

Linux Viruses and Such

SVLUG, 2013-05-01

Challenges in writing this talk:

- Avoiding Yet Another Windows Virus Lecture.
- Explaining any one thing first.
- Many antivirus and security people are not in the perspective business.
- Dealing with gadget freaks among us.
- The Net's collective memory is timeline-impaired.

Note: This is not[^]W a security lecture in disguise.

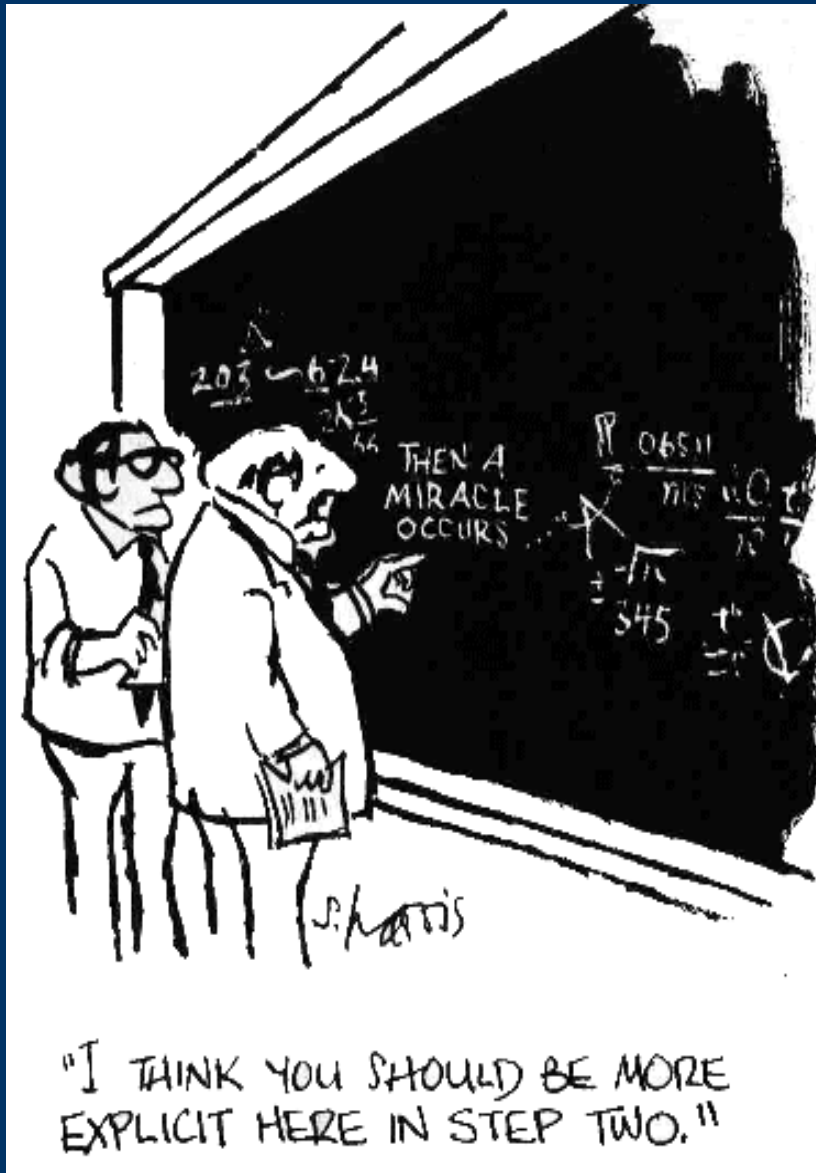
Linux Viruses and Such

tl;dr summary:

- No, you're not safe.
- But you're probably not worried about the right things.
- Don't Panic [tm].



Linux Viruses and Such



Most virus press coverage & analysis is like this cartoon.

Malware requires:

- authorship
- entry
- execution
- a vector

The first is easy on Linux, the second conceivable. The latter two tend to be non-trivial. But problems lurk.

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Malware Types:

- Virus: Modifies other programs.
 - Worm: Propagates across networks.
 - Trojan: Claims to do one thing, does another. (“Spyware” codebases are basically trojans.)
 - Logic bomb: “Blows up” in some way. (Milder versions are called “bacteria”.)
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Non-malware:

- Rootkit: Post-compromise toolkit, hides attacker's presence after entry *via other means entirely*.
 - [D]DoS tool: [Distributed] Denial of Service against remote host.
 - Backdoor: Post-compromise covert re-entry.
 - Documented but misunderstood: e.g., “sendmail -C”.
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Four thoughts to ponder:

- How do you know your system *isn't* compromised (virus or no)?
 - Viruses are canaries. (Thank them for pointing you towards *real* problems.) Measures to prevent or limit damage same for any process.
 - Code doesn't run itself.
 - Security forensics is difficult; bad guesses are easy.
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Linux Viruses and Such

Dept. of Reddish Herrings (errors & irrelevancies):

- “There are no Linux viruses.”
 - “Linux isn't invulnerable!”
 - “Unix is designed for security.” Dennis Ritchie, in “On the Security of Unix”: “The first fact to face is that UNIX was not developed with security, in any realistic sense, in mind; this fact alone guarantees a vast number of holes.”
 - “All I have to do is get the user to do [foo].”
 - “There's no protection against social engineering.”
 - “Open source will protect us.”
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Dept. of Reddish Herrings (cont'd)

- “Viruses are difficult to write.”
 - “Scripting support is dangerous.”
 - “Someone could write Outlook for Linux.”
 - “Data files can have executable code in them!”
 - “Hordes of new Linux users spell doom.”
 - “Security doesn't work, because users are lazy and do stupid things.”
 - “You're safe if you use the root account carefully.”
 - “You're safe if you patch all known bugs.”
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Linux Viruses and Such

Dept. of Reddish Herrings (concluded)

- “You have to worry about cross-platform threats from {Win32emulators|Java|JavaScript|Office Suites|Perl|PostScript|Python|Tcl|TeX|elisp|Web browser runtimes}.”
 - “All you have to do is post evil source code on Freshmeat.” (Freecode.com, now.)
 - “Linux is too insignificant to attack.” (Tell that to all the people running Apache httpd.)
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“Viruses are canaries” example:

Jan 25, 2003, 9:00 a.m., Saturday: Davis-Besse nuclear power plant, near Toledo, Ohio: SQL Slammer worm for Windows enters and overwhelms the SCADA network. Davis-Besse's safety-monitoring system was down for five hours.

North American Electric Reliability Council reported that two other electric plants' (one hopes, non-nuclear) SCADA networks were also affected.

Hooray for the virus! (relatively speaking)

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'The Slammer worm entered the Davis-Besse plant through a circuitous route. It began by penetrating the unsecured network of an unnamed Davis-Besse contractor, then squirmed through a T1 line bridging that network and Davis-Besse's corporate network. The T1 line, investigators later found, was one of multiple ingresses into Davis-Besse's business network that completely bypassed the plant's firewall, which was programmed to block the port Slammer used to spread.'

“This is in essence a backdoor from the Internet to the corporate internal network that was not monitored by Corporate personnel,” reads the April NRC filing by FirstEnergy's Dale Wuokko. “[S]ome people in Corporate's Network Services department were aware of this T1 connection and some were not””

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Malware Timeline:

- **1949:** John von Neumann invented concept of self-reproducing automata.
 - **1969 onwards:** Ken Thompson built into binaries of the original C compiler a backdoor for the UNIX login program, for his own convenience. No amount of source checking could find it, and it was still undetected when he revealed it in his 1983 Turing Award lecture.
 - **1972:** Novel “When HARLIE Was One” by David Gerrold had a fictional program called VIRUS, which was a war dialer that “injects itself into the new computer”.
 - **early 1970s:** Bob Thomas at BB&N created the Creeper program, which traveled from computer to computer within the network, then the Reaper program to hunt it down and kill it.
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Malware Timeline (cont'd)

- **mid-1970s:** Motorola staffers discovered exploitable security hole in the Xerox CP-V timesharing system, but *couldn't get Xerox to fix it*. So, the Motorola guys unleashed daemon programs “Robin Hood” and “Friar Tuck”, which carried out flamboyant pranks and re-launched one another if the system operator tried to kill them:

```
!X id1
```

```
id1: Friar Tuck... I am under attack! Pray save me!
```

```
id1: Off (aborted)
```

```
id2: Fear not, friend Robin! I shall rout the Sheriff  
of Nottingham's men!
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```
id1: Thank you, my good fellow!
```

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Malware Timeline (cont'd)

- **1975:** Novel “Shockwave Rider” by John Brunner invented a fictional “tapeworm” program.
- **1981:** Elk Cloner by Richard Skrenta. Simple floppy/OS infector for Apple II AppleDOS 3.3, and first non-fictional virus. Every 50th time it was run, an infected program displayed:

“Elk Cloner: The program with a personality

It will get on all your disks

It will infiltrate your chips

Yes it's Cloner!

It will stick to you like glue

It will modify ram too

Send in the Cloner!”

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Malware Timeline (cont'd)

- **1982:** John Shoch and John Hupp of Xerox PARC wrote an experimental worm program running across 100 Alto computers over ethernet. It ran amok because of a coding error, and had to be shut down.
 - **Nov. 3, 1983:** Fred Cohen wrote an experimental virus for a VAX 11/750 running 4BSD, to present to the Nov. 10, 1983 meeting of a weekly seminar on computer security, part of the work for his doctorate at USC. Leonard Adleman, his seminar advisor, applied the term “virus” to the work, published in 1984. Fred's virus used trojan techniques to (hypothetically) spread it: It was embedded in new debugging utility “vd”, posted on the system bulletin board.
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Malware Timeline (cont'd)

- **1983:** Film “War Games” introduced the public to the concept of a computer backdoor, and of war dialers.
 - **1986:** First MS-DOS virus, Brain, by brothers Basit and Amjad Alvi of Lahore, Pakistan. Infected floppy boot sectors.
 - **1987:** First file infector, Lehigh (infected command.com). Later, Suriv-02 was first .EXE infector (later reworked as "Jerusalem").
 - **1987:** First e-mail worm, Christmas Exec, for IBM VM/CMS mainframes, forced shutdown of several systems.
 - **1987:** U. of Wellington student unleashed Stoned, the first MS-DOS MBR virus. (Displayed “Your PC is now stoned!” and “Legalise Marijuana!”)
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Malware Timeline (cont'd)

- **Nov, 2, 1988:** Morris worm. Specific to VAXen and SUN3 boxes running BSD. Attempted fingerd buffer overflow, did password guessing, attempted to use sendmail DEBUG option.
 - **1989:** AIDS, by PC Cyborg Corporation of Panama: first trojan program.
 - **1992:** Michelangelo: Pioneer virus-industry press frenzy.
 - **1994:** Good Times hoax. (Cf. April 2000 “ILOVEYOU” worm.)
 - **1995:** Concept virus, by “Black Baron”. First macro virus.
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Malware Timeline (cont'd)

- **Sept. 29, 1996:** Bliss. First Linux virus. Third party posted it to Usenet groups comp.security.unix, alt.comp.virus and comp.os.linux.misc. ELF infector. *Most courteous virus ever:* Included “--bliss-uninfect-files-please” option. Can be compiled for any *ix variant.

Dishonest McAfee press release of Feb. 5, 1997 claimed to have “discovered” Bliss.

- **Oct. 1996:** Staog by “Quantum” of the VLAD virus group in Australia (published in VLAD Magazine issue #7). Often claimed in error to be the first Linux virus, because of a Feb. 5, 1997 Bliss “sighting” on linux-security mailing list that many mistakenly believed to be its first appearance. Staog probed for buffer overflow vulnerabilities in mount and tip, and a bug in suidperl, to try to gain root access.
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Malware Timeline (cont'd)

- **1998:** Strange Brew. First Java virus.
 - **May 1998:** Adm worm for Linux. Attacked hole in a BIND8 function that's never enabled, already fixed a month earlier.
 - **Jan. 21, 1999:** TCP Wrappers v. 7.6 package trojaned at ftp.win.tue.nl, Eindhoven U. Detected within hours by Andrew Brown of Crossbar Security, who noticed it was unsigned. util-linux 2.9g also found trojaned at the same site, next day: John Stange noticed modification to login.c.
 - **1999:** Melissa. First Word/Outlook e-mail virus.
 - **Sept. 25, 2000:** Red Hat Software, Inc. rolled out Red Hat Network auto-updating, default starting with Red Hat 7.0.
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Malware Timeline (cont'd)

- **2001-3**: Eleven network worms aimed almost entirely at Red Hat. (Details at my site.) Attacked obsolete versions of wu-ftpd, BIND8, NFS, lpd, LPRng, OpenSSL, Samba, OpenSSH, qpopper, wu-imapd. All holes had been patched months or years earlier. Claim made (Ryan Russell) that two of these (l10n, lpdworm) subverted “thousands” of RH boxen, when est. # of Linux installations was 10-20 million. Pundit Laura DiDio asserts that 2002 Slapper/Cinik attack on OpenSSL w/Apache subverted 20,000. (Symantec says 3,500.)
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Linux Viruses and Such

Malware Timeline (cont'd)

- **May 6, 2002.** Red Hat Software, Inc. started defaulting to enabling IP-filtering enabled, with its shipment of Red Hat 7.3.
 - **Mar-May 2003.** monkey.org and irssi.org sites compromised, leading to backdooring of dsniff, fragrouter, fragroute, and Irssi source tarballs. Detected seven days later, GnuPG signing of source releases commenced. 2,000 downloads.
 - **Jan. 25, 2003.** “SQL Slammer” worm, AKA Sapphire or Slapper, subverted an estimated quarter-million Windows boxes within about ten minutes. Saturated entire Internet in ½ hour.
 - **Nov. 5, 2003:** Attempt failed to plant a backdoor into the Linux kernel via a subtle addition, disguised as a two-line enhancement to the `sys_wait4` function's error-checking in file `exit.c`. Change planted at a CVS-checkout site (`kernel.bkbits.net`) housing copy of the BitKeeper tree was caught by an automated integrity check.
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Linux Viruses and Such

Malware Timeline (concluded)

- **Nov. 2003:** Compromise of four Debian Project servers, a server participating in the Gentoo Project's rsync.gentoo.org cluster (but neither project's packages), and FSF's Savannah server, using stolen login credentials plus escalation to root using a recently discovered (Sept. 2004) bug in the v. 2.4.22 kernel's brk() system call: Andrew Morton had patched the bug without realising its security implications.

Both the Debian and Gentoo compromises were detected within hours because of (1) file-integrity checkers, and (2) alert sysadmins noting a suspicious pattern of kernel “oopses”.

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- **Dec. 13, 2007:** Backdoored SquirrelMail 1.4.11/1.4.12 placed on www.squirrelmail.org. Devs weren't signing their code. Trojan found when downloader noted bad md5sum.
 - **Nov. 8, 2010:** Trojaned ProFTPd 1.3.3c on ftp.proftpd.org. Caught by downloader after 3 days, bad PGP signature.
 - **June 30, 2011:** Trojaned vsftpd on vsftpd.beasts.org, ditto 3 days. Switch to new hosting; possible severe site problem?
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- **Aug. 12, 2011:** kernel.org machine compromise. But SHA1-validated kernel code was safe. Oddly, source tarballs might have escaped notice for a while. (git checksum validation is your friend.)



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All known ELF infectors for Linux:

Abulia, Bliss, Cassini, Cron, Dido, Diesel, Dummy, Eriz, Gildo, Henky, Jac, Kagob, Kaot, Mandragore, Nel, Neox, Nuxbee, Obsidian.E (Obsid), OSF, Ovets, Pavid (Alfa.dr), Penguin, Quasi, RST = Remote Shell Trojan (Vit), Radix, RcrGood, Rike (Rike.1627), Satyr, Sickabs, Siilov, Silvio, Simile (Etap, MetaPHOR), Staog, Svat, Telf, Thebe, Winter (Lotek, LoTek), Winux (Lindose, PEElf, Pelf), Wozip, Xone, Ynit, and Zipworm (distinctive only in that it likes to infect ELF files in Zip archives).

Pretty much all functionally identical. Might as well be one virus. (A few include backdoor code, which please see.)

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Remedies / Lessons / Concluding Sermon:

- The “crunchy centre” approach: hardening executables.

libsafe, StackGuard, Stack Shield, FormatGuard, PointGuard, RaceGuard, PaX, ExecShield, RSX, Openwall, kNoX, grsecurity, AppArmor, PIE, PAE, Fortify Source. Non-eXecute (NX) or eXecute-Disable (XD). Most of these either modify gcc or interject a protective library.

Problem: Some things may break. Or not.

Linux Viruses and Such

Remedies / Lessons / Concluding Sermon (cont'd):

- **Sandboxing:** Little used, except inside Java.
Room for improvement to Linux systems, here --
e.g., in Internet “viewer” apps.
 - **Modular design, privilege-dropping, chrooting.**
 - **Access Control schemes:**
Mandatory Access Control:
SELinux, LIDS, RSBAC
Discretionary Access Control:
POSIX.1e draft (1003.1e/1003.2c) ACLs
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(Further sermon:) Surveillance of Self:

- Network IDSes / Vulnerability Scanners:
Snort, nmap, Nessus
 - Host-based IDSes / System Integrity Checkers:
OSSEC, Integrit, Samhain, Prelude-IDS
 - chkrootkit / rkhunter
...but note LKM stealth rootkits.
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(More sermon:) Competent system maintenance:

- *Do* use your packaging and maintenance regime. Avoid tarballs absent very compelling reasons, and then realise you're assuming all responsibilities of a packager. Also, install within `/usr/local` or `/opt`; avoid root authority if possible.
 - *Don't* use obsolete and/or unmaintained software
 - *Don't* use outright bad software, e.g., `wu-ftpd`.
 - *Do* check your `mime.types`, `mailcap`, or equivalent.
 - *Do* try to have some idea which code is more security-sensitive.
 - *Do* know that you're responsible for whatever you run with whatever authority you wield in so doing.
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Remedies / Lessons / Concluding Sermon (almost done).

How about Running a Virus-Checker for Linux, Too?

Rick's Not-At-All-Cynical Guide to Distinguishing Viruses from Virus Checkers:

	Virus	Virus-Checker
Unauditable, binary-only code?*	yes	yes
That you're expected to run as root?	yes	yes
From someone who claims to be a good guy?	no	yes

*(Sure, I do know about ClamAV, AMaViS, etc.)

Linux Viruses and Such

Cluebat: Hey, Linux guy: You have much more real and serious worries than viruses. E.g.:

The authentication problem, passwords, and \$FIRM's compromise as described in my file about “break-ins without remote vulnerability”.

Advantages of multifactor authentication. Maybe S/KEY or OPIE?

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We are protected by:

- Ground-up design for network and multiuser.
- Avoidance of system dependency on RPC calls.
- Modularity and generic, simple interfaces (scripting, pipes, etc.).
- Minimum privilege, no easy paths to escalation.
- System transparency.

(...in addition to just avoiding shooting at our feet.)

Linux Viruses and Such

We are hampered by:

- Rampant sloppy coding in key places
 - Looked through suid/sgid-root apps and their libs?
 - suid-root X clients! WTF?
- Questionable new code like dbus, ConsoleKit.
- Bloated codebases with carefree parsing of public data, no trust boundaries, no privilege separation
 - xlib, glibc, ld.so/ld-linux.so. Libshadow, qt

Linux Viruses and Such

In contrast to the Windows detection/removal treadmill, real-world security should concern all of these:

- prevention/avoidance
 - detection
 - damage reduction (what is at risk?)
 - defense in depth (how can we avoid having all our eggs in one basket?)
 - hardening
 - identification
 - recovery
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Linux Viruses and Such

References:

- North American Electric Reliability Council report on the SQL Slammer worm
http://www.esisac.com/publicdocs/SQL_Slammer_2003.pdf
 - Davis-Besse nuclear plant infection.
<http://www.securityfocus.com/news/6767>
 - Amit Singh's "A Taste of Computer Security"
<http://www.kernelthread.com/publications/security/>
 - Assembler source code to Staog:
[http://www.lisoleg.net/lisoleg/security/LINUX%20Virus\(very%20old\).txt](http://www.lisoleg.net/lisoleg/security/LINUX%20Virus(very%20old).txt)
 - Ken Thompson's "Reflections on Trusting Trust":
<http://www.acm.org/classics/sep95/>
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Linux Viruses and Such

References (cont'd):

- BK2CVS gateway's compromise discovered by Larry McVoy:
<http://www.ussg.iu.edu/hypermail/linux/kernel/0311.0/0621.html>
- Fyodor's gentle tutorial on port-scanning:
http://www.insecure.org/nmap/nmap_doc.html
- The Motorola/Xerox saga of “Friar Tuck” and “Robin Hood”, in Appendix A of the Jargon File:
<http://www.catb.org/~esr/jargon/html/meaning-of-hack.html>
- A virus written in TeX by Keith Allen McMillan:
<ftp://ftp.cerias.purdue.edu/pub/doc/viruses/KeithMcMillan-PlatformIndependantVirus.ps>
- Alexander Bartolich's ELF Virus Writing HOWTO. (Ego alert: Author cites Rick Moen's Linux virus pages as “inspiring”.)
http://virus.enemy.org/virus-writing-HOWTO/_html/index.html

Linux Viruses and Such

- References (cont'd):
 - Rick Moen's “Attacking Linux”, on how to study your systems' security by approaching/studying them the same way an attacker would:
<http://web.archive.org/web/20080427075329/http://security.itworld.com/4352/LWD000829hacking/pfindex.html>
 - Robert Graham's analysis of the SQL Slammer worm:
<http://www.robertgraham.com/journal/030126-sqlslammer.html>
 - *Psst! Want to download a Linux virus?*
<http://web.archive.org/web/20041011110030/http://www.digitaloffense.net/worms/> <http://vx.netlux.org/>
 - Rick Moen's “Constructive Paranoia at the End of 2003”, drawing the lessons of the 2003 compromises of prominent Linux sites using the brk() kernel bug and stolen login credentials:
<http://linuxgazette.net/issue98/moen.html>
-

Linux Viruses and Such

References (cont'd):

- Wichert Akkerman's outstanding Debian.org Compromise 2003 pages: <http://www.wiggy.net/debian/developer-securing/>
 - Rick Moen's piece on “break-ins without remote vulnerability”: <http://linuxmafia.com/faq/Security/breakin-without-remote-vulnerability.html>
 - Nick Petreley's analytical article “Security Report: Windows vs Linux”:
http://www.theregister.co.uk/security/security_report_windows_vs_linux/
 - Details and analysis of the eleven worms, almost entirely in 2001-2, directed at unmaintained RH 6.2 and prior:
 - <http://linuxmafia.com/~rick/faq/index.php?page=virus#virus5>
 - Slides for this talk: <http://linuxmafia.com/presentations/>
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Linux Viruses and Such

References (concluded) - Hardening Projects:

- Debian: <http://wiki.debian.org/Hardening>
 - Ubuntu: <https://wiki.ubuntu.com/Security/Features>
 - Gentoo: <http://www.gentoo.org/proj/en/hardened/hardened-toolchain.xml>
 - Fedora: http://docs.fedoraproject.org/en-US/Fedora/0.1/html/Security_Guide/chap-Security_Guide-Basic_Hardening.html and http://docs.fedoraproject.org/en-US/Fedora_Security_Team/html/Defensive_Coding/
- ## Depressing survey of Linux desktop security:
- <http://cansecwest.com/slides/2013/Assessing%20the%20Linux%20Desktop%20Security%20-%20Ilja%20van%20Sprundel.ppt>
-
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Linux Viruses and Such

- **This talk sucked!** (It was prepared on short notice.) You can do better. Write to volunteers@lists.svlug.org to tell us about it.

