSS

- **Background**
- **Quantitative measures (older & newer)**
  - **Market Share**
  - **Reliability**
  - **Scalability**
  - **Security**
  - **Total cost of ownership**
- **Other**
- **Miscellaneous & Parting Comments**

\*FLOSS: Free-Libre / Open Source Software / Free Software; aka Open Source Software (OSS), Free Software (FS), OSS/FS, Libre or Livre Software, FOSS

# Background

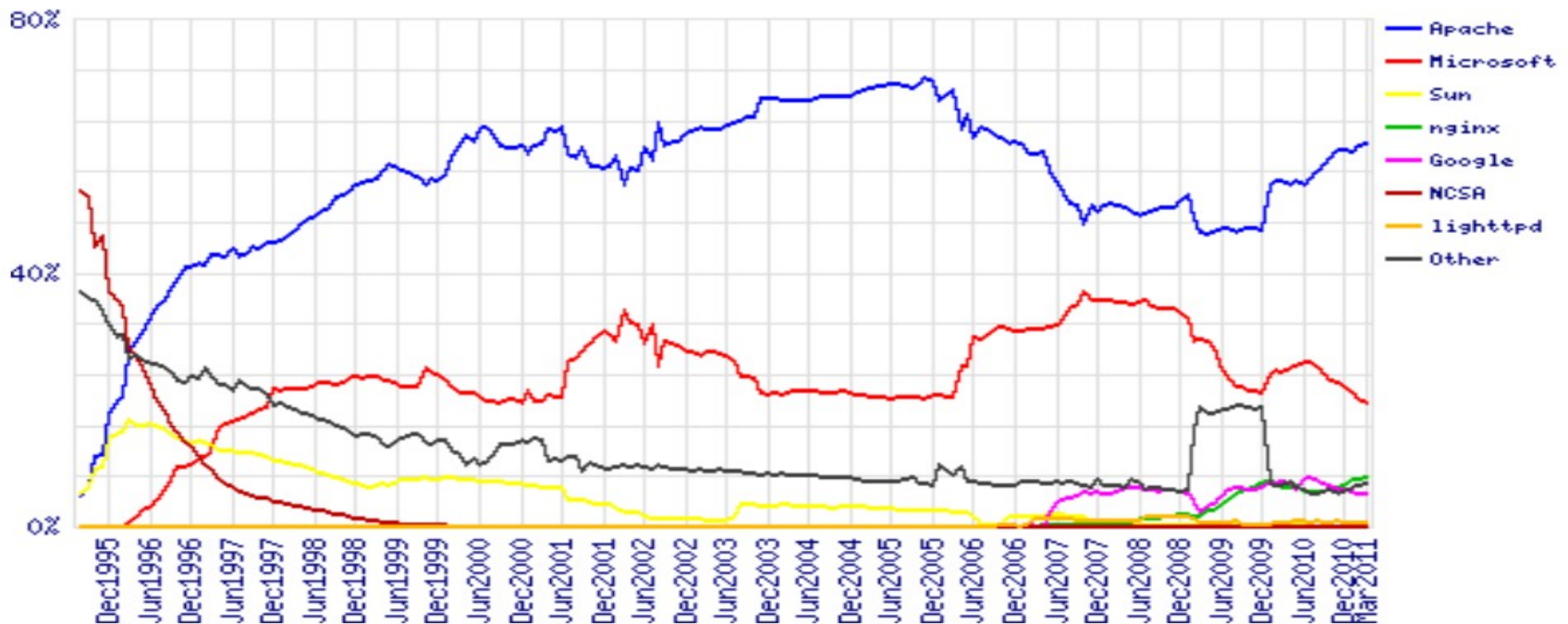
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- In 2000, many claims about FLOSS, yet their advocates gave little evidence
  - Investigated & found there was evidence
- Collection now widely-referenced
  - California Performance Review, 2004
- Challenges:
  - Vendor-funded studies (conflict of interest)
  - Some proprietary licenses claim to forbid speech
  - Some reports expensive & can't be republished
- Numbers can't prove “always better”

# Market Share: Web Servers

- FLOSS dominates web serving & has from the beginning. March 2011: Apache 60.31%, IIS 19.34% [Netcraft March 2011 survey of 298,002,705 sites]**

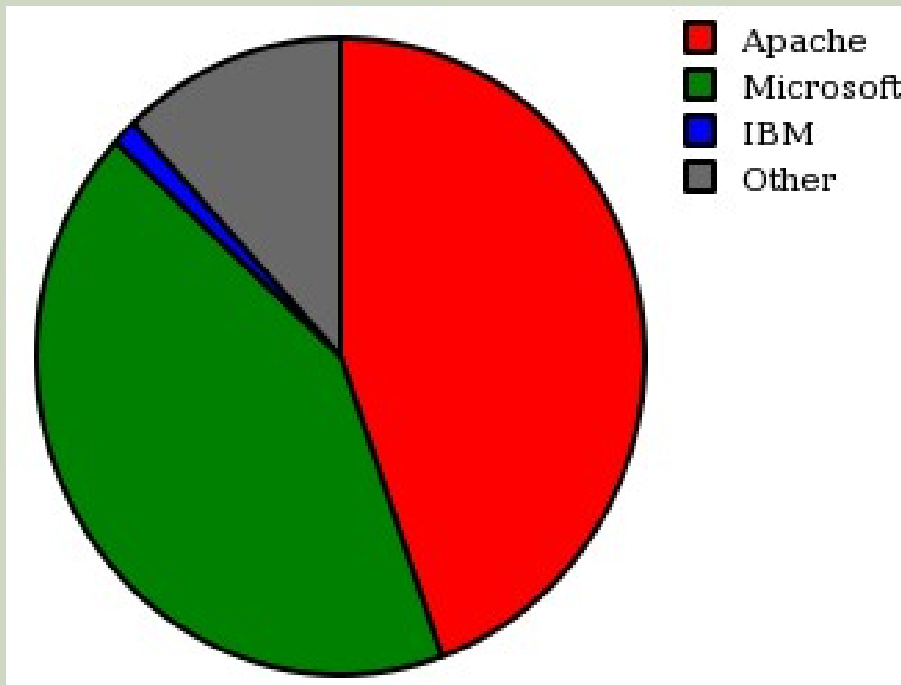
Market Share for Top Servers Across All Domains  
August 1995 - March 2011



# Market Share: SSL web servers

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- **Netcraft's latest public SSL survey (Jan 2009)**  
**<https://ssl.netcraft.com/ssl-sample-report/>**

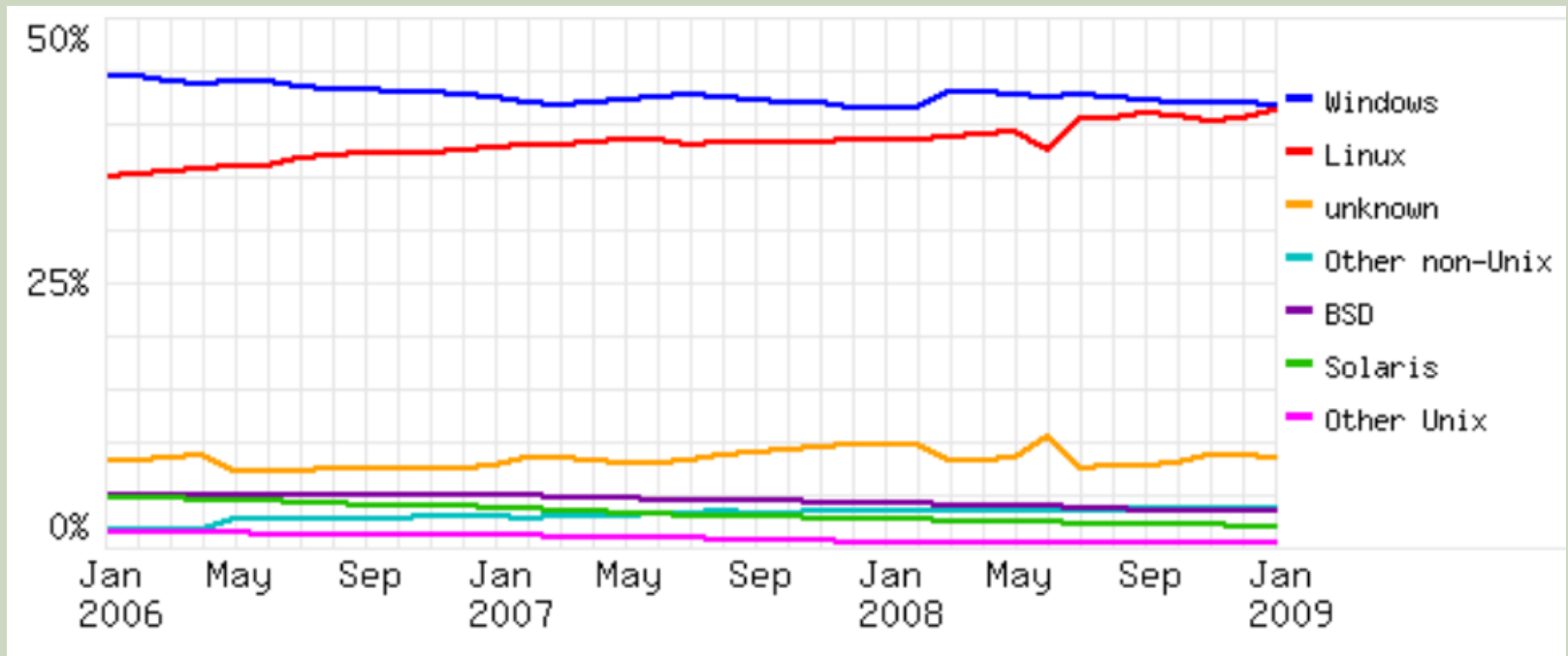


“Netscape once dominated... Microsoft soon caught up and passed... [and now the] most popular choice of SSL web servers is the open source Apache server.”

# Market Share: Operating Systems for SSL-enabled Web servers

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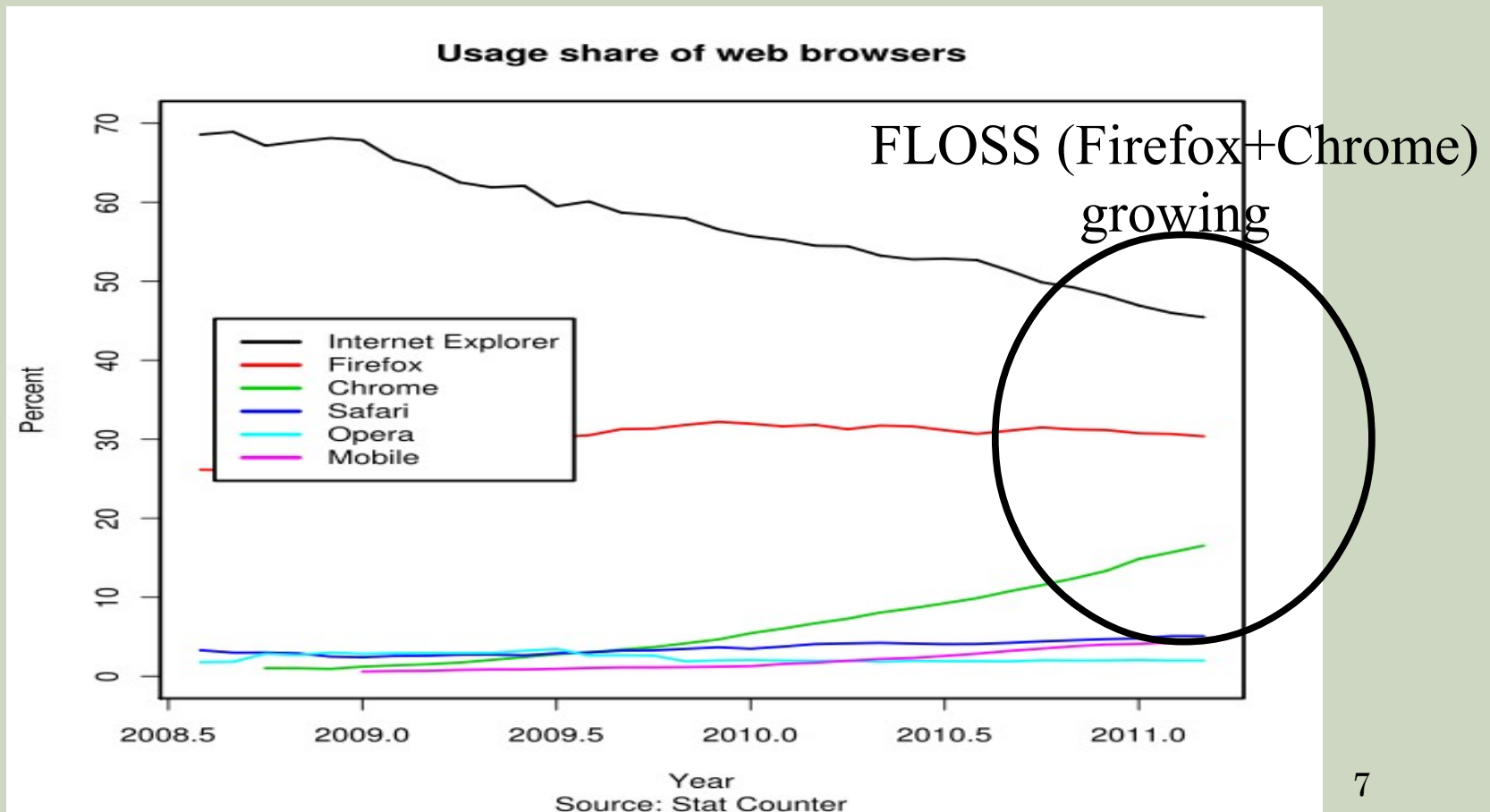
- Netcraft's latest public SSL survey (Jan 2009)  
<https://ssl.netcraft.com/ssl-sample-report/>



# Market share: Web browsers (Statcounter)

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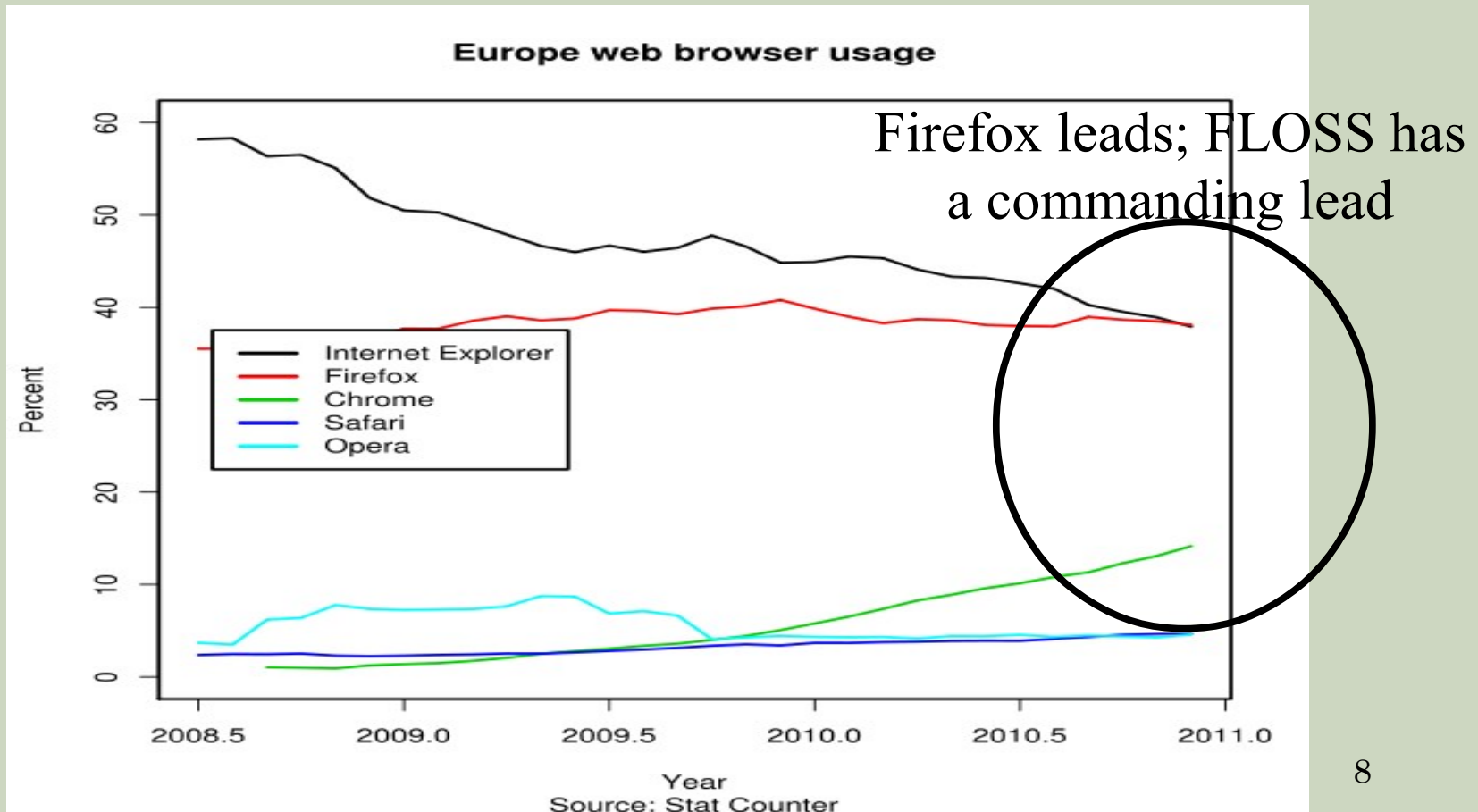
- Statcounter – Hits from 3 million sites



# Market share: Web browsers (Statcounter – European users)

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- Statcounter – European users

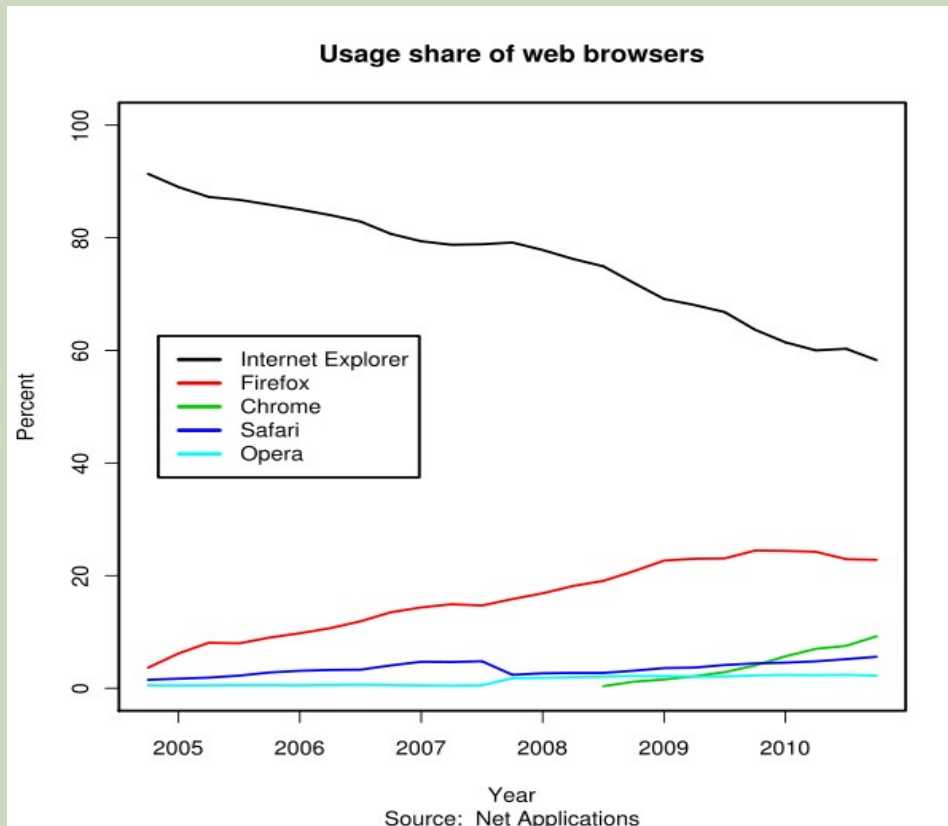




# Market share: Web browsers (Net Applications)

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- 40,000 websites, weighted by users/country



Weighting uses CIA data; new CIA data caused them to recalculate, weighting Chinese users more heavily and thus changing old share estimates (!)

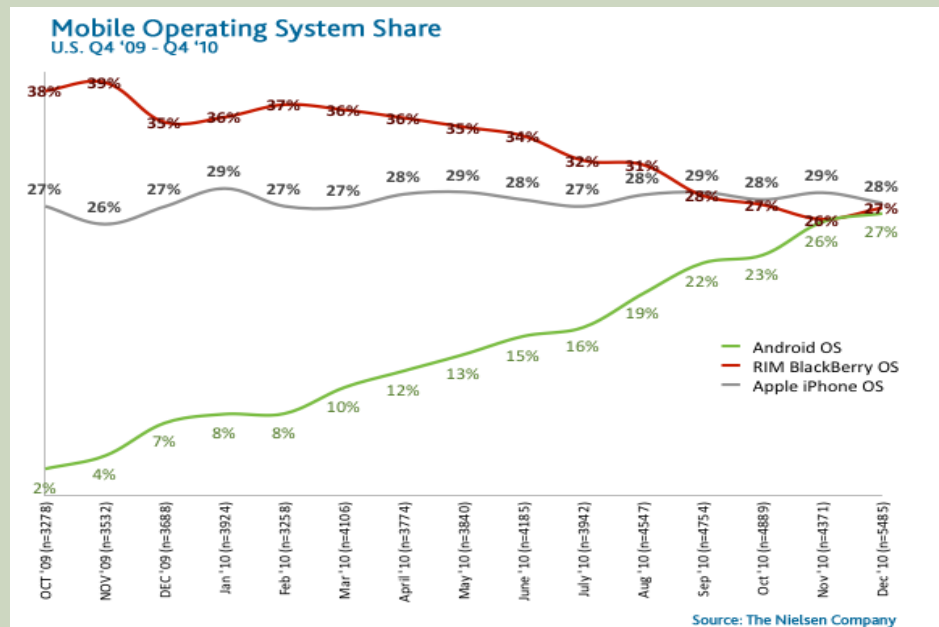
# Market Share: Smart phones – Linux-based Android's powerful growth

**3-month period ending Nov 2010 in U.S.: RIM 33.5% (fell 4.1%), Android 26% (grew 6.4%), Apple 25% (grew <1%), Microsoft 9% (fell 1.8%), Palm 3.9% (fell 0.7%)**  
**[Comscore via InformationWeek 2011]**

**Worldwide Smartphone Sales to End Users by Operating System in 2010**  
 (Thousands of Units)

Company	2010 Units	2010 Market Share (%)	2009 Units	2009 Market Share (%)
Symbian	111,576.7	37.6	80,878.3	46.9
Android	67,224.5	22.7	6,798.4	3.9
Research In Motion	47,451.6	16.0	34,346.6	19.9
iOS	46,598.3	15.7	24,889.7	14.4
Microsoft	12,378.2	4.2	15,031.0	8.7
Other Oss	11417.4	3.8	10432.1	6.1
<b>Total</b>	<b>296,646.6</b>	<b>100.0</b>	<b>172,376.1</b>	<b>100.0</b>

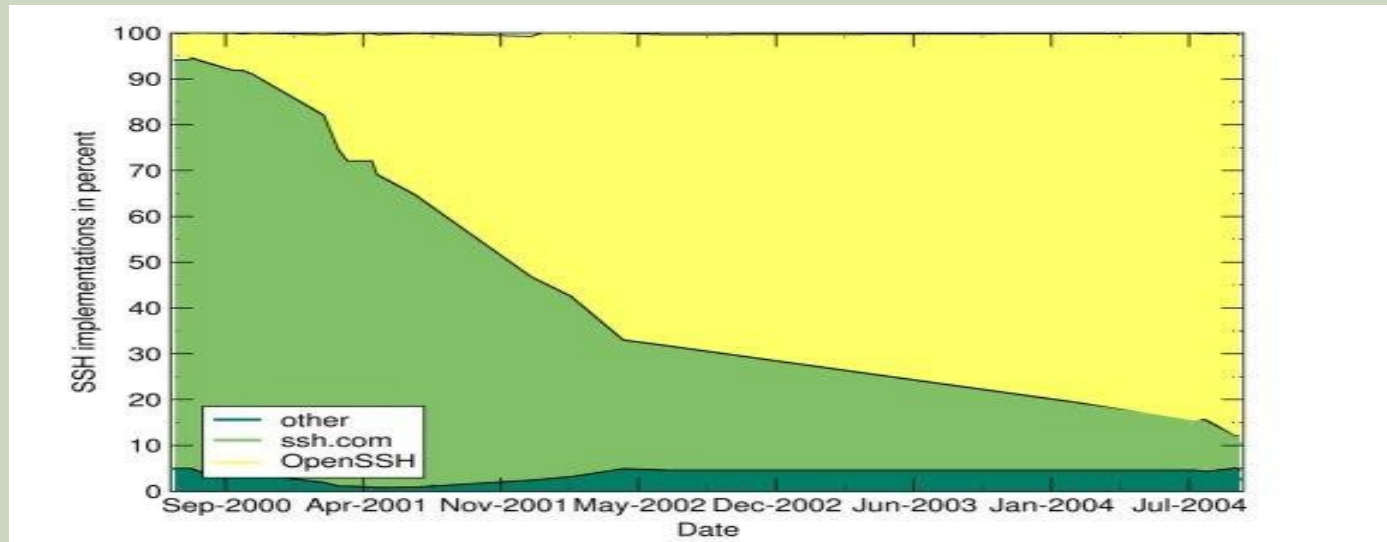
Source: Gartner (February 2011)



# Other Market Share Examples

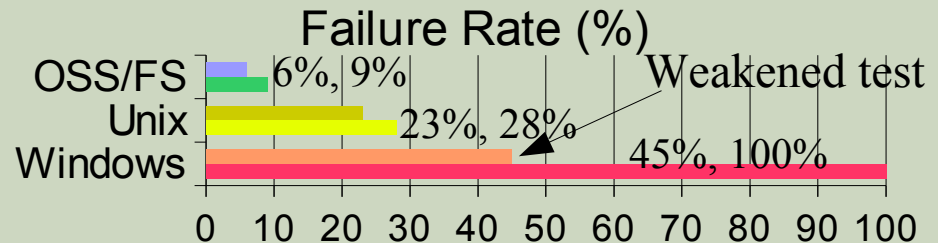
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- Of the top 500 supercomputers on Nov 2010, 93% (465) are FLOSS (Linux or Open Solaris) [top500.org]
- DNS: bind supports 95% of reverse-lookups [Manning]
- Sendmail #1 Email server [Bernstein]
  - Sendmail 42%, Microsoft Exchange 18%
- OpenSSH #1 SSH – FLOSS can take over *quickly*. ~5% Summer 2000, 50% Nov 2001, 87.9% by Sep 2004 [scanssh]



# Reliability

- Fuzz studies found FLOSS applications significantly more reliable [U Wisconsin]

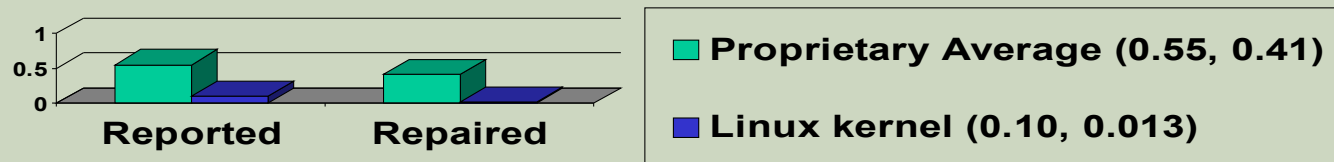


- GNU/Linux vs. Windows NT 10 mo study [ZDNet]
  - NT crashed every 6 weeks; both GNU/Linuxes, never
- IIS web servers >2x downtime vs. Apache [Syscontrol AG]
- Survey of 6MLOC: FLOSS “maintainability index” equal & sometimes better vs. closed [Samoladas in CACM, Oct 2004]
- FLOSS: More modular [MacCormack, Harvard Bus. School]

# Reliability (2)

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- **Automated defect detection analysis:**
  - Linux kernel: of 5.7MSLOC, only 985 detected (>5000 expected, 80% fewer) [Coverity]
  - MySQL: 0.09 defects/KSLOC vs. 0.57 average defects/KSLOC avg. 200 proprietary [Reasoning]
  - Linux kernel TCP/IP had smaller defect density [Reasoning]



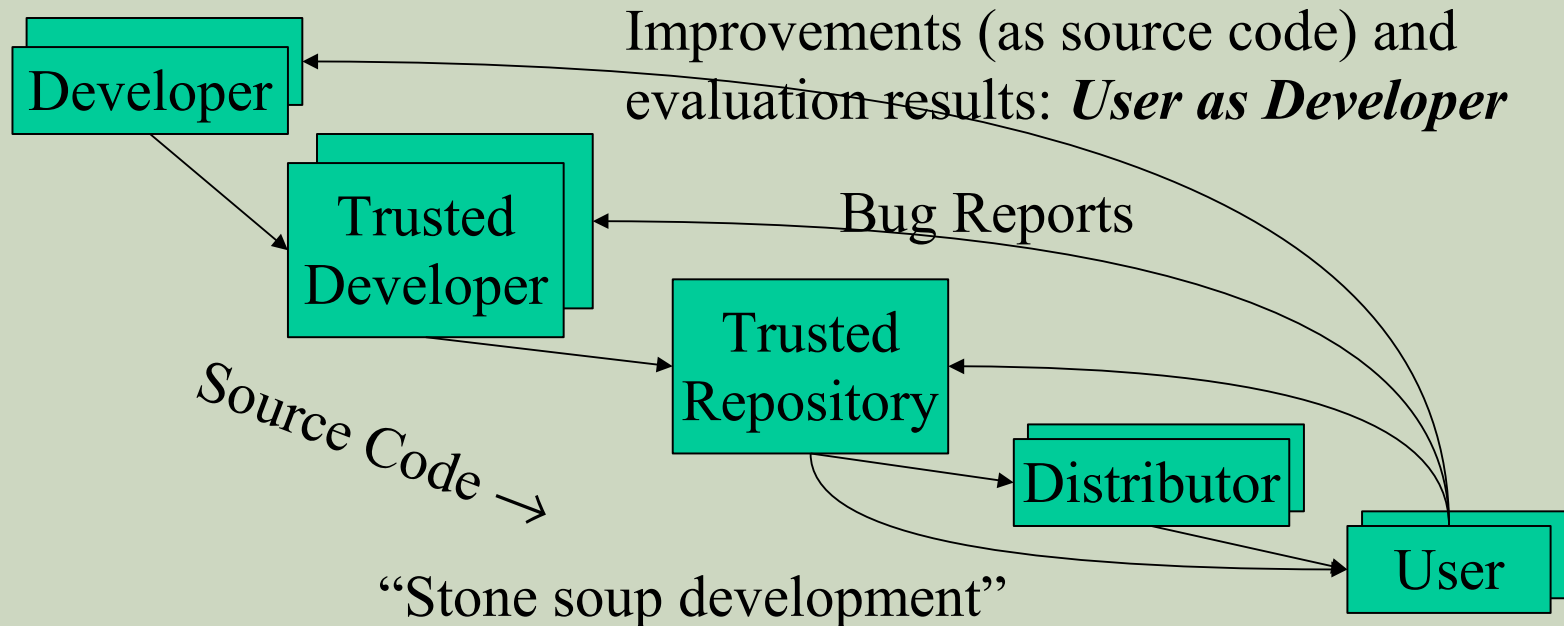
# Scalability

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- **GNU/Linux and NetBSD support more hardware platforms & performance ranges than any other**
  - **PC hardware, mobile phones, mainframes, clusters, supercomputers, ...**
- **Again, 93% of supercomputers use an OSS OS [Top500.org]**
- **FLOSS can develop large software systems**
  - **2001: Red Hat Linux 7.1 had 30million SLOC: 8,000 person-years & \$1B USD [Wheeler]**
  - **2008: Fedora 9 had 204.5million SLOC: 60,000 person-years & \$10.8B USD [Linux Foundation]**

# FLOSS Development Model

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- FLOSS users typically use software without paying licensing fees
- FLOSS users typically pay for training & support (competed)
- FLOSS users are responsible for developing new improvements & any evaluations that they need; often cooperate/pay others to do so

# Security

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- **May 2011 study analyzed 17 packages and found proprietary software had no security advantage; they were roughly only equal with FLOSS:**
  - “in terms of the severity of vulnerabilities, the type of development of vulnerability disclosure over time, and vendors' patching behavior” [Guido Schryen, CACM]
- **Browser unsafe days (known unpatched vulnerability)**
  - **2004: 98% Internet Explorer, 15% Mozilla Firefox**
  - **2006: 78% Internet Explorer, 2% Mozilla Firefox**
- **Windows websites disproportionately vulnerable**

Category	Proprietary	FLOSS
Defaced	66% (Windows)	17% (GNU/Linux)
Deployed Systems	49.6% (Windows)	29.6% (GNU/Linux)
Deployed websites (by name)	24.81% (IIS)	66.75% (Apache)



## Security (2)

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- **Unpatched networked systems: 3 months Linux, hours Windows (variance minutes ... months) [Honeynet.org, Dec 2004]**
- **50% Windows vulnerabilities are critical, vs. 10% in Red Hat [Nicholas Petreley, Oct 2004]**
- **Viruses primarily Windows phenomenon**
  - **60,000 Windows, 40 Macintosh, 5 for commercial Unix versions, 40 for Linux**
- **91% broadband users have spyware on their home computers (proprietary OS) [National Cyber Security Alliance, May 2003] vs. ~0% on FLOSS**

# Security (3)

- FLOSS systems scored better on security [Payne, Information Systems Journal 2002]

	Debian	Solaris	OpenBSD
Number of Features:	15	11	18
Features score:	6.42	5.92	7.03
Number of Vulnerabilities:	12	21	5
Vulnerabilities score:	7.72	7.74	4.19
Final Score (larger better):	-1	-3.5	10.2

- Survey of 6,344 software development managers April 2005 favored FLOSS [BZ Research]

	MS Windows Server	Linux	Sun Solaris	<i>What's more Secure?</i>	OSS/FS	Proprietary
Very insecure or Insecure:	58%	6%	13%	Desktop/Client OS:	58%	6%
Secure or very secure:	38%	74%	66%	Web Servers:	43%	14%
				Server OS:	38%	22%
				Components/Libs:	34%	18%
				Database Servers:	21%	34%

# Total Cost of Ownership (TCO): Background

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- TCO multifaceted; for software-based system: [CSC]
  - Direct software costs (purchase, maintenance, support)
  - Indirect software costs (license admin, audit)
  - Hardware (purchase/upgrade, maintenance, dispose)
  - Staffing (project management, systems engineering, administration (e.g., purchasing), systems admin)
  - Support (install, troubleshoot, casual learning, training)
  - Downtime
- TCO sensitive to circumstances & time horizon
  - Helpful for single decision, hard to generalize
  - *Anything* has a lower TCO for *some* circumstance
  - Architecture matters!: Independent clients, X-terms, stateless, cluster, etc. *May be best deployed differently*
- Proprietary software is really “Total Cost to Lease”

# TCO: General FLOSS

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- **FLOSS usually costs less to acquire than proprietary**
  - E.G., Web server, Windows \$3610 vs. \$156
- **Some other factors also tend to be lower**
  - Lower upgrade costs, can use cheaper hardware
  - Avoids license management & litigation
  - Downtime less: more modular, remove unneeded [CSC]
- **Maintenance/Support: Varies, can be *competed***
- **Cybersource: TCO 24%-34% less w/FLOSS**
- **InfoWorld Survey of CTOs:**
  - 60% CTOs: >\$50K/yr savings
  - 32% CTOs: > \$250K/yr savings (inc. above)
- **Survey of companies > \$5M revenue**  
**[InternetWeek/InformationWeek]**
  - 39%: FLOSS costs 25% to 50% less
  - 27%: FLOSS costs 50% to 75% less

# TCO: Specific Examples

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- **Measured Web server TCO of GNU/Linux is 40% (<1/2) of Windows' and 14% of Solaris' [RFG]**
- **Amazon.com: \$17M savings in 1Q via Linux**
- **UK Gov't Becta\* 3yr study: FLOSS savings significant in primary & secondary schools**
  - **Secondaries reduce IT overheads by 24% (inc. software, hardware, and support costs)**
  - **Primary schools cut computer costs by nearly half, primarily from support but also hardware**
- **Willamette U. Library \$41K vs. \$100-150K using networked X terminals [Murphy]**
- **Netproject: Desktop Linux 35% (save 65%!) of Windows**
- **Largo, FL: \$1M/yr savings thin clients**

\*Becta: British Educational Communications and Technology Association

# **FLOSS developers experienced & get paid**

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- **Average age 30 & 11 years experience [BCG]**
- **In 2004, 37,000 of last 38,000 changes in Linux kernel were from those paid to develop them**
- **At *least* 70% of Linux kernel developers paid to do so as of Dec 2010 [Linux Foundation]**
- **UC Irvine survey found core FLOSS contributor salaries 5-15% higher than average [Scacchi]**
- **“Developers with a specialization in [the LAMP stack] can get 30-40% pay increase...” because of the “huge wave of people embracing open source technologies” [Kirven 2008]**

- **To many, other (often non-quantitative) advantages of FLOSS are more important, e.g.:**
  - **Social/ethical/moral reasons**
  - **Avoids risks of single source solutions/lock-in**
    - **Create reversible decision: can switch/self-support if price jacked up, maliciously changes interface, drops support, needs change (can get data), ...**
  - **(Can) avoid security risks of monocultures**
  - **Supports local/domestic IT infrastructure**
  - **Long-term data retention (format not secret)**
  - **Many believe it encourages innovation**
  - **Avoids license management and litigation**
  - **Greater flexibility**
    - **Can change software (inc. via hiring) to meet needs**

# **FLOSS is Commercial!!!**

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- **Many OSS projects supported by commercial companies**
  - **Red Hat, Novell, IBM, Microsoft, ...**
- **Big money in OSS companies**
  - **Citrix bought XenSource (\$500 million), Red Hat bought JBoss (\$350 million), ...**
  - **IBM reports invested \$1B in 2001, made it back in 2002**
  - **Venture capital: \$1.44B in OSS 2001-2006 [InfoWorld]**
- **Paid developers**
- **OSS licenses/projects approve of commercial support**
- **U.S. Law (41 USC 403), FAR, & DFARS commercial definition**
- **U.S. copyright law (17 USC 101) “financial gain” definition**
- **Sell service/hw, commoditize complements, avoid costs**



# Misleading term: “Intellectual Property”

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- Laws on software often called “intellectual property rights” (IPR): Copyright, trademark, patent, trade secret, ...
- “Intellectual property” term extremely misleading
  - If I take your car, you have no car
  - If I copy your software.. you still have the software
  - Formal term: non-rivalrous
- Failure to understand differences leads to mistaken thinking
  - Knowledge & physical property *fundamentally* different
  - In OSS & government contracts often *many* parties have rights
  - U.S. Constitution permits exclusive rights *only* for limited times, *only* “to promote the progress of science and useful arts”
- Instead, say “intellectual rights” and “intellectual works”
  - Avoids mis-thinking & clarifies that all parties have rights

# Parting Comments

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- **FLOSS in many cases have measurable advantages over proprietary competition**
- **Consider using FLOSS software when acquiring**
- **Don't disadvantage FLOSS in policy**
  - **Be wary of vendor lock-in**
  - **Prefer open standards (publicly held, multi-vendor support, don't require patents)**
  - **Beware of “vendor pays” assumptions (CC)**
  - **Software patents justified?**
- **For more detailed information, see**  
**[http://www.dwheeler.com/oss\\_fs\\_why.html](http://www.dwheeler.com/oss_fs_why.html)**

# Backup Slides

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- **Introduction to FLOSS**
  - Basics, history, OSS vs. FS, licenses, development model
- **Unnecessary fears**
- **Acronyms**
- **Interesting sites/documents**

# Basics of FLOSS: Free-Libre / Open Source Software (OSS)

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- **Free-Libre / Open Source Software (FLOSS)** programs have licenses giving users the freedom:
  - to run the program for any purpose,
  - to study and modify the program, and
  - to freely redistribute copies of either the original or modified program (without royalties, etc.)
- ***Not* non-commercial, *not* necessarily free-of-charge**
  - Often supported via commercial companies
- **Synonyms: Libre software, FLOS, OSS/FS**
- **Antonyms: proprietary software, closed software**

# History of FLOSS

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- **1950s, 1960s: Software freely distributed**
- **~1970s: Rise of proprietary software**
- **1984: Richard M. Stallman establishes “Free Software Foundation”, creates “General Public License” (GPL)**
- **1990s: Increasing Internet availability enables developer coordination**
- **1997: Eric Raymond’s “Cathedral & the Bazaar” explains new approaches; term “Open Source Software” coined**

# **“Open Source Software” vs. “Free Software”**

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- **First named “Free Software” by Stallman**
  - Free as in Freedom
  - Officially defined by “Free Software Definition”
  - *Not* necessarily zero price; confused many
- **New term coined: “Open Source Software”**
  - Officially defined by the “Open Source Definition” (a long 9-point list)
  - Practically all OSS software is also FS
- **Terms sometimes indicate motivations**
  - FS: emphasize ethical/social issues
  - OSS: technical superiority/flexibility
  - OSS often used due to “zero price” confusion<sub>30</sub>

# Major FLOSS Licenses

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- Many licenses, but 4 dominate
- BSD-new & MIT license: anything but sue
  - Can incorporate code into proprietary software
  - Financial incentive to use, but *not* aid project
- General Public License (GPL): “Copyleft”
  - If distribute, *must* distribute source code or provide written offer to do so
  - Cannot link (embed) into proprietary software
- Lesser/Library GPL - a compromise
  - Must distribute source code/written offer, but only of component itself
  - *Can* link into proprietary software
- Public domain is FLOSS, but rare

# Unnecessary Fears

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- **Proprietary software always better supported? No.**
  - Non-traditional support (mailing lists, etc.)
  - Pay for traditional support, and can compete it
- **Proprietary more legal rights? No.**
  - Who do you sue? Nobody, in either case
- **FLOSS economically viable? Yes.**
  - Many business models
  - Customers can band together



# Unnecessary Fears

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- **Will programmers starve? No.**
  - Estimated 95% software not developed for sale
  - Companies hire programmers to make changes for themselves
  - Widespread use of FLOSS moves software development into a service (not product) model
- **FLOSS compatible with capitalism? Yes.**
  - FLOSS development involves trade: code for code
  - FLOSS business often based on payment for support or commoditizing complements of products
- **FLOSS mean no competition? No.**
  - KDE vs. GNOME, emacs vs. vim

# Unnecessary Fears

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- **Will FLOSS destroy intellectual property? No.**
  - **Usually, complaint is about GPL**
  - **GPL trades you the right to freely incorporate their code into your software in exchange for the right to freely incorporate your code [which incorporates their code] into theirs**
  - **Intellectual property traded for other intellectual property**
  - **Microsoft sells GPL'ed software, sponsored several FLOSS projects**

# Unnecessary Fears

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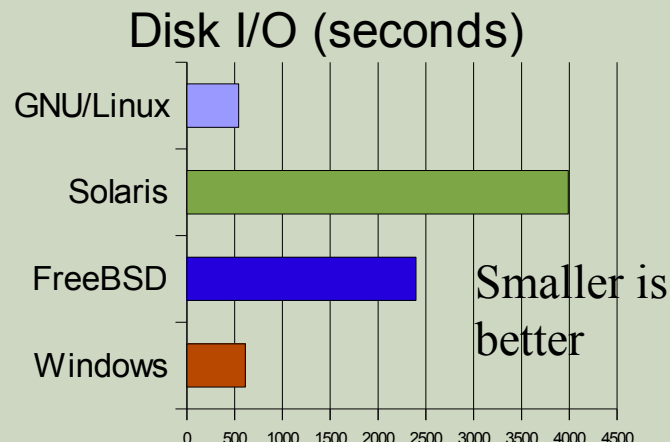
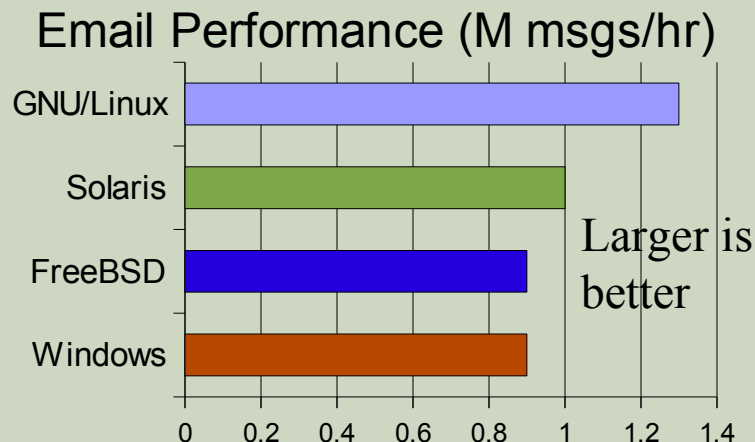
- **Viewing and changing source code valuable for non-programmers? Surprisingly, yes.**
  - **“Would you buy a car with the hood welded shut? If not, what do you know about modern ... engine technology?” [Bob Young]**
  - **Consumers demand this so they can have control over their product support, instead of dealers**
- **Anti-Microsoft campaign? No, not by all.**
  - **Jun02, 831 projects use Visual Basic; 8867 projects work on Windows [SourceForge]**
  - **Microsoft has been repeatedly asked to join community**
  - **Microsoft long used, and now develops FLOSS**
  - **Microsoft has sold GPL'ed software**

# Performance: GNU/Linux

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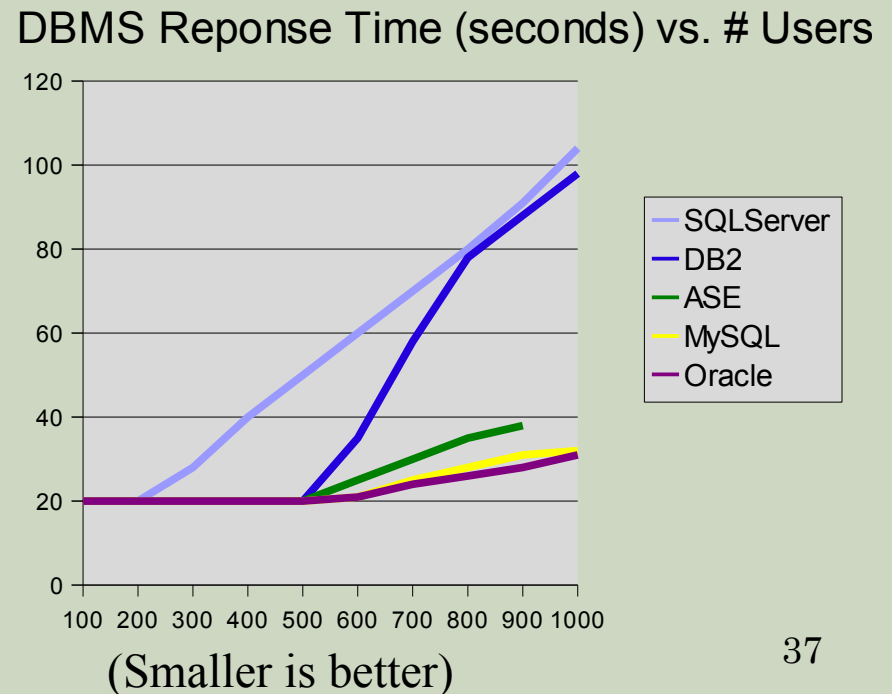
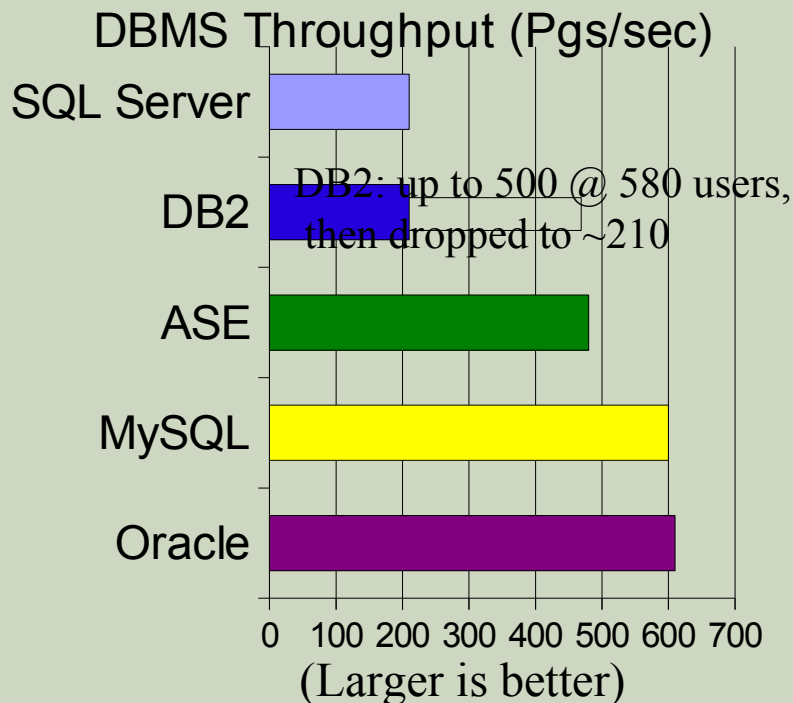
**Performance varies widely by circumstance!**

- **GNU/Linux with Samba faster fileserving at Windows' own file protocols [PC Magazine]**
  - Nov 2001, top end, 130MB/sec vs. 78MB/sec
  - April 2002, performance 2x; 4x many clients
- **GNU/Linux fastest (untuned systems) [Sys Admin]**



# Performance: DBMSs

- **eWeek Labs/PC Labs 2002 DBMS evaluation**
  - Unusual; most DBMS licenses forbid publication
  - **MySQL (FLOSS) did very well**



# Acronyms

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- **COTS: Commercial Off-the-Shelf (either proprietary or OSS)**
- **DoD: Department of Defense**
- **HP: Hewlett-Packard Corporation**
- **JTA: Joint Technical Architecture (list of standards for the DoD); renamed to DISR**
- **OSDL: Open Source Development Labs**
- **OSS: Open Source Software**
- **RFP: Request for Proposal**
- **RH: Red Hat, Inc.**
- **U.S.: United States**

# Interesting Documents/Sites

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- **“Why OSS/FS? Look at the Numbers!” (larger paper)**  
[http://www.dwheeler.com/oss\\_fs\\_why.html](http://www.dwheeler.com/oss_fs_why.html)
- **“Use of Free and Open Source Software in the US Dept. of Defense” (MITRE, sponsored by DISA)**
- **President's Information Technology Advisory Committee (PITAC) -- Panel on Open Source Software for High End Computing, October 2000**
- **“Open Source Software (OSS) in the DoD,” DoD memo signed by John P. Stenbit (DoD CIO), May 28, 2003**
- **Center of Open Source and Government (EgovOS)**  
<http://www.egovos.org/>
- **OpenSector.org** <http://opensector.org>
- **Open Source and Industry Alliance** <http://www.osaia.org>
- **Open Source Initiative** <http://www.opensource.org>
- **Free Software Foundation** <http://www.fsf.org>
- **OSS/FS References**  
[http://www.dwheeler.com/oss\\_fs\\_refs.html](http://www.dwheeler.com/oss_fs_refs.html)

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