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Hacks and
Apps for
the BUG

Keeping Track
of **Multiple
Servers**

MOBILE LINUX

Android Internals

Hacking a
Portable Linux
Server

Conquering
Small Screens
with Conkeror

Syncing
Thunderbird
and BlackBerry



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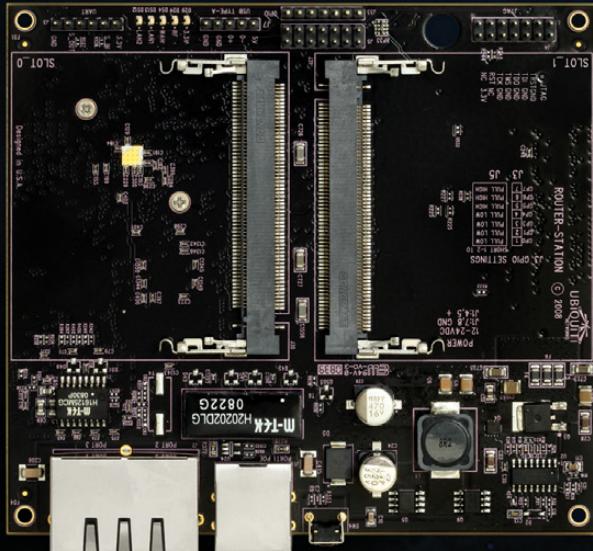
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Kindle
2**



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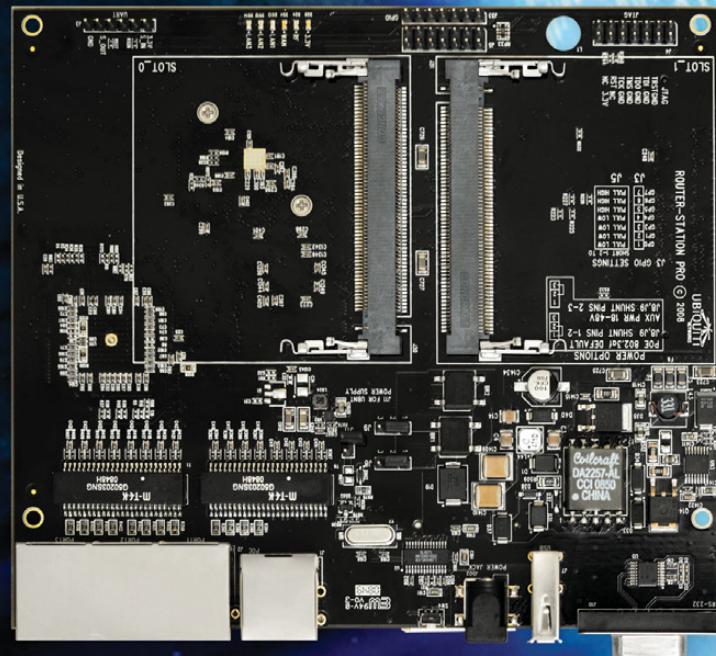


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CONTENTS

JULY 2009
Issue 183



ANDROID

FEATURES

60 THE JAVA API TO ANDROID'S TELEPHONY STACK

All Android apps are created equal, but some apps are more equal than others.

Alexander Sirokin

66 HACKING YOUR PORTABLE LINUX SERVER

Hacking the Western Digital MyBook II.

Federico Lucifredi

72 THE CONKEROR WEB BROWSER CONQUERS SMALL SCREENS

All the power of Firefox with an Emacs look and feel.

David A. Harding

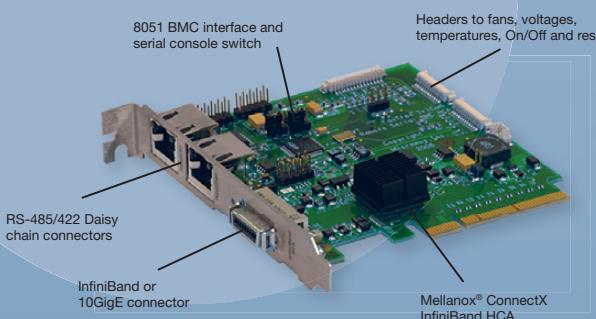
ON THE COVER

- Hacks and Apps for the BUG, p. 76
- Keeping Track of Multiple Servers, p. 40
- Android Internals, p. 60
- Hacking a Portable Linux Server, p. 66
- Conquering Small Screens with Conkeror, p. 72
- Syncing Thunderbird and BlackBerry, p. 24
- The Kindle 2, p. 50
- Indamixx: a Portable Recording Studio, p. 56

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CONTENTS

JULY 2009 Issue 183

COLUMNS

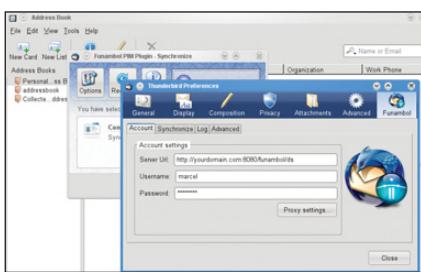
18 REUVEN M. LERNER'S

AT THE FORGE

Checking Your Ruby Code
with metric_fu

24 MARCEL GAGNÉ'S COOKING WITH LINUX

Linux, Thunderbird and the
BlackBerry—a Love Story



34 DAVE TAYLOR'S WORK THE SHELL

Parsing Command-Line Options
with getopt

36 MICK BAUER'S PARANOID PENGUIN

Building a Secure Squid Web Proxy,
Part III

40 KYLE RANKIN'S HACK AND /

Right Command, Wrong Server

80 DOC SEARLS' EOF

The Last Silos Standing

IN EVERY ISSUE

8 CURRENT_ISSUE.TAR.GZ

10 LETTERS

14 UPFRONT

44 NEW PRODUCTS

46 NEW PROJECTS

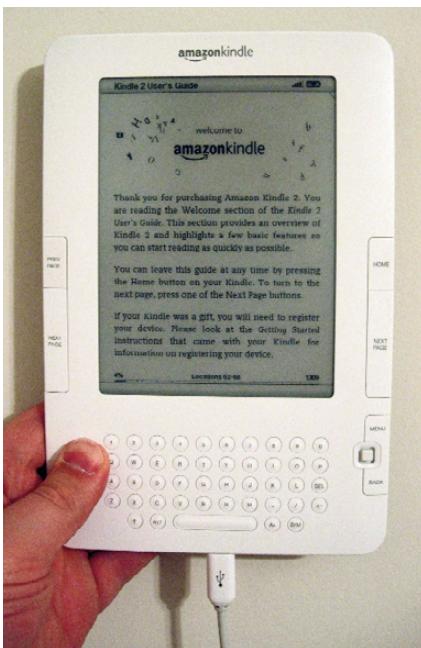
65 ADVERTISERS INDEX

79 MARKETPLACE

REVIEWS

50 THE KINDLE 2

Daniel Bartholomew



56 INDAMIXX: AN ON-THE-GO RECORDING STUDIO?

Dan Sawyer



INDEPTH

76 BUG LABS: HACKS AND APPS

Some buggy ideas for the BUG.

Alicia Gibb



76 THE BUG

Next Month

KERNEL CAPERS

All you kernel hackers put on your capes and get ready for next month's Kernel Capers issue. We've got articles on the Completely Fair Scheduler, which recently replaced the O(1) scheduler in the standard kernel. For you real-time types, we've also got an article about real-time scheduling with Linux.

If you're a security type, we've got something for you too. Learn how to make root unprivileged and instead use multiple less-privileged users, doling out only the responsibilities that each one needs.

Look for all that and more in next month's Kernel Capers issue—and all of them with more than just a kernel of truth to them!



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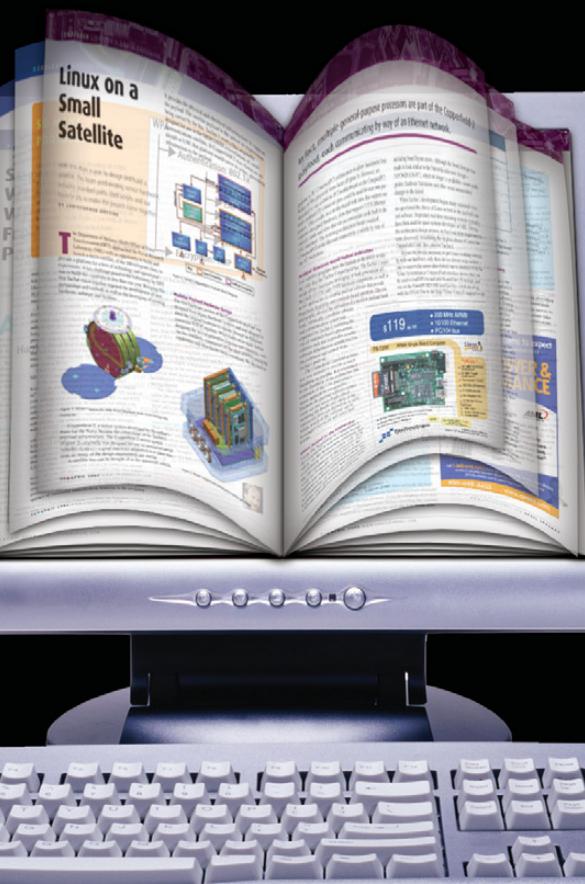
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LINUX JOURNAL

Executive Editor

Jill Franklin

jill@linuxjournal.com

Senior Editor

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Shawn Powers

shawn@linuxjournal.com

Associate Editor

Mitch Frazier

mitch@linuxjournal.com

Art Director

Garrick Antikajian

garrick@linuxjournal.com

Products Editor

James Gray

newproducts@linuxjournal.com

Editor Emeritus

Don Marti

dmarti@linuxjournal.com

Technical Editor

Michael Baxter

mab@cruzio.com

Senior Columnist

Reuven Lerner

reuven@lerner.co.il

Chef Français

Marcel Gagné

maggagne@salmar.com

Security Editor

Mick Bauer

mick@visi.com

Hack Editor

Kyle Rankin

lj@greenfly.net

Contributing Editors

David A. Bandel • Ibrahim Haddad • Robert Love • Zack Brown • Dave Phillips • Marco Fioretti

Ludovic Marcotte • Paul Barry • Paul McKenney • Dave Taylor • Dirk Elmendorf

Proofreader

Geri Gale

Publisher

Carlie Fairchild

publisher@linuxjournal.com

General Manager

Rebecca Cassity

rebecca@linuxjournal.com

Sales Manager

Joseph Krack

joseph@linuxjournal.com

Sales and Marketing Coordinator

Tracy Manford

tracy@linuxjournal.com

Associate Publisher

Mark Irgang

mark@linuxjournal.com

Webmistress

Katherine Druckman

webmistress@linuxjournal.com

Accountant

Candy Beauchamp

acct@linuxjournal.com

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SHAWN POWERS

Pocket-Sized Penguins

When my kids were young, it was difficult for me to convince them that penguins were birds. Frankly, they don't look much like birds. They don't exactly sit on bird feeders. Heck, they don't even fly. When they are waddling around in the snow, penguins look gangly and awkward. It's not until you see them in the water that their beauty and elegance really shines. Although I'm not suggesting Linux is awkward, there are some environments in which it really shines. Mobile devices are one of them.

This month, we're covering the whole gamut of mobile Linux. Alexander Sirotnik shows us how to bend Google Android to our will with the Java API. Marcel Gagné shows us a bit about syncing data from our non-Linux BlackBerry handsets with our Linux desktops. Most smartphones lack native Linux software, but thankfully, Funambol fills that gap nicely and supports many different mobile devices. If you have a smartphone, you'll want to check it out.

One of the frustrations of using mobile Linux devices is that the screens (if they have one) are really small. David Harding shows us the nuances of the Conkeror Web browser on small screens. Thankfully, more and more Web sites are being designed for the mobile-sized browser, but a flexible browser still is a great asset on tiny screens. Heck, with Linux, mobile computing doesn't even need screens. Federico Lucifredi shows us how to hack the Western Digital MyBook II. With a little bit of work, you'll be able to take your own Linux server with you wherever you go. Throw a couple in your backpack, and you could be a mobile cloud!

I was sure that for the mobile issue, Kyle Rankin would tell us about the time he did system administration on his server farm from a beach somewhere in Mexico with nothing more than an SSH prompt on his BlackBerry. I may have been wrong with my guess, but Kyle doesn't disappoint this month. He deals with the horrible mistake many of us have made: typing

a command remotely into the wrong server. As someone who accidentally has typed his password in an instant message window to someone by mistake, I'd advise reading his column. Twice.

Daniel Bartholomew is back this month to show us Kindle 2. The differences between that and the new Kindle DX are fairly easy to see (basically, it's huge). But, there are some significant differences between the original Kindle and the new regular-sized model too. Daniel compares the two and explains the pros, cons and general interesting things Amazon is offering in its Linux-based devices. If music or audio is more interesting than reading to you, Dan Sawyer tells us all about Indamixx, a recording studio you can take with you on the go. There may be some inappropriate places to set up your mobile studio, but with Indamixx, the problem won't be portability.

Fear not; this month we still have our regular lineup of columns to scratch that geeky itch. Dave Taylor demonstrates using getopt in shell scripts to parse the start flags. Reuven M. Lerner shows us how to check our Ruby code with metric_fu, and Mick Bauer continues his series on building a secure Squid proxy. This issue focuses on mobile Linux, but as with every other month, we aim to please everyone.

I suppose *Linux Journal* itself is a good example of mobility. Feel free to take this issue with you wherever you go. If you subscribe to the digital edition, you might be reading this on a laptop right now. My only suggestion would be that regardless of which format you are reading, try not to get carried away. Penguins might be able to "fly" underwater, but unless you have a Linux-powered submarine, *Linux Journal* is best enjoyed on dry ground. ■

Shawn Powers is the Associate Editor for *Linux Journal*. He's also the Gadget Guy for LinuxJournal.com, and he has an interesting collection of vintage Garfield coffee mugs. Don't let his silly hairdo fool you, he's a pretty ordinary guy and can be reached via e-mail at shawn@linuxjournal.com. Or, swing by the #linuxjournal IRC channel on Freenode.net.

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letters

The cover of Linux Journal's May 2009 issue features a large "COOL PROJECTS" section. It highlights projects like "Interact with the iRobot Create", "Convert 8mm Film to DVD", "Develop an Autonomous Underwater Vehicle", and "Build a Linux-Powered Rocket". A central image shows an iRobot Create robot with a green component attached. Other text on the cover includes "Phusion Passenger | iRobot Create | OpenFiler | AJAX | Squid", "Turn an Old Computer into a Network Appliance with OpenFiler", and "Interview with Neuros Technology's Joe Born".

Eliminate Blank Lines

Regarding Dave Taylor's Work the Shell column in the March 2009 issue of *LJ*: as you have been using UNIX nearly as long as I have, you probably already know this. The early UNIX spell program used a pipeline very similar to the one you develop in your column. Its purpose was to get a list of unique words from the document, sorted and single case. The rest of it used comm(1) to compare the document word list to a small system dictionary, /usr/lib/dict/words. I say small, as it had only about 25,000 entries.

One significant difference between the spell pipeline and yours was the handling of the tr(1) commands. Like your pipe, one tr did upper → lower translation. But, the second tr used options you did not mention in the article: -c and -s (complement and squeeze). Using today's syntax, that it would look like this:

```
tr -cs [:lower:] '\n'
```

By complementing the lowercase class, this style ensures that no punctuation, white space, digits, control chars and so on are missed. All are translated into newlines, and where multiple sequential newlines result (that is, blank lines), they are squeezed out by the -s option.

I notice from your uniq -c output that blank lines are the second-most frequent "word".

--
jl

Dave Taylor replies: Thanks for your note, Jon. You're right, using a bit more advanced call to tr would eliminate the blank lines, punctuation and so on. Thanks for the tip!

Beware On-the-Fly Certs

Regarding Mick Bauer's "Secure Squid Proxy, Part I" in the April 2009 issue: great article, Mick! However, I just wanted to draw some attention to the information in the "Just How Intelligent Is a Web Proxy" sidebar. It isn't necessarily true that "contents of HTTPS sessions are, in practical terms, completely opaque to the Web proxy". Some proxy software now has the ability to initiate a man-in-the-middle attack, issuing fake SSL certificates on the fly to enable the proxy to impersonate the remote server. This enables the proxy to inspect the traffic going between the client and server. Most browsers will detect this on-the-fly cert (generating a warning to the user), as it usually doesn't come from a valid Certificate Authority, but some companies are using tools, such as Group Policy, to push down custom CA settings within their organizations to configure the browsers to accept the on-the-fly certs as genuine (without throwing a warning).

--
Ray

Mick Bauer replies: Sure enough, you caught me oversimplifying. Thanks for the clarification, Ray!

Linux on the Desktop?

As I continue to search the forums for the issues I am having with a Linux desktop install, it seems that the Linux desktop (for me) still ranks as a hobby; Linux lacks a desktop that I can use in business. Linux has the applications—that's not the issue, desktop stability is. I think Linux on the desktop is up and coming, but there are still unresolved issues—look at the forums and the number of issues that go unresolved. I am not a Windows zealot by any

means and run a lot of Linux in the server environment (where it rocks!), but I have yet to have a Linux desktop install that just works out of the box. When you install Windows, you know what you're getting, warts and all, but it does work. It seems Linux lacks a level of stability and requires a level of experience that I don't have time for. Windows does not seem to have these issues and is why I continue to say that Windows wins the desktop war. Some will ask "what distro are you running, or what hardware platform are you installing on?" Or, they will say there is something I am doing wrong, and there probably is, but all I am looking for is usability so I can make a living. I will continue to search the forums and continue hoping that a stable Linux desktop OS emerges.

--
Kulmacet

I sound like a broken record when I keep saying this, but again, one of the weaknesses Linux has as a desktop operating system is the diversity we have. Linux can (and does) mean so many different things. Are you using a popular desktop distribution? By that, I mean one tailored for desktop use as opposed to server and/or corporate use? Distributions like Ubuntu, Linux Mint, OpenSUSE and a few others have a better track record for desktop stability and usefulness. Since you mention that applications aren't the problem, it makes me scratch my head, because stability is usually where Linux ROCKS. Feel free to drop me an e-mail with more specifics, and I'll see what I can do to help (shawn@linuxjournal.com).—Ed.

Geek-Speak?

Regarding James Gray's response to Jim Leuba in the April 2009 Letters: you may want to omit the political "Climate Change" nonsense. While I'm sure you eat it up with the spoon Al Gore sold you in exchange for carbon credits, the rest of us out here in the ether don't want to hear it. Stick to geek-speak and keep your audience.

--
Seth Miller

James Gray replies: While the decisions

regarding how to respond to climate change—or not to respond to it—are political, the fact that climate change is occurring is not. The Theory of Global Climate Change is one supported by huge amounts of empirical data and enjoys near unanimous consensus among climatologists. You can read more about it in documents published by the Intergovernmental Panel on Climate Change (IPCC), which summarizes the findings of climatologists around the world (www.ipcc.ch).

Your reference to Al Gore suggests that I am a person who does not analyze evidence before making a decision. This I do not appreciate. Because you don't know me, you have no idea how I make my decisions. However, the scientific literature I have read on climate change, and not bombastic rhetoric from blowhard opinionators, is the basis for my writings on the topic.

Regarding your advice to "stick to the geek-speak", I would argue that I am doing so. In most of the "green" pieces I write, I discuss solutions to the challenge of reducing energy consumption in the data center. Discussions of climate change is simply part of the rationale that I offer for taking on such challenges.

Recycling

I usually enjoy Shawn Powers' articles, but I feel that his editorial was a bit misleading ["Free to a Good Home: Junk", in the UpFront section of the May 2009 issue]. The idea of recycling old computers into the hands of those who need them is great: "Don't worry about running out of hardware, the local school district likely has parts piled in closets in would love for you to 'recycle'." I work for my local school district and had the same thought. I quickly received a lot of flack from the people at the top and discovered it is easier for them to trash computers than to give them away. As a result, I started a 501(c)(3) at reglue.org (Recycled Electronics and Gnu/Linux Used for Education). A lot of things did and didn't happen. I quickly had a lot of CRTs; I didn't have nearly as many working mainboards with RAM to couple them with. I also quickly discovered that sometimes it's hard to give stuff away.

On a lighter note, I know someone who has been a lot more successful with refurbishing and giving away computers

than I—Helios from the Helios Project (www.heliosinitiative.org/news.php). He's also the author of the blog about the teacher and the Knoppix CD.

He and others are working to create a nation-wide (originally, just in Austin) Linux Against Poverty drive and installfest on August 1, 2009 (geekaustin.org/2009/02/01/linux-against-poverty). Maybe you'll consider coordinating your own Linux Against Poverty installfest.

As a side note: no one is really interested in having a computer without Internet access. Community-based mesh networks are a great idea. I think those distributing computers might want to help others access the Internet—the greatest cleft in the Digital Divide (wiki.freifunk.net/Kategorie:English and freifunk-texas.net).

--
D Davis

Unfortunately, it is easier to throw stuff away. That doesn't mean the school wouldn't love to give stuff away, just that it's difficult. Unless we break some ground and push for some new policies, those computers will continue to be thrown away instead of put to better use. If I misled you into thinking it would be easy, I do apologize. Also, as a big coincidence, I'm actually writing this response on Earth Day. It seems all the more important that we do make the effort, however difficult, to get the piles of usable computers into the hands of those who can use them. I'm speaking to myself as much as anyone, because in my school district, it's much easier to dispose of hardware than to give it away. That just has to change. Thanks for your comments. Hopefully, with people like us willing to do the grunt work, some real change can take place.—Ed.

Cool Projects Issue

I just wanted to send a quick note of thanks for the May 2009 issue. The hardware articles were thoroughly enjoyable and just the right technical level. I enjoyed the articles on the amateur rocket and underwater vehicle in particular, and am eagerly awaiting the land-based RC Linux mobile to complete the Earth/Air/Sea trilogy.

--
Kwan Lowe

Me too! I'd go one further and anticipate the interstellar Linux probe, but that might be a while yet. Thanks for the kind comments. It's nice to hear we're bringing you material that is enjoyable and useful.—Ed.

When Disaster Strikes, Don't Forget the Freezer!

Kyle Rankin had a great article in the March 2009 issue: "When Disaster Strikes: Hard Drive Crashes". Good stuff there, and "Linux Hacks" has saved my backside more than once.

It has been my observation that most of my drive failures, particularly in laptops, involve heat. By cooling the drive, it is sometimes possible to pull an image—often an error-free image—before the unit fails entirely. If a drive won't run long enough to pull an image, sometimes it is possible to extract important files quickly.

I wrap them in anti-stat plastic and freeze them for a couple hours. Once out of the freezer, I leave them wrapped to avoid condensation, sandwich with gel-pacs, connect directly to a host machine, or via USB to SATA/PATA adapter, and pull an image as quickly as possible. Rinse and repeat as necessary. I'm about 70% with this technique. Your mileage may vary. Great article and great magazine. Keep it up.

--
Bill

Kyle Rankin replies: Ah, the famous freezer trick! I admit I have used that one myself a few times, although I've always wondered how much of it was science and how much was voodoo. Either way, when one's data is at stake, I think most people are willing to try anything that works (just look out for condensation on the drives if you live in a humid environment).

Bad Guys

Whoever wrote the May 2009 "They Said It" column in UpFront saw fit to include quotes by Marx and Lenin. Why go half-baked? Allow me to submit a few more choice quotes for the next issue, in chronological order:

"Western intellectuals that profess admiration for Communism are suspect....They are objective traitors to

[LETTERS]

their class and to their interests, and must be treated as such....After their final victory in Western Europe and America, revolutionary forces will eliminate all bourgeois traitors."—Lenin

"Death solves all problems—no man, no problem."—Joseph Stalin

"The only good bourgeois is a dead bourgeois."—Pol Pot

I could go on, but I think you are starting to see my point.

Marx and Lenin are responsible for some of the most horrible dictatorships in history. And those are the people you chose to quote. Kudos. What elegance, what taste! Truly, you outdid yourself.

I am extremely disappointed in you and your journal. I have been reading *LJ* since 2000, and in all these years, this is the first time you display such an utter contempt for decency and history.

I expect you to apologize in the next issue, and I'd very much like not be subjected to repeat offenses.

--
Francis Kohl

Mitch Frazier replies: Francis, I'm responsible for those quotes. Sorry to have offended you, but I have to disagree with your apparent arguments that a bad guy can never have said anything useful and that all bad guys should just be erased from history.

Video Request

I was watching the video on LinuxJournal.com about the various programs for screencasting, but I didn't see a reference to Wink. It is fairly decent.

I also was wondering if you could do a video tutorial on how to get the sound from both the microphone and Rhythmbox to be recorded with some of the other screencast programs? I enjoy your mag; keep it up.

--
Josh McClanahan

Ha! I thought Wink was Windows only. Either it added Linux support since I last looked at it, or (more likely) I just never realized it. Thanks for the tip! As far as diverting audio, I can look into the process, but I generally use an external hardware mixer, so I'd be guessing and poking too.—Ed.

PHOTO OF THE MONTH

Have a photo you'd like to share with *LJ* readers? Send your submission to publisher@linuxjournal.com. If we run yours in the magazine, we'll send you a free T-shirt.



Peter Wilson reading up on open-source code. Submitted by Tiffany Wilson.

LINUX JOURNAL

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Existing Users

BOINGO MEMBER LOGIN
Username _____ Password _____ submit

ROAMING ACCOUNT LOGIN
My wireless provider is: _____ submit

ACCESSPASS CODE
Enter AccessPass code _____ submit

Opti
Enjoy airport Barne

TarinNet Wireless Internet Provider

Please log on to use the TarinNet hotspot service

Username: _____ Password: _____ OK

Mon Sep 29 12:54:10 2000 - Location: Marinonet - IP:203.160.100.128
Service Information: Local Information: Free Sites: [!Create New Account](#)

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diff -u

WHAT'S NEW IN KERNEL DEVELOPMENT

Geert Uytterhoeven has replaced the old, dead **CVS** repository for the **m68k Linux port** with a shiny new **git** repository, and added a make install build target, as well as various other code fixes.

Steven Rostedt has updated **ftrace** to let users turn kernel tracepoints on and off simply by setting values in files in the /debug directory.

Jaswinder Singh Rajput has added some performance-counting features to **AMD K7** and later processors. A range of data can be tracked, including processor cycles, number of executed instructions, page faults and context switches. The patches seem likely to go into the kernel soon. **Ingo Molnar** has given his endorsement and offered some bug reports to which Jaswinder responded quickly.

Matthew Wilcox has done a major rewrite of the **MSI HOWTO**. The Message Signaled Interrupts (MSI) HOWTO had not been updated significantly since 2004. It provides a mechanism for triggering interrupts on **PCI devices**, entirely in software. Previously, PCI devices needed to have a physical pin corresponding to the desired interrupt. MSI is much more flexible, and proper documentation will be quite useful. **Grant Gundler** and **Michael Ellerman** offered their own technical feedback to the HOWTO, and **Randy Dunlap** and **Sitsofe Wheeler** helped polish up the language.

Cheng Renquan has enhanced the **KBuild system**, so that when viewing help for any given compilation option, the currently selected build choice is visible at

the same time. He also made various less user-visible changes, and Randy Dunlap has signed off.

Alex Chiang has submitted a bunch of **PCI patches**, including code to create /sys/bus/pci/rescan, a user-controlled file that can force a rescan of all PCI buses on the system. He added several other files to the /sys/ directory to give greater and greater PCI control to the user.

It's nice to remove features that no one uses. For one thing, it can simplify kernel code greatly. **H. Peter Anvin** wanted to remove the **zImage build target** recently and asked if anyone was still using it. As it turns out, **Woody Suwalkski** noted that **ARM** still used zImage. H. Peter probably will remove it from the x86 tree and leave ARM alone.

Bartłomiej Zolnierkiewicz has expunged the **IDE floppy** and **tape drivers** from the kernel and the MAINTAINERS file and listed them in the CREDITS file instead. He thanked **Gadi Oxman** and **Paul Bristow** for all the work they did in the early days on those drivers.

Michael Kerrisk has removed his name as the official maintainer of the **kernel man pages**. The **Linux Foundation** funding has run out, and a supplemental round of **Google** funding also has run out, so now he'll have to focus on other things. He still plans to support the project as best he can, but he cautions that the man pages likely will be orphaned soon, if no further funding or willing maintainer steps forward.

—**ZACK BROWN**

USER FRIENDLY by J.D. "Illiad" Frazer



They Said It

Don't you wish there was a knob on the TV to turn up the intelligence? There's one marked "Brightness", but it doesn't work.

—**Gallagher**

Nobody in the game of football should be called a genius. A genius is somebody like Norman Einstein.

—**Joe Theismann**

Downgrade rights are hugely important for Windows 7. Will Microsoft offer downgrades [from Windows 7] to XP? They've not answered that question yet. But it's really important.

—**Michael Silver, Garter analyst**

One day soon the Gillette company will announce the development of a razor that, thanks to a computer microchip, can actually travel ahead in time and shave beard hairs that don't even exist yet.

—**Dave Barry**

Once a new technology rolls over you, if you're not part of the steamroller, you're part of the road.

—**Stewart Brand**

The Internet today is an open platform where the demand for Web sites and services dictates success. You've got barriers to entry that are low and equal for all comers. And it's because the Internet is a neutral platform that I can put on this podcast and transmit it over the Internet without having to go through some corporate media middleman. I can say what I want without censorship. I don't have to pay a special charge. But the big telephone and cable companies want to change the Internet as we know it. They say they want to create high-speed lanes on the Internet and strike exclusive contractual arrangements with Internet content-providers for access to those high-speed lanes. Those of us who can't pony up the cash for these high-speed connections will be relegated to the slow lanes....We can't have a situation in which the corporate duopoly dictates the future of the Internet and that's why I'm supporting what is called Net Neutrality.

—**President Barack Obama**

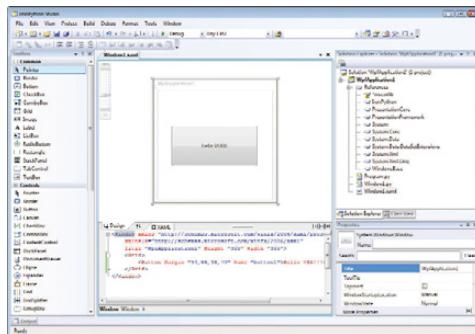
LJ Index

July 2009

1. Percent of US homes that don't have Internet access: **29**
2. Percent of US homes that think the Internet is useless: **12.7**
3. Highest average number of spams per user in a single day in 2008 (April 23) at Google: **194**
4. Approximate number of spams per second that can be attributed to the McColo ISP (recently shut down): **33**
5. Approximate number of spammers responsible for 80% of Internet spam: **200**
6. Rank of US in list of "10 Worst Spam Origin Countries": **1**
7. Rank of China in list of "10 Worst Spam Origin Countries": **2**
8. Rank of Russian Federation in list of "10 Worst Spam Origin Countries": **3**
9. Rank of United Kingdom in list of "10 Worst Spam Origin Countries": **4**
10. Rank of South Korea in list of "10 Worst Spam Origin Countries": **5**
11. Approximate cost per megabyte of RAM in 1957: **\$411,041,792**
12. Approximate cost per megabyte of RAM in 2008: **\$0.021**
13. Billions of dollars of legal music downloads in 2008: **3.7**
14. Percent increase in legal music downloads from 2007 to 2008: **25**
15. Downloaded music sales as a percent of total music sales: **20**
16. Percent of total music downloads that were not "legal": **95**
17. Average "step-on-it" factor used during software estimation phase: **2.5**
18. Average number of weeks left to complete a software project: **2**
19. US National Debt as of 04/05/09, 1:29:32pm CDT: **\$11,135,460,534,223.90**
20. Change in the debt since last month's column: **\$185,190,792,300**

Sources: 1, 2: Park Associates | 3: Google Message Security Data Centers | 4: Spamcorp | 5–10: Spamhaus
 11, 12: www.jcmit.com/memoryprice.htm
 13–16: IFPI | 17, 18: Common knowledge
 19: www.brillig.com/debt_clock | 20: Math

NON-LINUX FOSS



IronPython Studio (from ironpythonstudio.codeplex.com)

IronPython is an implementation of Python that runs on the .NET framework as well as on Mono. The current version of IronPython is compatible with Python 2.5, and an alpha release of a Python 2.6-compatible version also is available. IronPython is written entirely in C#, and the current version is built on top of the Dynamic Language Runtime (DLR).

IronPython features an interactive console that does

full dynamic compilation of Python code to .NET. It provides full access to all .NET libraries while maintaining compatibility with the Python language.

There also is a Visual Studio plugin called IronPython Studio that supports the creation of Python-based GUI applications. In addition to IronPython, there are "Iron" versions of Ruby and Scheme (LISP). If you like Python but crave static typing, check out BOO for .NET/Mono.

IronPython is licensed under the terms of the "Microsoft Public License", which was approved by the Open Source Initiative (OSI) in October 2007. The license allows redistribution of compiled code for either commercial or noncommercial use (similar to a BSD license). For this reason, although it is recognized as a "free" software license by the Free Software Foundation, it is considered incompatible with the GPL. And, if getting too close to Microsoft makes you nervous, be aware that the IronPython Project is hosted on a Microsoft-controlled site: codeplex.com.—MITCH FRAZIER

Netbooks—Dying or Evolving?

I'm just as guilty as everyone else that jumped on the Netbook bandwagon when it started with the 7" Eee PC. After a few weeks, the limitations of such tiny notebooks become fairly clear. The Netbook market has evolved to the point that it's almost laughable. What are the latest features of that market? Bigger screens! Ten- to twelve-inch screens are becoming the new rage in the "Netbook" world.

Um, we had 12" screens before. We called them notebooks. I'm not sure if the Netbook fascination is wearing off or if low-power laptops are just going to become the norm. Because "low power" is becoming a misnomer as the CPU speeds creep up on ultra-portables, I think the term Netbook might just die away.

Another option is that something like Android, Moblin or Ubuntu Netbook Remix will standardize the tiny-screen laptop market, and it will become more like a souped-up cell phone as opposed to a stripped-down notebook. One thing seems clear, the days of a 7–9" screen running a customized and minimal Linux distribution are fading away into history. Is the Netbook a dying fad or still an infant going through growing pains? Sadly, I think that depends on how hardware manufacturers choose to push their upcoming models.

I certainly don't have the ability to see the future, but I hope the future of Netbooks doesn't continue along the path of adopting Microsoft Windows. Low-powered hardware just begs to have the Linux kernel running on it. If the interface could be something standard that ran familiar applications, we might have a chance to retake the entire Netbook market. Only time will tell, and only hardware manufacturers can pick the standard.—SHAWN POWERS

bc—When Integers Aren't Enough

Most people have the need to do some kind of math when they are using a computer. In shell scripts, you can make integer calculations by using functionality in the shell itself. But what if that's not enough? Luckily, the POSIX standard includes a very useful command-line utility called bc. With this, you can do arbitrary precision arithmetic. Actually, it is a complete, C-like language that can do some pretty sophisticated programming, supporting variables and functions.

In bc, numbers are all represented internally as a decimal number. They have a length, which is the total number of digits, and a scale, which is the number of decimal spaces. You can find these values by using the built-in functions `length()` and `scale()`. For example, the number 10.23 would have a length of 4 and a scale of 2. The variable `scale` holds the number of decimal places to keep when internal functions are executed. The default value is 0. bc supports all number bases from 2–16, with base-10 being the default. The input and output base of numbers can be set by using the variables `ibase` and `obase`. All of the basic mathematical operations are supported in bc. You can multiply, divide, add, subtract, do mod and exponentiation. There are all of the standard comparison operations too. Less than, less than or equal to, greater than, greater than or equal to, equal to and not equal to all give results of 0 for false and 1 for true. This is very useful in the conditional statements available in bc.

bc can be used in shell scripts or on the command line as a very effective calculator. It will read from a list of files given on the command line or read from standard input. On the command line, expressions simply can be echoed through a pipe to bc:

```
echo "1+1" | bc
```

The above will give the answer of 2. As a more complex example, the sine of 5 can be assigned to a shell variable with the following:

```
RESULT=`echo s(5) | bc -l`
```

The `-l` command-line option tells bc to load the math library, giving access to the trigonometric functions.

As a bit of a contrived example, say there are two values and you need to find out which one has a larger sine. With the math library and the built-in comparison operations, you can do this with the following:

```
echo "s(5) < s(10)" | bc -l
```

The result 1 is printed out on standard output, verifying that the sine of 5 is less than the sine of 10. bc can print out a text string telling the user whether the result is true or false with the following:

```
echo 'if (s(5) < s(10)) print "true\n" else print "false\n"' | bc -l
```

This prints out the word true. If this string is to be stored in a variable, the newline characters would be removed from the executable line. This value then can be used later in a shell script by saving it to a shell variable.

What if you have a data file of input values and you want to apply some function to them? Say you need to calculate the logarithm base-10 of each value and dump it into another file. The following example takes a list of the first ten numbers, calculates the logarithm base-10 of each number and writes the value into the file `output.lst`:

```
LIST="0 1 2 3 4 5 6 7 8 9"
for INPUT in $LIST
do
echo "l($INPUT)/l(10)" | bc -l >>output.lst
done
```

These examples already have done some useful work, but what if the requirements are more robust? Does this necessitate a move to a heavyweight math program, like Mathematica or Maple? Not necessarily. With bc, you can create and use functions to make more complicated calculations. Even recursive functions can be written, like in this example to calculate a factorial:

```
define f (x) {
    if (x <= 1) return (1);
    return (f(x-1) * x);
}
print "Factorial:"; factorial = read();
print f(factorial); print "\n";
quit
```

This can be dumped into a file called `fact.bc` and run through bc to get the factorial of some number by executing:

```
bc fact.bc
```

This script asks the user for a number and then finds the factorial. It can be used without interaction simply by feeding the number in to standard input with a pipe:

```
echo 10 | bc fact.bc
```

This prints out the factorial of 10 (3628800) to standard output. But, how fast can such a program be? For a variety of values run on a generic laptop, the following times were measured:

10	0.004s
100	0.004s
1000	0.028s
10000	3.099s

These times were averaged over three runs to account for varying system load. It seems more than fast enough to be useful for a lot of heavy work.

For a more scientific example, the following bc script finds how long it takes for an object to fall from a series of heights:

```
define t(h) {
    g = 9.81;
    return (sqrt(2 * h / g));
}
```

Now there is no excuse for abandoning a shell script simply because it can't handle some mathematical problem. With bc, you can do a lot of really useful work straight from the command line. Go forth and enumerate.

—JOEY BERNARD

STOP BURNING CDS; BURN USB DRIVES INSTEAD

It seems that every week there's a new version of some Linux distribution available. I don't know about you, but I have enough burned "last version" CDs to build a very reflective fort in the backyard. I'm also really bad about labeling CDs when I burn them, so I end up burning the same CD over and over.



Thankfully, there is help for people like me—Unetbootin. I did a video tutorial on this a while back, but the gist of Unetbootin is that you create a bootable USB drive instead of burning an installer CD. The

application automatically will download the latest CD image, or you can create a bootable USB drive from an already-downloaded ISO file. Unetbootin even works in Windows, so if you're stuck with only a Windows machine, you can create a bootable USB drive to install our favorite operating system.

The great thing is that USB drives are easily rewritable. Most modern systems will boot from them without issue. The only downside is that it's harder to build forts out of USB drives. So, unless you really want to build that highly reflective fort, I'd suggest checking out Unetbootin.

Unetbootin video tutorial: www.linuxjournal.com/video/creating-bootable-usb-install-drives-unetbootin.

—SHAWN POWERS



EFI-X: When Dual Boot Isn't Enough

I recently was contacted by the folks selling the EFI-X. It's a small USB device that allows EFI-booting operating systems to boot on traditional BIOS-based machines. The big selling point for such a device is that it allows native booting of Apple OS X on off-the-shelf PC hardware. I couldn't get any specifics as to why a Linux user would benefit from such hardware, but at the same time, I guess it's useful to know Linux is fully compatible with EFI-booting technology.

So although the \$240 it takes to buy an EFI-X module won't really benefit your Linux install very much, if you want to install OS X on your trusty Linux machine, you now can do so. It most likely violates EULA terms with Apple to install on non-Apple hardware, but it doesn't require a hacked and pirated version of OS X to install. I bought an EFI-X, and OS X installed from the retail DVD right next to my Linux install. It takes a separate drive for each operating system, but I now have a triple-booting quad-core computer that cost less than \$800. If you don't want to buy Apple hardware, but would like to dual- (or triple-) boot your system, check it out: www.expresshd.com.

—SHAWN POWERS

Mobile LinuxJournal.com

After reading all about mobile Linux this month, I'm guessing you might be in the mood to take your *Linux Journal* mobile too. If you haven't visited our mobile version at m.linuxjournal.com, you missed the chance to catch all the content you find on LinuxJournal.com formatted to fit your mobile device. Even if you have visited us on your mobile device, you may have missed the link to our mobile videos. Scroll down to the bottom of the screen, and you'll see a link to our videos on YouTube mobile, which provides our videos in 3gp format for your mobile device. Just think, now you can whip out Shawn Powers' tech tips any time and almost anywhere! Happy viewing!

—KATHERINE DRUCKMAN



REUVEN M. LERNER

Checking Your Ruby Code with metric_fu

By combining automated testing with automated code analysis, you can make your Ruby code easier to test and easier to maintain.

Among programmers, there has long been a dispute between those who want a language to constrain them and those who want great flexibility.

If you have been programming for a while, you'll understand the benefits that each side touts. A rigid language can help check your code, often using a compiler and a strict type system, to find potential problems before they make their way into production systems. By contrast, a more flexible language is designed with the knowledge that compiler and strict typing don't find all bugs and often force programmers to work around the system's constraints, rather than benefit from them.

This brief description is little more than a caricature of modern programmer attitudes. But, it does point to a tension programmers often face when choosing a language. How much do you want the language to constrain you, and what trade-offs are you willing to make? Would you rather have a strict language that doesn't let you express yourself the way you want or a flexible language that won't stop you from doing something foolish or dangerous?

Done correctly, testing actually can be better than a compiler and strict typing.

Like many Web developers, I have come to prefer dynamic, flexible languages. I don't want the language to stop me preemptively from doing things, even if what I'm doing might seem crazy or weird. I've become quite a fan of Ruby over the last few years because of the balance it tries to strike.

However, the lack of a compiler or other tool to perform regular sanity checks does bother me somewhat. I wouldn't ever claim that a compiler is the only tool a programmer should use to test the code, but it does perform a first-pass inspection that can provide some useful feedback.

Fortunately, the Ruby community encourages the use of regular automated testing to ensure that code works in the way you expect. Done correctly, testing actually can be better than a compiler and strict typing. It can check the code at multiple levels, reflect actual use cases and serve as a sanity check not only for the code's syntax, but also for its logic

and specification. Moreover, writing tests forces programmers to reflect on their work, chewing over how they have implemented a particular feature. Such reflection is an essential part of the learning process, and it offers programmers a chance to become better at their craft, as well as to write better programs.

Automated testing, accompanied by automated analysis, thus, can help improve programmers, as well as improve the programs they write. So, I was delighted to discover metric_fu, a Ruby gem from Jake Scruggs and others that pulls together some of the best-known analysis tools in one convenient package for Rails programmers. The combination of these various tools—including rcov, Flay and Flog—makes it easy to locate potential problems in code you've written and improve it. Automated analysis tools won't ever provide you with 100%-accurate feedback, but it's always good to get this sort of input.

This month, I look at metric_fu and some of the code-analysis tools it makes available to Rails programmers. It's true that metric_fu is "just" a wrapper for these individual tools, but by making them so easily available and integrated with the rest of your testing, you'll constantly be in a position to understand where potential problems might lie and to fix issues before they cause you any real trouble.

Installing metric_fu

metric_fu is a Ruby gem, which means you can download and install it with:

```
sudo gem install metric_fu
```

The metric_fu gem specification automatically requires a number of other gems that it uses, including rcov and Flog. So installing the metric_fu gem should mean your system is ready, without the need for additional downloads and installations.

Assuming you are using metric_fu with Rails, you probably will want to tell Rails that it should look for and include the metric_fu gem. You can do this in modern versions of Rails by adding the following line to config/environment.rb:

```
config.gem 'jscruggs-metric_fu', :version => '0.9.0',
:lib => 'metric_fu', :source => 'http://gems.github.com'
```

In other words, you want Rails to load the gem known as metric_fu, which can be downloaded from Github as jscruggs-metric_fu, version 0.9.0. If this gem does not exist, Rails will exit with an error.

Finally, you must add a line to your Rails application's Rakefile, telling it you want to load the Rake tasks associated with metric_fu:

```
require 'metric_fu'
```

Once this is complete, you should find a number of new tasks, all of whose names start with metric, available in Rake. You can list them with:

```
rake -T | grep metrics
```

I typically run all the tests, which you can invoke with:

```
rake metrics:all
```

This runs all of the software metric_fu works with, a list that has grown somewhat in the last year. At the time of this writing, running metrics:all includes:

- churn: which files change the most?
- coverage: which parts of your code are tested?
- flay: which parts of your code are duplicated?
- flog: is your code unnecessarily complex?
- reek: does your code suffer from well-known bad practices?
- saikuro: how complex is your code?

I cover a number of these tests in greater detail below. But, before continuing, it's important to note that metrics:all will fail to run all the tests if the rcov coverage tool encounters one or more errors. This isn't a problem if you test frequently, but it can bite you if you break a test and then run metrics:all.

When you run the full report with rake metrics:all, metric_fu puts all the output files under your application's tmp/metric_fu directory. Each test has its own separate subdirectory and produces output in HTML for easy reading with a Web browser. The fact that the files are put in tmp/metric_fu makes them easy to find and view on a local system, but it requires that you move them into a Web-accessible directory (for example,

public/tmp/metric_fu) if you want to view them from a remote machine. It should go without saying that you don't want this information to appear on a Web site that is publicly viewable, so be sure to password-protect or delete these reports to avoid unpleasantness.

Although metric_fu's defaults work for most initial cases, you may find yourself wanting to customize one or more of its tests. You can do this within your Rakefile by adding a MetricFu::Configuration block and invoking config.*, where * is one of the tests that metric_fu brings in. For example, you can customize which tests run for :all with:

```
MetricFu::Configuration.run do |config|
  config.metrics      = [:coverage, :flog]
end
```

If you modify config.metrics to include only a subset of metric_fu's tests, you may find yourself puzzled when other tests fail. For example, if you were to set config.metrics to the above value of [:coverage, :flog], invoking rake metrics:reek would fail, with Rake complaining that it wasn't able to find such a task.

Code Coverage

Perhaps the best-known member of the metric_fu family is rcov, the Ruby code-coverage checker, written by Mauricio Fernandez. rcov invokes all your automated tests and then produces a report indicating which lines of your source code files were untouched by those tests. This allows you to see precisely which lines of each file have been tested, letting you concentrate on those paths that are highlighted in red (that is, untested), rather than writing additional tests for code that already has been tested.

rcov, as invoked by metric_fu, produces two basic types of HTML output. One provides an overview of the pages of a site. This output, with red and green bar graphs, shows the percentage of each file that has been secured. If any of your files has a graph whose bar is partly red, this tells you on which files to concentrate your initial effort.

But, once you have decided to make sure that a particular file has better test coverage, which lines do you improve? That's where rcov's individual file output comes in handy. It shows the source code of the file, with lines of the code in either green (to show that it was covered in tests) or red (to show that it was not). If you have any red lines, the idea is for you to add tests that force those lines to be covered next time around. And, of course, if there are red lines that don't need to be there, rcov has helped you refactor your code, making it leaner and meaner.

Reading rcov's output is pretty simple—you want everything to be green, rather than red. Any red is an invitation to write more tests or realize that the code is no longer in use and can be removed.

One of the main reasons for testing your code is that it gives you some peace of mind when you make further changes. So, although you can refactor and otherwise change your code without 100% test coverage, it's always possible something will slip through the cracks. For that reason, rcov should be your first priority when using metric_fu. Once your code coverage is high enough to ensure that new problems and changes will be detected, you can try to make your code better, without changing what it does.

Flog

Another tool that comes with metric_fu is Flog, written by Ryan Davis. Flog produces what it calls a "pain report", identifying code that it believes to be "tortured"—in such pain that you really should rescue it. Even if you disagree with some of its results, looking at Flog's output often can provide an interesting perspective on your code's complexity. It measures variable assignments, code branches (that is, if-then and case-when statements) and calls to other code, assigning a score to each of those. The total Flog score is the sum of the individual items that Flog finds.

As the Flog home page says, "the higher the score, the harder it is to test". Even if you're not worried about testing, you certainly should consider other programmers who might work on your project. Complex code is hard to maintain, and maintaining software is (in my view) a bigger problem than writing it. So, by looking at Flog's output, you can get a sense of how hard your code will be for someone else to understand.

Flog produces what it calls a "pain report", identifying code that it believes to be "tortured"—in such pain that you really should rescue it.

metric_fu provides an HTML version of Flog's output. I demonstrate it here from the command line, where it can be run as:

```
flog *.rb
```

This produces a simple set of outputs, such as the following, which I got for a small project I recently worked on and didn't test or analyze much:

```
181.0: flog total
60.3: flog/method average
```

```
72.5: UploadController#advertiser_file_action
70.1: UploadController#whitepage_listing_file_action
```

This would seem to indicate that my upload controller has two different methods, both of which have a relatively high level of complexity. I can get further information about these two methods by invoking Flog with the --details command-line argument. That gives me the following output, which I have truncated somewhat:

```
~/Consulting/Modiinfo/modiinfo/app/controllers$ flog --details
upload_controller.rb
181.0: flog total
60.3: flog/method average
```

```
72.5: UploadController#advertiser_file_action
40.6: assignment
17.3: branch
4.8: split
4.0: blank?
3.2: strip
3.2: params
3.1: +
3.0: map
2.8: []
2.1: downcase
```

In other words, a large proportion of Flog's high score results from the large number of variable assignments in UploadController#advertiser_file_action. And sure enough, I have a bunch of variable assignments in that method, which led to a high score. For example, I wanted to display the number of uploaded records to the end user, and, thus, had the following code, assigning values to instance variables:

```
if advertiser.save
  @number_of_successes = @number_of_successes + 1
else
  @number_of_failures = @number_of_failures + 1
  @error_messages[index] = advertiser.errors
  next
end
```

I find this code easy to read and maintain, but Flog thinks otherwise, preferring a more functional style of programming, with methods chained together. This is one case in which I'll take Flog's assertions and scores into consideration, but I'll apply my own judgment regarding the complexity of my code and whether it needs to be changed or updated.

Flay

One of my favorite tools that comes with metric_fu is Flay, also by Ryan Davis, which looks for duplicate

code. One of the key principles of good coding is DRY (don't repeat yourself), and Flay makes it easy to find places where your code could use some extra DRY-ness. By running:

```
rake metrics:flay
```

you will get a nicely formatted report showing the places where your code has exact duplicates (which are embarrassing and problematic enough) and structural duplicates. So, if you have the same variable assignment in multiple controllers, Flay will find those for you and will point to the need for refactoring. For example, the simple project on which I hadn't yet run Flay had three methods, each of which contained the following identical code:

```
if params[:filename].blank?  
  flash[:notice] = 'No file was attached. Please try again.'  
  redirect_to :back  
  return  
end
```

If this sort of code appears three times in the same controller, it means some refactoring is in order. In this particular case, I can remove the problem by putting this code into a separate method and then by defining a before_filter:

```
before_filter :check_for_blank_filename,  
  :only => [:residence_file_action,  
            :advertiser_file_action,  
            :whitepage_listing_file_action]
```

Here is the method, which looks (not surprisingly) just like the code that was duplicated:

```
def check_for_blank_filename  
  if params[:filename].blank?  
    flash[:notice] = 'No file was attached. Please try again.'  
    redirect_to :back  
    return  
  end  
end
```

Re-running Flay indicates that I now have made

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my code DRY-er than before, increasing its readability and making it easier to test. Sure enough, the Flay score for this controller dropped from 392 to 221. The measures are meaningful only relative to one another, but it seems undeniable that the code is now better, and the numbers reflect that.

Flay can find subtler similarities as well, indicating where two pieces of code look similar to one another. For example, I had the following two lines in my code, in separate locations:

```
(name, telephone, address, url, email, category_string) =
  line.split("\t").map { |f| f.strip }

(company, telephone, address, url, email, category_string) =
  line.split("\t").map{ |f| f.strip}
```

Flay noted that this code is almost identical and can be refactored to be a bit DRY-er. Would I actually change this code? Maybe and maybe not, but at least I'm more fully aware of it, which is important in and of itself. If and when I spend time refactoring this code, Flay will point to the first and most necessary areas that need attention.

Reek

Finally, I should mention Reek, a tool written by Kevin Rutherford, which also is invoked by metric_fu. Reek looks for "code smell" or code that doesn't follow commonly accepted style. This includes finding code duplication (similar to what Flay does), as well as long methods and poorly named variables. It also tries to find cases in which a method sends more messages to another object than to itself, which it calls feature envy, and methods that contain more than five lines of code, which are flagged as long.

For example, regarding code I mentioned above, which read:

```
(company, telephone, address, url, email, category_string) =
  line.split("\t").map{ |f| f.strip}
```

Flay noticed that this code was duplicated. But beyond that, a one-letter variable name is almost always a bad idea, because it reduces the readability of the code. Sure enough, Reek will flag this code as having an "uncommunicative name" for the variable f.

Even if I'm not totally sold on "Reek-driven development", as Rutherford describes on the Reek home page, Reek is a useful way to find potential problems and provide additional feedback on the program that I'm writing.

Conclusion

Because of its dynamism and flexibility, Ruby offers

programmers the chance to do things that might lead to maintainability problems down the road. Fortunately, the Ruby community has produced a set of excellent tools for automated testing and analysis that make it possible to produce high-quality code that is easy for others to follow, test and maintain. metric_fu puts many of these tools into a single package, making it easy to run a variety of tests on your code. ■

Reuven M. Lerner, a longtime Web/database developer and consultant, is a PhD candidate in learning sciences at Northwestern University, studying on-line learning communities. He recently returned (with his wife and three children) to their home in Modi'in, Israel, after four years in the Chicago area.

Resources

The Ruby language comes with all modern Linux distributions, but it can be downloaded from www.ruby-lang.org. The Ruby on Rails framework for Web development is at www.rubyonrails.com.

Like many modern Ruby gems, metric_fu is hosted at Github, a commercial git hosting service that offers free accounts to open-source projects. You can download metric_fu from github.com/jscruggs/metric_fu/tree/master.

And, you can download rcov from github.com/spicycode/rcov/tree/master, and Flay, Flog and Reek from github.com/seattlerb/flay/tree/master, github.com/seattlerb/flog/tree/master and wiki.github.com/kevinrutherford/reek, respectively.

Two excellent essays on the nature of programming languages, and depending on type systems and the compiler, are Steve Yegge's blog entry about the return of dynamic languages (steveyegge.blogspot.com/2008/05/dynamic-languages-strike-back.html) and Bruce Eckel's essay on the use of testing instead of strong typing to ensure good code (www.mindview.net/WebLog/log-0025).

Donald Schon's excellent book, *The Reflective Practitioner*, describes different ways professionals can and should reflect upon their work while they are engaged in it. Although Schon does not mention programmers per se, what he says is very appropriate for programming work and has convinced me why automated testing and analysis tools are so valuable.

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MARCEL GAGNÉ

Linux, Thunderbird and the BlackBerry—a Love Story

Keeping various devices in sync with our Linux systems can be the source of nightmares for many. After all, asking for an open-source solution that can keep millions of smartphones, cell phones, e-mail clients, contact databases and calendars on the same planet, never mind the same page, seems akin to asking for the moon—to which *Chez Marcel* would like to ask, “Would you like a nice rich Merlot with that moon?”

Excuse me, François, but what are you doing? Are you sending text messages while you should be getting ready for the restaurant to open? You aren't? Well, if you aren't texting, what are you doing hunched over that cell phone? *Quoi?* You are typing into three cell phones? My apologies, *mon ami*, but now I really have no idea what you are doing. Ah, I see, you're trying to update your contact list and calendars, and you can't think of a way to do that with your Linux system. But, three phones? One is your BlackBerry, and the other two phones belong to your aunt and your mother. Sigh...tech support for the family on restaurant time, François? What am I going to do with you? Put those phones down, and I'll show you a better way to synchronize all those contacts. Quickly! I can see our guests arriving even now.

Good evening, everyone, and welcome to *Chez Marcel*, where excellent Linux and open-source software finds its match with exquisite wines. Please, sit and make yourselves comfortable, *mes amis*. François was just getting ready to make his way to the cellar to get tonight's wine. Hurry, *mon ami*, and bring back the 2005 Vina Requingua Puerto Viejo Merlot from Chile that we were sampling, er, submitting to quality control earlier today. *Vite, mon ami!*

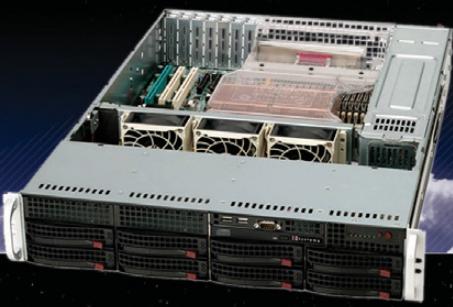
While we wait for his return, let me tell you about François' dilemma. He has multiple portable devices, including a BlackBerry, an Android phone and a Motorola RAZR, all of which he wants to synchronize with Evolution on his Linux notebook. On the store workstation, he uses Thunderbird instead, and at home, something else. Getting those contact lists, calendars and so on synchronized is easier than it sounds, and it all can be done with Linux and open-source software.

All this is possible, and easy, with a great little package from a company called Funambol. The software itself also is called Funambol, and it is freely distributed and open source. Essentially, it's a program that lets you perform over-the-air (also known as OTA) synchronization of your contacts, calendars and so on, using your cell phone or smartphone, desktop contact management software (Evolution, Thunderbird, Outlook and so forth) and other hardware. Part of the magic behind all of it is SyncML (Synchronization Markup Language), which also is known as Open Mobile Alliance Data Synchronization (OMA DS). SyncML is an open standard for synchronizing information, such as calendars and contacts, that is platform-independent. Several mobile phone manufacturers, such as Motorola, Nokia and Sony Ericsson, already include SyncML in their devices. SyncML also supports e-mail, which is handy for those needing (or just plain wanting) an alternative to proprietary products, like the BlackBerry.

Funambol consists of a server component and a client for your device or application. Start by getting your copy of Funambol server from funambol.org, and save it somewhere on your system. The package file, with a .bin extension, needs to be made executable before you execute it:

```
chmod +x funambol-7.1.bin  
./funambol-7.1.bin
```

The whole thing takes only a few seconds. The steps that follow are extremely simple. Type yes at the “agree to the above terms” prompt (it's the GPL version 3). You'll be prompted for an installation directory which, by default, is /opt. It's best to accept the default unless you have a very good



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reason to do otherwise. The resulting folder will be /opt/Funambol. Once the product has been extracted, you'll be asked whether you want to start the server. Type yes and continue on. To make sure things are working properly, point your browser to <http://localhost:8080/funambol/ds>, and you should get status information back from the Funambol data synchronization server (Figure 1).

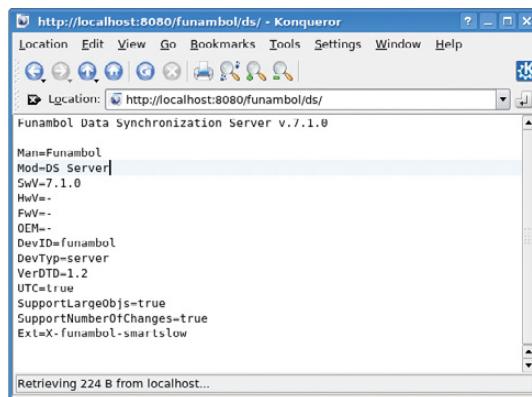


Figure 1. A Quick Test to Make Sure the Server Is Up and Running

Of course, if you aren't running this test directly on the server, you'll want to change localhost to the hostname or IP address of the server.

Funambol also comes with a simple Web app to test the contact as well as calendar creation and update before you turn it over to your mobile device. Point your browser to <http://localhost:8080/funambol> to bring up the demo page. You won't be able to do a great deal at this point, other than read the terms and conditions and test a very limited Web client. That demonstration will allow you to log in as guest with a password of guest and create contacts (Figure 2)

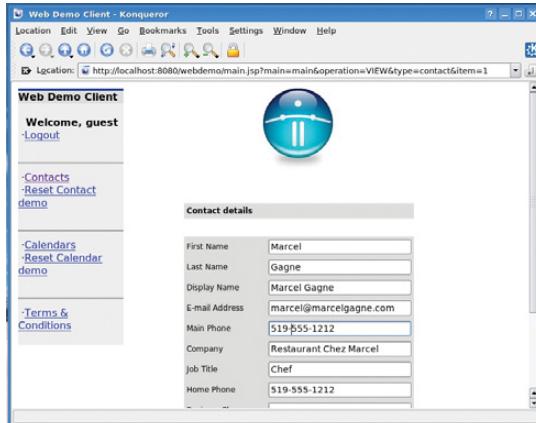


Figure 2. The Web client demo lets you create calendars and contacts, making it a better test.

or a calendar entry. Once you have done so, update a record or two, and make sure the changes are being saved.

Now that you know it works, you still can't do a great deal with Funambol in this form. In order to do more interesting things, you need to do a little system configuration. On the server side, there is a graphical administration tool. You can start it from the command line like this:

```
cd /opt/Funambol
admin/bin/funamboladmin
```

A couple seconds later, you'll see the Funambol administration tool appear (Figure 3). To use the administration tool, you first need to log in. If you don't see the login window up front, click File on the menu bar, and select Login. By default, the admin password, sa, already is set (you always can change it later), but for now, simply click Login.

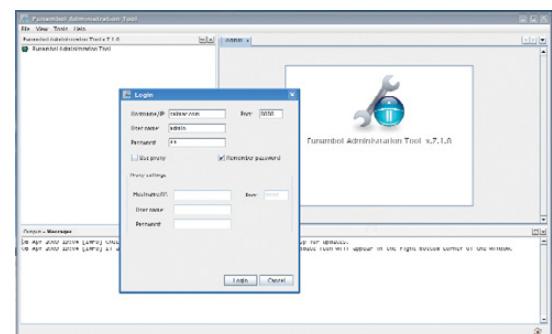


Figure 3. Funambol Administration Tool and Login Screen

The Funambol administration tool is divided into three panes: a navigator pane fills the top left half, an admin tool pane is at the top right, and a status pane is located along the bottom (Figure 4). Take a look at the navigator window, and you will see your system's domain name at the top. To expand the

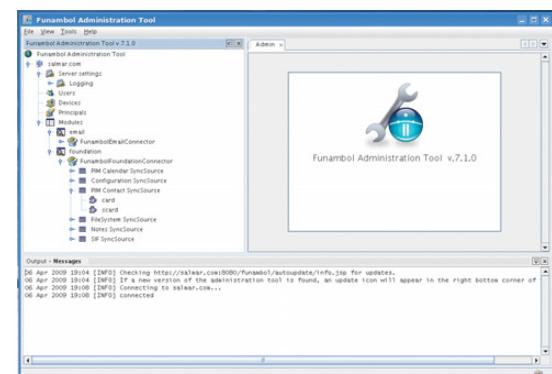


Figure 4. On the left, you can see the Funambol administration tool's system navigator with several expanded properties.

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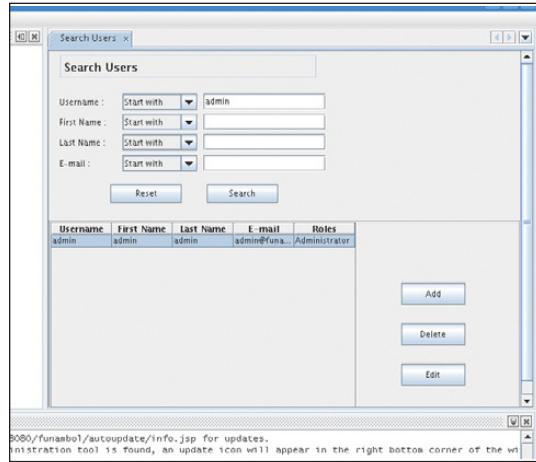


Figure 5. Using the Tool to Change the Admin Password

system tree, click the switch icon next to the domain name. You'll then see Server Settings (which expands into its own subtree), Users, Devices, Principals and Modules. That last one also expands into several other branches. To see how this all works and how you can configure and change things, let's deal with that admin password right now.

Double-click on Users and look at the admin tool window (Figure 5). The Search Users tool appears. You can search by user name, first name, last name and e-mail address. Enter admin in the search box beside Username, and click the Search button (notice that you can search by a part of the name as well as position of the text by clicking the drop-down box beside the label). Only one admin name should show up, so it naturally will be highlighted. If you did this by searching for part of a name, and you had multiple names, you would, of course, need to select the correct name.

Click the Edit button, change the password, and then save your changes. That takes care of controlling access to the tool. Your next step is to define access to the system. As it stands, your Funambol implementation allows connections only from localhost and then only to a limited set of users. You need to change that. Double-click on Server Settings in the navigator window. Now, look to the left and locate the Server URI field in the settings window (Figure 6).

Enter the hostname (or the IP address) of your server, then click Save. You should see a confirmation message in the status window below. It should look something like this:

<http://yourdomain.com:8080/funambol/ds>

Believe it or not, that's pretty much it on the server end. Now, let's take a break, have François refill everyone's glass, and then let's see what we

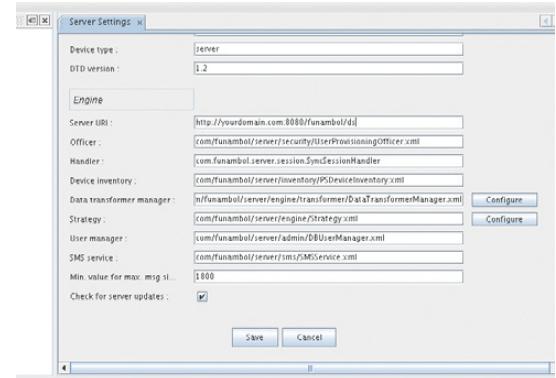


Figure 6. As a final first step, you need to configure the URI to the Funambol service on your server.

need to do on the BlackBerry end of things.

The first step is to install the BlackBerry client, which you can find at <https://www.forge.funambol.org/download/downloads-bb.html>. You will see an e-mail client in addition to the sync client, but, for the sake of this article, let's just concentrate on the sync client. Make sure you get the right client for your particular BlackBerry OS version.

Note: In this article, I concentrate on BlackBerry synchronization with a Linux system, but remember that Funambol offers sync clients for many different mobile devices and smartphones. Simply point your browser to www.forge.funambol.org/download to find the right client for your mobile device. You even can sync your Android phone.

Once installed, you will see the Funambol BlackBerry sync icon in your list of applications on the BlackBerry screen (Figure 7).



Figure 7. The Funambol Client Icon as It Appears on My BlackBerry

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This is all wonderful, because the Funambol server effectively is keeping an over-the-air backup of your data—handy if you ever need to reload it.

Click the icon, and you should see a status screen showing Contacts, Calendar, Tasks and Notes, all with Not Synchronized below the labels. To perform a sync, you need to configure the client. Press the menu key on your BlackBerry, and select Settings (Figure 8).

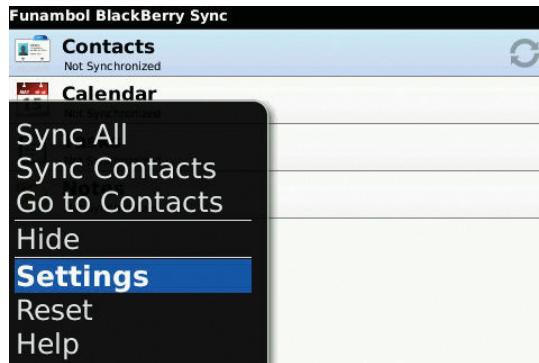


Figure 8. Press the menu key to configure the client settings.

When the Funambol client configuration screen appears (Figure 9), enter the URI for your machine's Funambol server. This is the same address that you entered when you configured the server. You also must enter your user name and password—that's your Linux server user name and password. A little farther down that screen, there are check boxes beside labels to Sync Contacts, Sync Calendar, Sync Tasks and Sync Notes. These are all checked by default, but you may decide you don't want to sync all those resources, so change it here if you like. You also can configure a scheduled sync and have the

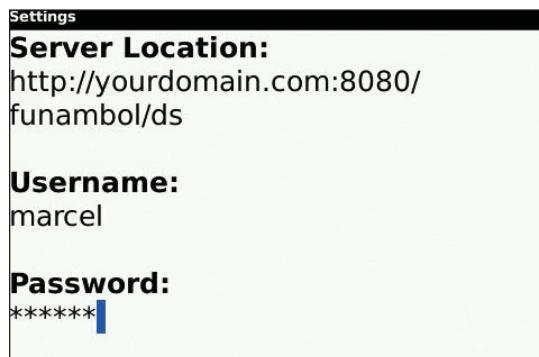


Figure 9. Funambol BlackBerry Client's Configuration Screen

client update your information every 30 minutes (the default) or whatever period makes sense to you. That feature is not turned on unless you specify otherwise.

When you're done, save your settings (on my BlackBerry, I just press the trackball or the back arrow). You'll find yourself back at the status screen, and now you're ready to synchronize for the first time. Press the menu key, and select Sync All from the menu. The Funambol client will connect with your server and start transferring the information on your BlackBerry. Underneath the labels for Contacts (and Calendar and so on), the client will show how many records are being transferred. Once complete, the status screen lists the last successful sync for each resource (Figure 10).

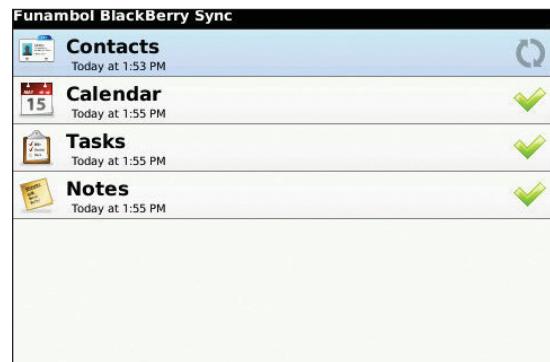


Figure 10. During synchronization, the status screen shows you the number of records transferred. Once complete, you can see the latest sync at a glance.

This is all wonderful, because the Funambol server effectively is keeping an over-the-air backup of your data—handy if you ever need to reload it. But, what if you use another client on your Linux desktop for e-mail, contacts and appointments, such as Evolution or Thunderbird? Funambol provides download clients for these and others as well. Figure 11 shows a screenshot of a pretty desolate-looking address book in Thunderbird.

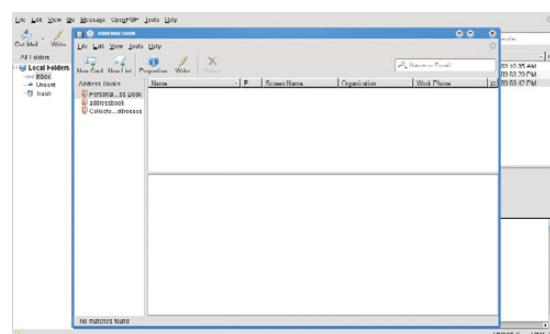


Figure 11. My Thunderbird Address Book, without Any Contacts

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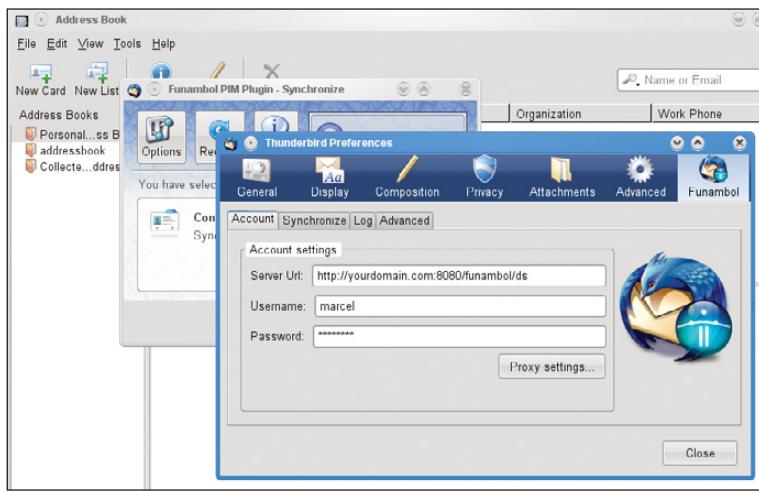


Figure 12.
Configuring the
Funambol
Thunderbird Plugin

The plugin you need for Thunderbird is available from the Funambol community download page. Download it, and save it to a local directory. Once that's done, click Tools on the Thunderbird menu bar and select Add-ons. When the Add-ons window appears, click the Install button, and navigate to the folder where you stored the file, then click on it and install it. Once finished, Thunderbird needs to restart to load the new extension. After Thunderbird restarts, you must configure the Funambol client to connect to your server. Click Tools from the menu bar, and select Funambol plugin. When the Funambol PIM Plugin window appears, click the Options button, and you'll see a screen that, although shinier than the one on the BlackBerry, is similar as it asks for the same information, namely the server URL, user name and password (Figure 12). Enter the information, then click Close.

That's it. To synchronize Thunderbird with the contacts from my BlackBerry, all I do is click the Synchronize button and wait while my contacts



Figure 13. The Thunderbird Sync Plugin Happily Doing What It Is Built to Do

are transferred (Figure 13). How long this takes depends, of course, on how much information is being synchronized and how fast your connection is.

In this way, I can keep my desktop client in sync with my BlackBerry and the server itself. As an added bonus, I get over-the-air backup with my own server without having to shell out the dollars for a BES server. Funambol, Linux and my BlackBerry—it's a match made in open-source heaven.

With the help of Funambol, a great open-source application, you (and François), can keep all that personal information in sync without having to resort to entering the information manually or paying huge sums of money for a *special* server running proprietary code. Well, *mes amis*, the time is finally upon us. That old clock on the wall says closing time has arrived yet again. François will be happy to refill your glasses a final time while we say our goodbyes to one another. Please, *mes amis*, raise your glasses, and let us all drink to one another's health. *A votre santé! Bon appétit!* ■

Marcel Gagné is an award-winning writer living in Waterloo, Ontario. He is the author of the *Moving to Linux* series of books from Addison-Wesley. Marcel is also a pilot, a past Top-40 disc jockey, writes science fiction and fantasy, and folds a mean Origami T-Rex. He can be reached via e-mail at marcel@marcelgagne.com. You can discover lots of other things (including great Wine links) from his Web sites at marcelgagne.com and cookingwithlinux.com.

Resources

Funambol: funambol.org

Funambol Downloads Page:
<https://www.forge.funambol.org/download>

Funambol Community Projects:
<https://www.forge.funambol.org/participate/projects.html>

Mozilla Thunderbird:
www.mozilla.com/thunderbird

Open Mobile Alliance (the Home of SyncML):
www.openmobilealliance.org

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DAVE TAYLOR

Parsing Command-Line Options with getopt

Make your shell scripts more flexible and more command-line-friendly by accepting command-line arguments/flags.

I've talked before about how I am a lazy shell script programmer. It might be because I'm simply not a full-time professional software developer, and I don't even administer my own servers anymore—I outsource the job to Wisconsin.

Regardless of how much I program nowadays though, I still find myself needing simple little applications—tiny programs that do one simple task well.

And, then there are the throwaway scripts that stick around, ultimately becoming a mainstay of one's toolkit, spreading out to cover multiple functions and mysteriously growing to 100 lines or more.

I have one of those in my toolkit, a script that originally was intended simply to figure out the dimensions of a graphic file and produce the proper height and width attributes for an HTML image tag.

Now the script scale.sh has grown to 133 lines and does a variety of different, albeit related tasks. No surprise, it's also grown to have a variety of command-line arguments, as shown here:

```
$ ./scale.sh
```

```
Usage: scale {args} factor [file or files]
-a      use URL values for APParenting.com site
-b      add 1px solid black border around image
-i      use URL values for intuitive.com/blog site
-k KW    add keywords KW to the ALT tags
-r      use 'align=right' instead of <center>
-s      produces succinct dimensional tags only
```

```
A factor 0.9 for 90% scaling, 0.75 for 75%, or max width in pixels.
A factor of '1' produces 100%.
```

Crack open the code, and you'll see my dirty little scripting secret—a very sloppy approach to parsing command-line options:

```
if [ "$1" = "-a" ] ; then
  baseurl="www.apparenting.com/Images/"; shift
fi
```

I did warn you that I was a lazy programmer, right? This is a pretty classic way to parse and

process command-line arguments, actually. Check the value of \$1, and if it's a known flag, change a default variable or two, then use the shift command to move \$2 → \$1, \$3 → \$2 and so on, effectively deleting the processed flag from the command-line args.

The problem is, when you have more than one or two flags, this really doesn't work. I step through the command flags alphabetically in my script—for example, invoking the script as scale -r -a will fail. It'll process the -r flag but never see the -a and generate an error condition.

Fortunately, there's a very nice Linux command called getopt that lets you parse through your command flags in a far more sophisticated manner.

getopt In Shell Scripts

The getopt command first requires that you let it rearrange how your command flags are organized, then you use the set command to update all the positional variables. After that, you can step through the positional variables with a case statement.

The first step is:

```
args=`getopt FLAGS $*`
set -- $args
```

where FLAGS should be the individual letters of known and accepted command flags. If a flag has an argument that goes with it (like -s 30), append a colon to it.

For my script, it looks like this:

```
args=`getopt abik:rs $*`
set -- $args
```

To see what happens, I've added a bonus echo statement. Here's the result:

```
$ scale -abs -k fdfs 100 *png
args = -a -b -s -k fdfs -- 100 blooeeh.png
```

As you can see, getopt separates out each and every command flag and adds a -- flag that indicates when the command flags end—simple, really!

Now that the args have been restructured, parsing is relatively easy, though it looks pretty complicated (warning, I've stripped out a few clauses for simplicity):

```
for i; do
  case "$i" in
    -a ) baseurl="www.apparenting.com/Images/"
          shift ;;
    -k ) keywords="$($2)"
          shift ; shift ;;
    -s ) verbose=0
          shift ;;
    -- ) shift; break ;;
  esac
done
```

Let's read this backward. At the -- option, the loop will exit due to the break. Until that's hit, the for loop will just keep iterating, stepping through all the flags specified. This is how the order of the flags becomes irrelevant.

Each time a flag is matched, the desired action is taken, variables are set and so on, then the shift command shows up again to move all the command flags down one (for example, \$2 to \$1, \$3 to \$2 and so on).

Shell script case statement matching lines are all in the form of:

```
regex ) actions ;;
```

The double semicolon is an oddity, but that's how you indicate the end of an individual case match, hence the notation shown above.

Grabbing the argument for the -k flag is easy too, because getopt has made sure that it's a separate argument, and since we're using shift as we go along to move things around, \$2 will always be the argument itself.

Finally, also notice that as a stylistic approach, I have the double semicolon with a leading space. That's just so when I eyeball the script, I quickly can recognize if there are any cases that are missing the double semicolon.

The only piece missing is some error handling, because right now, if a bad flag is encountered, here's what happens:

```
$ scale -ax 100 *png
getopt: illegal option -- x
```

Nice, but the script doesn't catch the error condition or stop running—not so good.

To fix it, immediately after the call to getopt, simply test the return code:

```
if [ $? != 0 ] ; then ...
```

In the conditional, you probably would put a usage statement and an exit command. For my script, I actually also test to ensure that there are a minimum of two arguments on the command line as well, because the script is never valid

without them:

```
if [ $? != 0 -o $# -lt 2 ] ; then
  echo ""
  echo "Usage: scale {args} factor [file or files]"
  echo ""

  ... stuff skipped ...

  exit 0
fi
```

At this point in our shell script writing journey, I certainly hope you can read that rather cryptic conditional statement and understand what it does.

Ultimately, it's a bit of work to parse command-line flags the right way, but it makes for a far more flexible and robust shell script.■

Dave Taylor has been involved with UNIX since he first logged in to the on-line network in 1980. That means that, yes, he's coming up to the 30-year mark now. You can find him just about everywhere on-line, but start here: www.DaveTaylorOnline.com.

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MICK BAUER

Building a Secure Squid Web Proxy, Part III

Tighten the controls on your Squid Web proxy.

We've been building a secure Squid Web Proxy the past few months, and we'll continue to do so for a couple more. Last time [May 2009], we got Squid installed, running and restricted to serve only local clients (based on their IP addresses). This month, we delve deeper into Squid's Access Control List (ACL) capabilities and other built-in security features.

ACL Review

As you may recall from my last column, all we had to do to get Squid running on a standard Ubuntu 8.04 system was add two lines to the file /etc/squid/squid.conf:

```
acl mick_network src 10.0.2.0/24
http_access allow mick_network
```

We inserted those two lines, which allow outbound proxy connections from clients whose IP addresses fall within the network 10.0.2.0/24 (that is, addresses 10.0.2.1 through 10.0.2.254), right above Squid's default "deny all" ACL, which looks like this:

```
http_access deny all
```

You can correctly infer from this that, by default, Squid denies proxy connections from all clients. This is a refreshing change in default server application configurations during the past few years. Whereas in the past, many applications had default configurations that would "just work", which is a very user-friendly but also excessively open stance, nowadays few network applications will do much of anything without some administrative intervention. This is only sensible. Connecting things to the Internet that you don't even know how to configure is the way of pain.

Getting back to our example ACL, the acl statement itself is fairly self-explanatory: acl tells Squid we're defining an ACL; mick_network is its name; src indicates it matches the client's source IP address or network address; and 10.0.2.0/24 is the network address in CIDR notation that will match this ACL.

This is the simplest type of ACL and still one of the most useful. In February 2002, if the *New York Times* had had a simple source-IP/network ACL correctly configured on its Internet-facing corporate Web

proxies, the rogue hacker Adrian Lamos couldn't have gained access quite so easily to its editorial-page contributor database or its Lexus-Nexus portal.

ACLs in More Depth

Besides clients' (source) IP addresses, Squid also can match a great deal of other proxy transaction characteristics. Note that some of these deal with arcane HTTP headers and parameters, many of which are minimally useful for most Squid users anyhow.

I've presented the full range of possible ACL types to give you a taste for how rich Squid's ACL functionality is. Needless to say, however, I can't cover usage scenarios for (or even adequately explain) all of these. ViServe's "Squid 2.6 Configuration Manual" (see Resources) gives complete syntax and usage examples for all.

Many, if not most, Squid installations don't go much beyond a few src ACLs, along with perhaps a few simple dstdomain blacklist entries thrown in for good measure. Many of the other most useful ACL types, such as myip, time, port, proto, method, dst_mime_type and rep_mime_type, should be reasonably self-explanatory (or at least easy enough to understand from the examples shown in squid.conf's comments).

One category of less-intuitive ACL types is particularly powerful and useful: the ones that enable Squid to authenticate client users via external authentication authorities. Before we tackle authentication, however, we should give a little more attention to ACL operators, the tags that perform some action (most commonly, to allow or deny a request) based on a matched ACL.

By far, the most important ACL operator is http_access, which specifies whether Squid should allow the transaction matching the specified ACL to proceed. Going back to the example ACL/operator pair from the beginning of this section, after we defined the ACL mick_network as all transactions involving client/source IP addresses within 10.0.2.0/24, we operated on it with this line:

```
http_access allow mick_network
```

This is simple enough to understand: "allow HTTP requests matching the ACL named mick_network."

Table 1. Complete List of ACL Types Supported in Squid 2.6

ACL Type	Description
src	Client (transaction source) IP address or network address.
dst	Server (transaction destination) IP address or network address.
myip	Local IP address on which Squid is listening for connections.
arp	Client's Ethernet (MAC) address (matches local LAN clients only).
srcdomain	Client's domain name as determined by reverse DNS lookup.
dstdomain	Domain portion of URL requested by client.
srcdom_regex	Regular expression matching client's domain name.
dstdom_regex	Regular expression matching domain in requested URL.
time	Period of time in which transaction falls.
url_regex	Regular expression matching entire requested URL (not just domain).
urlpath_regex	Regular expression matching path portion of requested URL.
urllogin	Regular expression matching requested URL's "login" field.
port	Requested site's (destination) TCP port.
myport	Local TCP port on which Squid is listening for connections.
proto	Application-layer protocol of request (HTTP, HTTPS, FTP, WHOIS or GOPHER).
method	Request's HTTP method (GET, POST or CONNECT).
browser	Matches the client's browser, per HTTP "User-Agent" header.
referer_regex	Regular expression matching the unreliable HTTP "Referer" header (that is, the supposed URL of some page on which the user clicked a link to the requested site).
ident	Matches specified user name(s) of user(s) running client browser, per an "ident" lookup. Note that ident replies, which often can be spoofed, should not be used in lieu of proper authentication.
ident_regex	Regular expression defining which client user names to match per ident lookup.
src_as	Matches client IP addresses associated with the specified Autonomous System (AS) number, usually an ISP or other large IP registrant.
dst_as	Matches destination-server IP addresses associated with the specified AS number.
proxy_auth	Matches the specified user name, list of user names or the wild card REQUIRED (which signifies any valid user name).
proxy_auth_regex	Regular expression defining which user names to match.
snmp_community	For SNMP-enabled Squid proxies, matches client-provided SNMP community string.
maxconn	Matches when client's IP address has established more than the specified number of HTTP connections.
max_user_ip	Matches the number of IP addresses from which a single user attempts to log in.
req_mime_type	Matches a regular expression describing the MIME type of the client's request (<i>not</i> the server's response).
req_header	Matches a regular expression applied to all known request headers (browser, referer and mime-type) in the client's request.
rep_mime_type	Matches a regular expression describing the MIME type of the server's response.
rep_header	Matches a regular expression applied to all known request headers (browser, referer and mime-type) in the server's response.
external	Performs an external ACL lookup by querying the specified helper class defined in the external_acl_type tag.
urlgroup	Matches a urlgroup name, as defined in redirector setups.
user_cert	Matches specified attribute (DN, C, O, CN, L or ST) and values against client's SSL certificate.
ca_cert	Matches specified attribute (DN, C, O, CN, L or ST) and values against client certificate's issuing Certificate Authority certificate.
ext_user	Matches specified user name(s) against that returned by an external ACL/authentication helper (configured elsewhere in squid.conf).
ext_user_regex	Matches a regular expression describing user names to be matched against that returned by an external ACL/authentication helper.

The most common use of ACLs is to specify a list of ACLs and http_access statements, ending (as we've seen) with a "drop by default" line, like this:

```
http_access deny all
```

This has the effect of creating a "whitelist"—a list of types of transactions that are allowed, with all others being denied.

Squid recognizes a number of additional ACL operators besides http_allow, including no_cache, ident_lookup_access, always_direct, never_direct and snmp_access. Because most of these concern cache performance, HTTP redirects and communications with other Squid servers rather than security per se, I'll leave it to you to explore those (or not) as your particular needs dictate. The Squid User's Guide referenced in the Resources section is a good source of information about Squid's various ACL operators.

Squid Authentication

As I mentioned previously, one of Squid's most handy capabilities is its ability to authenticate proxy users by means of a variety of external helper mechanisms. One of the simplest and probably most commonly used helper applications is ncsa_auth, a simple user name/password scheme that uses a flat file consisting of rows of user name/password hash pairs. The HOWTO by Vivek Gite and, to a lesser extent, the Squid User's Guide, explain how to set this up (see Resources).

Briefly, you'll add something like this to /etc/squid/squid.conf:

```
auth_param basic program /usr/lib/squid/ncsa_auth /etc/squid/squidpasswd
auth_param basic children 5
auth_param basic realm Squid proxy-caching web server at Wiremonkeys.org
auth_param basic credentialsttl 2 hours
auth_param basic casesensitive off
```

And, in the ACL section:

```
acl ncsa_auth_users proxy_auth REQUIRED
http_access allow ncsa_auth_users
```

The block of auth_param tags specifies settings for a "basic" authentication mechanism:

- **program** is the helper executable ncsa_auth, using the file /etc/squid/squidpasswd as the user name/password hash list (created previously).
- **children**, the number of concurrent authentication processes, is five.
- **realm**, part of the string that greets users, is "Squid proxy-caching Web server at Wiremonkeys.org".

■ **credentialsttl**, the time after authentication that a successfully authenticated client may go before being re-authenticated, is two hours.

■ **casesensitive**, which determines whether user names are case-sensitive, is off.

In the ACL section, we defined an ACL called ncsa_auth_users that says the proxy_auth mechanism (as defined in the auth_param section) should be used to authenticate specified users. Actually in this case, instead of a list of user names to authenticate, we've got the wild card REQUIRED, which expands to "all valid users". The net effect of this ACL and its subsequent http_access statement is that only successfully authenticated users may use the proxy.

The main advantages of the NCSA mechanism are its simplicity and its reasonable amount of security (only password hashes are transmitted, not passwords proper). Its disadvantage is scalability, because it requires you to maintain a dedicated user name/password list. Besides the administrative overhead in this, it adds yet another user name/password pair your users are expected to remember and protect, which is always an exercise with diminishing returns (the greater the number of credentials users have, the less likely they'll avoid risky behaviors like writing them down, choosing easy-to-guess passwords and so forth).

Therefore, you're much better off using existing user credentials on an external LDAP server (via the ldap_auth helper) on an NT Domain or Active Directory server (via the msnt_auth helper) or the local Pluggable Authentication Modules (PAM) facility (via the pam_auth helper). See Resources for tutorials on how to set up Squid with these three helpers.

Note that Squid's helper programs are located conventionally under /usr/lib/squid. Checking this directory is a quick way to see which helpers are installed on your system, although some Linux distributions may use a different location.

Other Squid Defenses

Access Control Lists really are Squid's first line of defense—that is, Squid's primary mechanism for protecting your network, your users and the Squid server itself. There are a couple other things worth mentioning, however.

First, there's the matter of system privileges. Squid must run as root, at least while starting up, so that, among other things, it can bind to privileged TCP ports such as 80 or 443 (although by default it uses the nonprivileged port 3128). Like other mainstream server applications, however, Squid's child processes—the ones with which the outside world actually interacts—are run with lower privileges. This helps minimize the damage a compromised or hijacked Squid process can do.

By default, Squid uses the user proxy and group proxy for nonprivileged operations. If you want to change these values for effective UID and GID, they're controlled by squid.conf's cache_effective_user and cache_effective_group tags, respectively.

Squid usually keeps its parent process running as root, in case it needs to perform some privileged action after startup. Also, by default, Squid does not run in a chroot jail. To make Squid run chrooted, which also will cause it to kill the privileged parent process after startup (that is, also will cause it to run completely unprivileged after startup), you can set squid.conf's chroot tag to the path of a previously created Squid chroot jail.

If you're new to this concept, chrooting something (changing its root) confines it to a subset of your filesystem, with the effect that if the service is somehow hacked (for example, via some sort of buffer overflow), the attacker's processes and activities will be confined to an unprivileged "padded cell" environment. It's a useful hedge against losing the patch rat race.

Chrooting and running with nonroot privileges go hand in hand. If a process runs as root, it can trivially break out of the chroot jail. Conversely, if a nonprivileged process nonetheless has access to other (even nonprivileged) parts of your filesystem, it still may be abused in unintended and unwanted ways.

Somewhat to my surprise, there doesn't seem to be any how-to for creating a Squid chroot jail on the Internet. The world could really use one—maybe I'll tackle this myself at some point. In the meantime, see Resources for some mailing-list posts that may help. Suffice it to say for now that as with any other chroot jail, Squid's must contain not only its own working directories, but also copies of system files like /etc/nsswitch.conf and shared libraries it uses.

Common Squid practice is to forego the chroot experience and to settle for running Squid partially unprivileged per its default settings. If, however, you want to run a truly hardened Squid server, it's probably worth the effort to figure out how to build and use a Squid chroot jail.

Conclusion

Setting ACLs, running Squid with nonroot privileges most or all of the time and running Squid in a chroot jail constitute the bulk of Squid's built-in security features. But, these are not the only things you can do to use Squid to enhance your network and end-user systems' security.

Next time, I'll show you how to use add-on tools such as SquidGuard to increase Squid's intelligence in how it evaluates clients' requests and servers' replies. I'll also address (if not next time then in a subsequent

column) some of the finer points of proxying TLS/SSL-encrypted sessions. Until then, be safe!■

Mick Bauer (darth.elmo@wiremonkeys.org) is Network Security Architect for one of the US's largest banks. He is the author of the O'Reilly book *Linux Server Security*, 2nd edition (formerly called *Building Secure Servers With Linux*), an occasional presenter at information security conferences and composer of the "Network Engineering Polka".

Resources

Wessels, Duane: *Squid: The Definitive Guide*. Sebastopol, CA: O'Reilly Media, 2004. Includes some tips on creating and using a Squid chroot jail.

The Squid home page, where you can obtain the latest source code and binaries for Squid: www.squid-cache.org.

The Ubuntu Server Guide's Squid chapter: <https://help.ubuntu.com/8.10/serverguide/C/squid.html>.

The Squid User's Guide: www.deckle.co.za/squid-users-guide/Main_Page.

ViSolve's Squid 2.6 Configuration Manual and Comprehensive squid.conf Reference: www.visolve.com/squid/squid26/contents.php.

"The Homeless Hacker v. *The New York Times*", Jennifer Kahn's article in *Wired* about Adrian Lamos: www.wired.com/wired/archive/12.04/hacker_pr.html.

Chris Wichura's slideshow "The Squid Caching Proxy": www.uniforum.chi.il.us/slides/squid/UniForum-Squid.ppt.

Vivek Gite's tutorial "Howto: Squid proxy authentication using ncsa_auth helper": www.cyberciti.biz/tips/linux-unix-squid-proxy-server-authentication.html.

Vivek Gite's Tutorial "Configure squid for LDAP authentication using squid_ldap_auth helper": www.cyberciti.biz/tips/howto-configure-squid-ldap-authentication.html.

David Bolton's "Howto: Squid + msnt_auth + Active Directory": www.davidbolton.com/?p=32.

Paul Matthews' HOWTO "Squid with PAM Authentication and Squish Download Manager": www.opensourcehowto.org/how-to/squid/squid-with-pam-authentication--squish-download-manager.html.

Thread from the squid-users mailing list, on what should go into a Squid chroot jail: www.squid-cache.org/mail-archive/squid-users/200609/0782.html.

Thread from the squid-users mailing list, about some of the finer points of running Squid in a chroot jail: www.squid-cache.org/mail-archive/squid-users/200811/0411.html.



KYLE RANKIN

Right Command, Wrong Server

It's easy to lose track of what your servers do when they number in the tens or hundreds. Here are a few simple techniques I've found that make it easier to manage them all.

When I first started out in systems administration, I had only a few machines to keep track of. It was relatively easy to remember which servers did which functions (mostly because one or two machines did just about everything). If a server had a problem, I immediately knew everything it would impact.

For better or worse, nowadays my position has become more complicated. When you personally manage tens or hundreds of machines, it can be difficult to keep everything straight. When a server goes down, you might no longer know what services are impacted or who else to notify. Beyond that, there's also the dreaded running-the-right-command-on-the-wrong-server mistake. I think every sysadmin has typed `halt`, `rm -rf` or some other destructive command in the wrong terminal at least once (just ask my old boss Bill).

Although I can't guarantee you'll never type a command on the wrong server, I can say that as your environment grows to hundreds of servers, these techniques will help you pick up where your brain left off.

In this column, I discuss some methods I've found to help you keep track of your servers. Although I can't guarantee you'll never type a command on the wrong server, I can say that as your environment grows to hundreds of servers, these techniques will help you pick up where your brain left off.

Message of the Day

The message of the day (mota) is the message that greets you every time you log in to your system on the command line. For instance, here is the message of the day on one of my old Debian servers:

```
Linux napoleon 2.6.20-1-k7 #1 SMP Tue Apr 24 22:37:29 UTC 2007 i686
```

The programs included with the Debian GNU/Linux system are free software; the exact distribution terms for each program are

described in the individual files in `/usr/share/doc/*/copyright`.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent permitted by applicable law.

No mail.

Messages like this are pretty generic, so it's easy to take them for granted and leave them alone. After all, in this example, I already know the OS, hostname and kernel version (Linux, napoleon, 2.6.20-1-k7). You can extend this information, however, and list anything you want.

The message of the day is managed in a file called `/etc/motd`. It's a simple text file, so you can modify it to say anything you want, although you'll want to limit it to what can fit on a standard console screen. Note that on modern Debian-based systems, the `/etc/motd` file is somewhat dynamic, so you will want to modify `/etc/motd.tail` instead.

So, how can you use this file to your advantage? A lot of security-minded administrators add a special terms of use in this file to note that their systems are private and do not allow unauthorized access. In that case, the motd acts like a No Trespassing sign, so if someone hacks in to the system, law enforcement has help demonstrating that the attacker was notified that it was a private system.

Although you may or may not want to add a No Trespassing sign to your motd, there are a number of other things you can add to the motd to make your life as an admin simpler. For instance, you could add a short set of documentation about the server, including what the server does, other groups to contact if there is a problem on the machine and even any special locations where custom files are stored. That way, when you log in, instead of a boring default motd, you could get something more like:

```
Linux napoleon 2.6.20-1-k7 #1 SMP Tue Apr 24 22:37:29 UTC 2007 i686
```

Welcome to Napoleon.

Local services: DNS, DHCP, Internal Wiki (<http://wiki.example.net>)

DNS config: /etc/bind, /var/named.
DHCP config: /etc/dhcpd.conf
Wiki files: /var/www/wiki

Support team: root@example.net, wikiadmin@example.net

You even might want to use the motd to pass along useful tips to regular users on the system. For instance, let's say your users use vim to view log files. On some systems, vim stores a complete copy of any files you open in /tmp. Although that's fine for a small text file, when you have users opening 1GB+ Apache logs, your /tmp space fills up quickly, and you are paged again and again. One solution might be to add a gentle reminder in your motd to use less, not vim, to read large text files.

Tweaked Shell Prompts

Another great way to help remind you which servers you are on is to tweak your shell prompt. If you are a good security-minded admin and become root only when necessary, a quick tip is to make the

root prompt a different color (like red), so it stands out and reminds you that everything you do is with root privileges.

There are many different tastes when it comes to a custom shell prompt, so you might want to tweak this to suit your preferences. Also, I'm assuming you will be using the bash shell that most systems tend to default to these days, so the file you should edit is /root/.bashrc. What shows up in your prompt is defined by the PS1 environment variable, so if you are curious what it is set to by default, simply type:

```
root@napoleon:~# echo $PS1  
\u@\h:\w\$
```

In this example, you have a very basic prompt that lists the current user (\u), the @ symbol, the hostname (\h), a colon, the current working directory (\w) and a # symbol (if I'm root), or a \$ otherwise (\\$). On my sample system, it would look like root@napoleon:~# when I log in as root.

There are plenty of other ways you can tweak

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the prompt, and if you are curious, the full list of aliases you can use for it is found in the bash man page—just search for PS1.

Because I'm focused on colorizing the prompt and not necessarily changing the format, I mostly will leave the prompt as is. There are a few ways to colorize the prompt, but the simplest way I've found is to define some of the potential colors you'd like to use in environment variables ahead of time, and then you can assign them to the PS1 variable without going cross-eyed from all the escape characters. Open up /root/.bashrc, and if PS1 already is defined, add these lines above it:

```
NORMAL=`tput sgr0 2> /dev/null`  
BOLD=`tput bold 2> /dev/null`  
RED="\[\033[31m\]"  
GREEN="\[\033[32m\]"  
BLUE="\[\033[34m\]"  
GREY="\[\033[1;30m\]"  
PURPLE="\[\033[0;35m\]"
```

Now that all the colors are defined, I simply can define PS1 with the default settings, only with these color settings around it:

```
PS1 = "$RED\u@\h:\w\$NORMAL"
```

Once you save the changes to .bashrc, the next time you log in, you will notice your prompt is colorized. Now you can spend the rest of the afternoon tweaking the prompt with different sets of colors and symbols like I did the first time I found out about it. It even might be worthwhile to use a different prompt color scheme for different types of servers.

DNS TXT Records

One of the problems with the previous two methods is that you must log in to a machine to get information on it. That leads me to one of my favorite

If you add a TXT record as well, that gives you a nice centralized place to document what each server does in a way that can be queried from any machine on the network.

ways to organize my servers, DNS TXT records. Most people probably are familiar with a DNS A record (it maps a hostname to an IP address) and probably CNAME and PTR records (it maps one hostname to another hostname and an IP address to a hostname, respectively), but many admins aren't aware of (or don't use) TXT records. A TXT

record essentially allows you to assign text to a particular hostname. If you have an internal DNS infrastructure for your machines, you probably already have A records for all your servers. If you add a TXT record as well, that gives you a nice centralized place to document what each server does in a way that can be queried from any machine on the network.

To demonstrate how to use TXT records, let's assume I'm using a standard BIND server for DNS, and this is a short section of the file that defines A records for three hosts—napoleon, snowball and major:

napoleon	IN	A	192.168.1.6
snowball	IN	A	192.168.1.7
major	IN	A	192.168.1.8

All I would do is add a new TXT record below any A records I have that lists what those servers do:

napoleon	IN	A	192.168.1.6
napoleon	IN	TXT	"DNS, DHCP, Internal wiki"
snowball	IN	A	192.168.1.7
snowball	IN	TXT	"Primary Internal File Server"
major	IN	A	192.168.1.8
major	IN	TXT	"Failover Internal File Server"

Once I save my changes and reload BIND, the TXT records are ready to go. The next time I'm scratching my head trying to figure out what snowball does, I just have to issue a dig query:

```
$ dig snowball.example.net TXT +short  
"Primary Internal File Server"
```

Note that I used the +short option with dig. That way, I get back only the contents of the TXT record instead of the volume of data dig normally gives me. Not only does this make it easy to narrow in on the information I want, it also makes it a handy little one-liner to add to other programs. I even could see some savvy administrators tweaking their shell prompt or motd so that it contained this value.

Again, the beauty of using TXT records to document this is that it puts the information in a central place that you control and that you typically have to modify whenever you add a host anyway. Just be careful if you use this for externally facing DNS hosts—you might not necessarily want to broadcast all of your server info to everyone on the Internet.■

Kyle Rankin is a Senior Systems Administrator in the San Francisco Bay Area and the author of a number of books, including *Knoppix Hacks* and *Ubuntu Hacks* for O'Reilly Media. He is currently the president of the North Bay Linux Users' Group.

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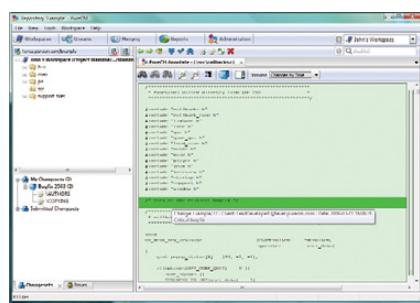
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Blackmagic Design's Broadcast and Post-Production Products

The company Blackmagic Design recently announced a wholesale move to the Linux platform of its formerly Windows- and Mac OS-only products. Linux support was added to the new Media Express 2.0, a video capture and playback software application compatible with all Blackmagic Design DeckLink, Multibridge and Intensity products. This new version is a major update that adds support for direct capture and playback of DPX, AVI and QuickTime files, as well as list-based batch capture and playback, plus a major UI overhaul. Also adding Linux support are the DeckLinux (video cards), Intensity (HDMI/analog editing component) and Multibridge (external capture and playback solution) products. A free, cross-platform SDK is included. Finally, the DeckLink Optical Fiber, which Blackmagic calls "the world's first 10-bit SD/HD broadcast capture card with both optical fiber SDI and regular SDI", now has a Linux driver and SDK. The card is designed for high-end broadcast and post-production customers who work in large facilities needing lots of creative workstation seats and seek to use both types of cabling.

www.blackmagic-design.com



PureCM

Software development companies should take note of the new PureCM 2009-1, a Software Configuration Management (SCM) solution that controls, tracks and visualizes changes to digital assets. PureCM facilitates software development in team environments, accommodating best practices, such as task-based version control, parallel development and build automation. One key new feature involves greater advance insight into and control of changes that need merging. Merge conflicts also can be resolved pre-integration using a visual resolve tool. A second key feature is a new and simplified cross-platform GUI, allowing developers

to see on which files their colleagues are currently working within their private workspace. They also can preview their completed changes before integrating them automatically into the workspace. PureCM is cross-platform for Linux, Mac OS and Windows, and it offers native integration with Eclipse and Visual Studio.

www.purecm.com

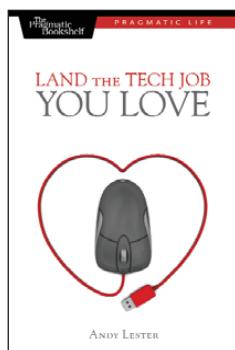
ASUS VH Series LCD Monitors

Greening your computing experience keeps getting easier, thanks to the efforts of companies like ASUS, whose new VH Series LCD monitors garnered a Gold rating under the EPEAT environmental standard. The VH series offers five models with screen sizes ranging from 20"-24". Each model has been certified by the EPEAT organization, which evaluates PCs based on their environmental attributes. EPEAT's standards demand exceptional performance in areas such as reduction or elimination of hazardous materials, design for end of life, product longevity, resource conservation, end-of-life management, corporate performance and packaging. Gold is EPEAT's highest rating. ASUS says that with the VH monitor series, it perfected new manufacturing techniques to reduce mercury and utilize post-consumer recycled plastic without affecting product performance and reliability.

www.asus.com



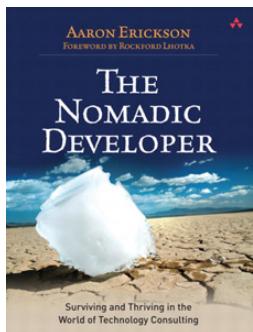
ASUS VH



Andy Lester's *Land the Tech Job You Love* (Pragmatic Bookshelf)

If you're laid off or stuck in a dead-end career, Andy Lester's new book *Land the Tech Job You Love* from Pragmatic Bookshelf may land you a gig that springs you out of bed each morning. The book will help techies learn the job-search techniques that work for finding an fulfilling career. Lester claims that we techies have a tougher time finding and winning the right job, because companies are ever-more demanding and our competition is smart, tech-savvy and resourceful. The reader will learn skills such as how to uncover hidden jobs that never get publicized, perform effective social networking, craft an effective résumé, understand the mindset of hiring managers and perform well in interviews. The book is further peppered with real-life stories about what works and hilarious tales of what doesn't.

www.pragprog.com



Aaron Erickson's *The Nomadic Developer: Surviving and Thriving in the World of Technology Consulting* (Addison-Wesley)

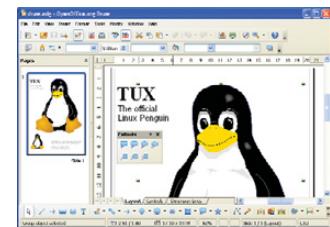
If your dream job means saying adiós to your boss and running your own show, pick up Aaron Erickson's new book *The Nomadic Developer: Surviving and Thriving in the World of Technology Consulting*, published by Addison-Wesley. Making a living as a technology consultant has its pros and cons, and author Erickson first helps readers assess whether it's their ideal career path. Should readers decide to choose to become (or continue as) consultants, Erickson presents a guide to success in the field. He explains issues such as how to break into the business and build a career path, understand the mechanics of consultancies and avoid the traps of unscrupulous ones, master secret consulting success tips, add more value than competitors, enhance professional development and build a personal brand. Erickson and other battle-worn consultants also offer the lessons they learned from years in the trenches.

www.informit.com

OpenOffice.org

The Linux community's favorite office suite, OpenOffice.org, continues its forward progress with the latest 3.1 release. New overall features include improved screen appearance due to anti-aliasing, easier dragging and placement of graphics and improved file locking. New features in Writer include overlining (and not just underlining) and better comment functionality. New to Calc are a zoom slider, formula hints and improved sorting. New to Base are SQL syntax highlighting and the ability to a complete database application by including macros and scripts within a Base document. OpenOffice.org's supported platforms are Linux, Solaris, Mac OS and Windows.

www.openoffice.org



Virident's GreenCloud Server Family



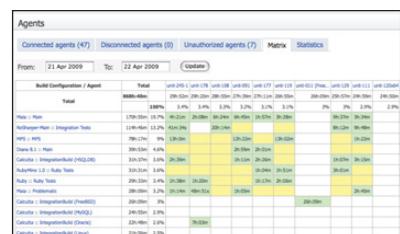
Virident recently released a new class of servers, which the firm says "is the first to be designed with the Internet in mind". The GreenCloud Server Family is optimized to deliver high-performance, as well as energy- and cost-efficient computing for data-centric, query-rich applications that predominate in the Internet data center. The first two members of the product line are GreenCloud Server for MySQL and for Memcached. Each server is based on the GreenCloud Architecture, which, says Virident, transforms an industry-standard server into a data-centric "in-memory server platform". The architecture allows applications to "directly interact with large volumes of data hosted in memory tightly integrated into the CPU complex, which ensures optimal utilization of all server elements—compute, memory and I/O". The resulting "Storage Class Memory", a new memory tier that bridges the performance and persistence gap between main memory and mass storage in traditional server architectures, works in tandem with a co-optimized software stack within an industry-standard x86 server platform. The result, says Virident, is "orders of magnitude higher performance and previously unattainable capabilities to data-centric applications".

www.virident.com

JetBrains' TeamCity

And the award for most visually stimulating company name goes to JetBrains, who recently released version 4.5 of TeamCity, a distributed build management and continuous integration tool. JetBrains says that with TeamCity, one can set up a build server within minutes and enjoy out-of-the-box continuous unit testing, code-quality analysis and early reporting on build problems—all without leaving the IDE. Furthermore, TeamCity is "the place to find all kinds of information about your projects—from their current status and health, to the detailed change history with metrics and statistical trends". The company also cites TeamCity's gentle learning curve that allows users to improve release management practices quickly by gradually adopting its advanced features and capabilities. New in version 4.5 are improved integration with Visual Studio and Eclipse with added support for VCS systems, and enterprise-level features, such as user groups and LDAP support, and multiple UI improvements.

www.jetbrains.com



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Fresh from the Labs

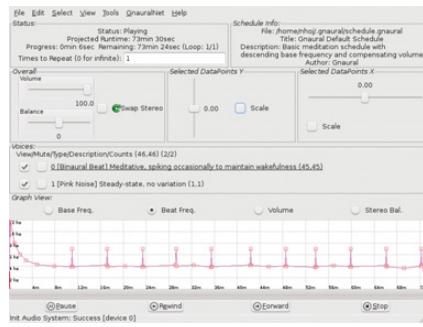
Gnaural—Binaural Brain Wave Entrainment

gnaural.sourceforge.net

This has been one crazy month. Why? Because I've discovered the weird-science world of Binaural Beats. For the uninitiated (which I'm guessing you are), binaural beats are basically just two sound streams running against each other, but usually for a very specific purpose: brain wave entrainment.

The way it works is you'll have an audible base frequency, say 200Hz. Then you have a beat frequency, which usually will be below what your ear can hear, say 8Hz. You then run the carrier frequency down both sides of the stereo spectrum (and this is best on headphones), but with a slight difference on one channel from the other (in this example, 200Hz down the left, and 208Hz down the right). When you hear these played, your brain concentrates on the 8Hz difference, or whatever beat frequency you're running.

Why would you do this, you ask?



Gnaural can help slow down or speed up your brain waves—here it's being used for inducing a meditative state.



Here's Gnaural being used to maintain alertness—very handy for studying.

Because these binaural frequencies can have strange and unique effects on your body and state of consciousness. This really is weird stuff, and the program we're looking at using is Gnaural, made by my good friend from Yale Psychology, Bret Logan. According to its Web site:

Gnaural is a multiplatform programmable binaural-beat generator, implementing the principle of binaural beats as described in the October 1973 *Scientific American* article "Auditory Beats in the Brain" (Gerald Oster)....In over a decade of experience with the technique, I have found it mainly useful in areas of sleep induction and "power napping", and also as a way to bring meditation both within reach (when stress has put it out of reach) and to extend its boundaries over time.

Installation Provided on the Web site are packages specifically for Debian; however, there are packages natively available for Ubuntu, Fedora, SUSE, Gentoo and Arch Linux. There are two versions available: Gnaural and Gnaural 2. I'm not sure what the difference is (maybe it's that they use GTK 1 and 2—they look the same to me), but Gnaural 2 is obviously the latter, so I've stuck with that. When I went to install the binaries, there were no dependency issues, so they installed right away.

If you're working with source, you'll need the -dev packages for libglade2, libportaudio and libsndfile. If you download the tarball, extract it, and enter the folder with the command line, apparently the installation is the usual case of:

```
$ configure  
$ make  
$ sudo make install
```

However, I had problems with conflicting Portaudio versions and couldn't get past the ./configure script, so better luck to you if you're compiling the source (I just stuck with the binary).

Once Gnaural is installed, you can start it at the command line with:

```
$ gnaural2
```

Usage Before you do anything, plug in some decent headphones. When Gnaural loads, you'll see a bunch of controls and a field with a strange graph. This is Gnaural's default pattern, a playlist of binaural frequencies. This default pattern is designed to be "Meditative, spiking occasionally to wakefulness", and it has a default play time of 73.5 minutes, which safely will fit on any audio CD. If you're patient, press Play and go for it. Otherwise, you might want to scale back the runtime to something you can easily hack, say ten minutes or so (check the Scale box under Selected Datapoints X, and drag the slider left to do this).

Now, I must state from the outset, this is nothing to do with New Age stuff. Gnaural is purely scientific in its methods, and it uses only two sound waves running against each other. When it refers to meditation, although someone who meditates in the traditional sense would find use here, in this case, it's purely to do with slowing down the brain and relaxing—shutting off parts that needn't be running for the moment. This default pattern will take you through various stages of consciousness by entraining your brain to certain frequencies.

In the background, "pink noise" will be playing, which is a sort of soft static that helps drown out noise from the outside world. This can be muted if you like, which generally will make the effect of the binaural sounds stronger and more apparent. I haven't really got the space to go into much further detail here, but explore, and you'll find that you can make your own frequencies and design your own patterns, among many other features.

In terms of bodily effects, generally it will make you feel more relaxed and probably sleepy—that's the desired effect of the default pattern. However, on experiments with myself and my friends, I found I had strange REM-like eye movements and rapid blinking. One

friend had momentary changes in vision. Another seemed to lose track of time. One got really sleepy. Our guitarist felt amazingly relaxed, and his brother said it felt like his ears were shrinking. And, one of my mates said it felt like his tongue was slowly disappearing!

The uses of binaural beats aren't limited purely as a tool of relaxation though. If you have a bit of a trawl around the Web site's discussion boards, you can find other presets for things, such as staying alert, helping you wake up, maintaining concentration while studying and helping travel times pass quickly.

These usually sub-audible frequencies have different effects on different people—everyone's brain is unique. I'd like to say this is harmless, but that would be irresponsible. This is still a fairly unexplored area of science. If you try it, do so at your own risk, and if you have negative effects, stop using it immediately. On the other hand, you also might find it's brilliant, soothing

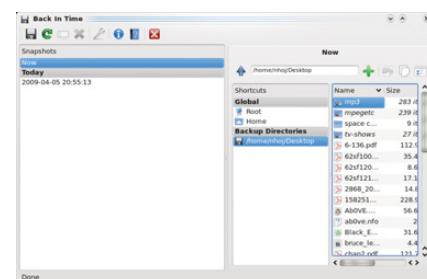
and love every minute of it, and some people are using binaural beats every day for this very reason. Check it out, but take care.

Back In Time—a Backup Tool with a Difference

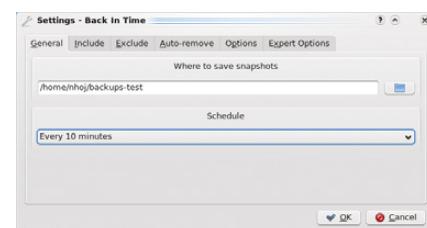
backintime.le-web.org

Ever made a mistake, deleted or overwritten something, and wanted to go back a day? This might be the tool for you. According to the project's Freshmeat entry:

Back In Time is a simple backup system for Linux (GNOME and KDE4) inspired by the flyback project and TimeVault. The backup is done by taking snapshots of a specified set of directories. All you have to do is configure where to save the snapshot, what directories to back up, and when a backup should be done (manually, every hour, every day, every week or every month). It



Back In Time—Simplistic Backups for Specific Folders



Back In Time lets you decide how often you want to back up your folders and where, in handy folder snapshots.

Expert included.

Meet Victoria (on the right). She is the Silicon Mechanics marketing expert responsible for the events and promotions that keep our customers informed about exciting new products and technologies. She's pictured here with her twin sister Veronica, an industrial designer, to help us make a point about what makes twin servers from Silicon Mechanics so popular. Victoria and Veronica are twins, but they don't look exactly alike and they don't do the same job. Twin servers are two servers in a single 1U chassis: they can be configured differently, and they handle their own individual workloads.

With the introduction of the Rackform iServ R4410 from Silicon Mechanics, twin power has reached a whole new level: the twin². A twin² is a 2U 4-node system. It supports four swappable, full-featured nodes in a 2U chassis with redundant power. In each node you'll find 2 of the new Intel® Xeon® 5500 Series processors, 12 DDR3 DIMM slots, 3 hot-swap drives, and an integrated dual-port GigE adapter. Integrated InfiniBand is also

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Project at a Glance

LongoMatch: the Digital Coach

You know how much I love a niche project, and here is something genuinely cool-looking. According to its Web site:

LongoMatch is a sports video analysis tool for coaches to assist them in making game video analysis. You can tag the most important plays of the game and group them by categories to study each detail of the game strategy. A list with

all the tagged plays lets you review them with a simple click, even in slow motion. The timeline gives a quick overview of the game and lets you adjust the lead and lag time of each play frame by frame. LongoMatch has support for playlists, an easy way to create presentations with plays from different games. Besides, you can create new videos with your favorite plays using the video editing feature.

acts as a user-mode backup system. This means you can back up and restore only folders to which you have write access.

Installation If you check out the Web site's download page, it has instructions to integrate repositories for Ubuntu and Fedora, where you can install the packages straight from your system's package manager. If you don't have either of these distros though (or prefer to compile it), the source is available too. The link where these are found is misleadingly marked "You can download older versions here" on the main downloads page (you actually can get the latest source tarballs from this section too, newer than the main binaries).

If you're going with the binaries, you'll have to install the available common package first, and then install either the GNOME or KDE4 package, depending on

```
$ sudo ./install-gnome.sh
```

It now will be ready to run under GNOME and requires python-glade2, python-gnome2 and meld.

For KDE, enter:

```
$ sudo ./install-kde4.sh
```

The KDE option requires x11-utils, python-kde4 (>= 4.1) and kompare. Once the installation is finished, you can run the program by entering:

```
$ backintime
```

Usage Once you're inside, Back In Time is a pretty basic affair. On a first-time run, it starts off with the Settings Dialog, where you define where the backup snapshots are saved, what folders to back up and how often to do it (among other features).

Ever made a mistake, deleted or overwritten something, and wanted to go back a day?

your preference. If you choose to run with the source tarball, installation is surprisingly easy. Download the tarball, extract it, and open a terminal in the folder. Enter the command:

```
$ sudo ./install-common.sh
```

This first step installs the base of the program (not the GUI) and requires that you have Python and rsync installed.

If you want to run with GNOME, enter:

Start with where to back up. You'll see the General tab first, and the first field will let you choose where to save the snapshots of what you want backed up. Below that is the drop-down box for how often you want snapshots updated, which has the choices of disabled (you'll have to do it yourself), every five minutes, ten minutes, hour, day, week or month. I've got mine set to every ten minutes. It checks to see whether there are any folder differences, and if so, it takes



LongoMatch

Hopefully, I can get this working by next month; it looks to be a juicy little project!

another snapshot.

Click on the Include tab, and you can define what actual folders you want backed up in your snapshots. I've got my desktop being backed up in snapshots, which are in the form of separate folders in my home directory, under backups. Every time there's a change, a new folder is made, each with a different date and time code, allowing me to backtrack accurately if I need to retrieve something. Other tabs include more advanced options, such as excluding certain files and the like, but I'll let you explore that yourself.

All in all, Back In Time is a very simple application that is best used on smaller folders that you work with a lot. As a musician with my own recordings, I have a lot of music files being constantly altered, and quite often, I make silly mistakes that result in files being irretrievable. Back In Time is invaluable for such circumstances. If you're chasing something super-advanced with a lot of wizz-bang features that work system-wide, this probably isn't it, but for those who want something simple for use on a small scale, it's ideal.

John Knight is a 24-year-old, drumming- and climbing-obsessed maniac from the world's most isolated city—Perth, Western Australia. He can usually be found either buried in an Audacity screen or thrashing a kick-drum beyond recognition.

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REVIEWS

HARDWARE

The Kindle 2

A review of the sleek, slim, sexy successor to the Kindle. DANIEL BARTHOLOMEW

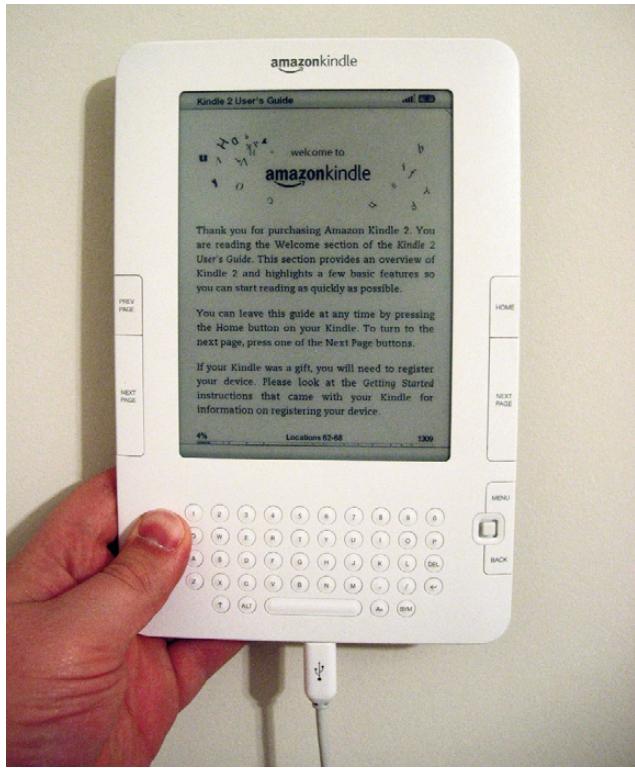


Figure 1. The Kindle 2 is the length and width of a paperback book and much thinner.

Everyone knew Amazon would announce a successor to its popular Kindle ebook reader. What people did not know was when. Thankfully, the time between when the Kindle 2 was announced and when it started shipping was short. Now that it has been released, it's time to put Amazon's Linux-powered book reader to the test.

Like the original, the Kindle 2 is built around an e-ink display. The dimensions of the display are the same, but every other aspect of the device is either new or modified. Instead of being shaped like a wedge, the Kindle 2 is a flat slab. Instead of a rubberized back, it has brushed aluminum. Instead of angled rectangular keys in a split keyboard configuration, it has circular keys in a rectangular grid. Instead of a scroll wheel, it has a five-way thumbstick. Instead of four shades of gray, it has 16. You get the idea.

Things the Kindle 2 Does Better

Let's start with my favorite Kindle 2 improvement: battery life. Of all the changes, this is the one I appreciate the most. With

the wireless turned on, I can use the Kindle for several days before having to charge it. With the wireless turned off, I have to charge the Kindle only two or three times a month. This is a vast improvement over the original Kindle—when I did not have the charger with me, I had to be careful never to turn on the wireless except when I wanted to purchase something or knew I had a subscription waiting for me to download. Turning on the wireless on the original Kindle is a sure way to kill your battery life.

Another improvement is that newspapers and magazines are easier to navigate on the Kindle 2. Instead of having to use the scroll wheel to select links to jump between different articles, I can move the joystick to the left or right anywhere on the page to jump between stories. Likewise, a single click takes me to the section list.

Browsing Web sites also is better on the Kindle 2. The combination of better graphics and a faster processor makes the experience tolerable. It still could be improved, sure, but it is a definite step up from the original. Web pages appear quicker and are much easier to navigate.

On the entertainment front, the *Find the mines!* (aka *Minesweeper*) game (that you can get to by pressing Alt-Shift-M) works much better on the Kindle 2. For one thing, it's actually playable, which I consider to be a requirement for games. The game works so well, I wish there were more games. *Hangman*, *Scrabble* or some other word game would be nice, for example.

Another improvement is that you now can attach notes to individual words, thanks to the five-way joystick controller. The original Kindle let you attach notes only to individual lines of text. Of course, that being said, there aren't many instances where I have wanted multiple discrete notes per line, but just in case I do, the feature is there. Unfortunately, although the original Kindle can see the multiple notes per line that I made on the Kindle 2, it can't select or edit them properly.

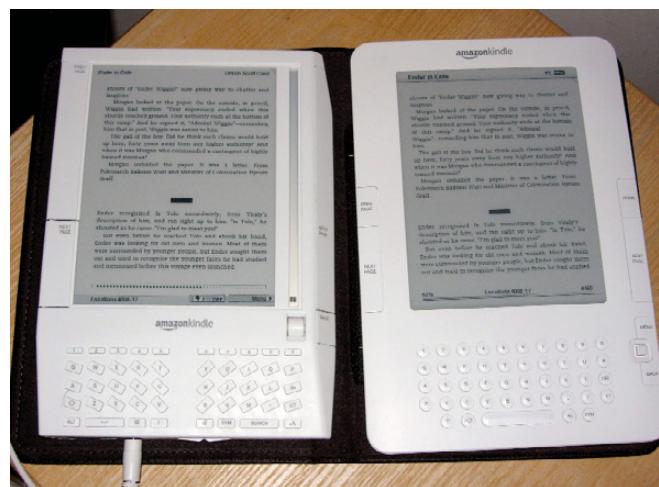


Figure 2. The screen size has stayed the same between the two versions of the Kindle.

Things the Kindle 2 Does Differently

The power and USB ports have been combined on the Kindle 2. The included power adapter is really just a standard USB-A to micro USB-B cable with a wall adapter. The use of a micro USB end instead of the more common mini USB that the original Kindle used is a disappointment, because I can't use the same cable to connect both Kindles to my computer. A lot of manufacturers are moving to micro USB, because although the width of the plug is the same compared to mini USB, it has about half the height, which makes it easier to incorporate into thinner devices. Two years from now, I'll probably have lots of micro USB cables, because most devices will have moved to it, and it



Figure 3. The Kindle 2 plug (bottom) is much smaller than the plug for the original Kindle.

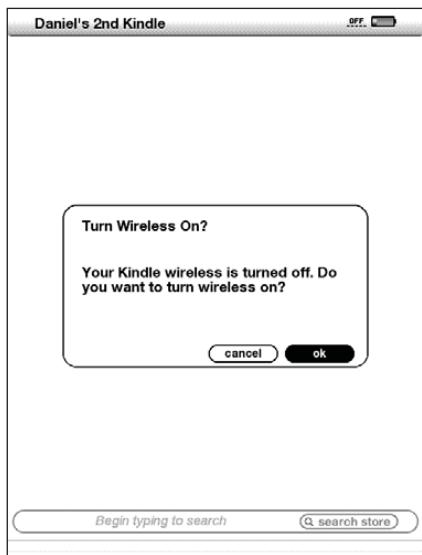


Figure 4. There is no physical switch to turn the wireless on and off, so the Kindle offers to turn it on for you if you try to do something that requires it.

won't be a big deal. Right now, the cable that came with the Kindle 2 is my only micro USB cable, so I need to keep an eye on it. At least Amazon did not do something stupid and create its own custom connector. I also hope more manufacturers take Amazon's lead and combine both the data and power cables. Fewer cables is good, and the more devices I can charge with the exact same cable, the happier I'll be.

There is no longer a physical button

for turning the Kindle's wireless on and off. This has both good and bad sides to it. For one, if you attempt to do something that needs the wireless, the Kindle 2 offers to turn the wireless on for you. On the other hand, it takes more effort to turn the wireless off now that it is not a physical switch. It takes only a couple clicks from anywhere in the Kindle 2 interface, so it's not a big deal. And, with the longer battery life, I don't need to stress as much about

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leaving the wireless on like I did with the original Kindle.

Things the Kindle 2 Does Not Do Better

Despite all the nifty new features, the original Kindle did a few things better than the Kindle 2. For one, no cover is included. Instead, you are forced to purchase one. I say forced, because with a device this expensive and fragile, going out without a cover is *not* a good idea. The original Kindle's cover was not anything to be proud of, but it was included with every Kindle, and it worked well enough, most of the time. I happily admit that the covers are much better this time around. They snap securely into the left side of the Kindle 2, and I'm not worried about the Kindle 2 falling out of the cover like I was with the original Kindle.



Figure 5. The Kindle 2's covers are nice, but they are no longer included. You have to purchase them separately.



Figure 6. The way the Kindle 2 attaches to the covers is more secure than it was with the original Kindle.

Another thing the original Kindle did better was contrast. The contrast between the gray-ish background and the text is just not as good as on the original Kindle. It's hard to notice unless you have them side by side, but if you

do, it's instantly recognizable. The text on my original Kindle is sharper, darker and easier to read than the text on my Kindle 2. If there was one thing I wish they would have kept from the original, the screen is it. I would happily go back to four shades of gray if it means better contrast. I use the Kindle for reading, not looking at gray-scale pictures, and why Amazon thought that improving picture quality was more important than text legibility is a mystery to me.

There also are a few things the original Kindle had that the Kindle 2 does not. For one, the Kindle 2 does not have a removable battery. This seems to be a trend among consumer electronics manufacturers these days. It's a trend I do not like. Maybe it was necessary to get the desired thinness and battery life, but I still would prefer a removable battery. If the battery dies on my Kindle 2, I likely will have to send it in to Amazon to be fixed. On my original Kindle, I can replace the battery myself and even carry around spares.

Another thing that got axed this time around is the SD card slot. The internal memory of the Kindle has been beefed up to 2GB, but that's no excuse in my opinion. Using SD cards was one of the ways I used to organize my growing collection of ebooks. On the Kindle 2, I can carry them all with me, but I have to page through screen after screen to get to a particular book. Since they have removed removable storage,

Amazon really needs to update the Kindle software to allow for some sort of organizational hierarchy, manual or otherwise—folders, tags, genres, whatever. Right now, things can be displayed alphabetically (by title or author), or by how new they are. That's a poor way to organize things if you have 100+ ebooks on your Kindle.

New Things the Kindle 2 Can Do

So, the question you probably are asking is "What's new?" The answer is, not a lot. There are a pair of major new features. The first of these is Text-To-Speech (TTS). Personal computers have had TTS of varying quality for decades. I remember toying around with a rather primitive TTS system for Apple IIe computers back in the early 1980s, and then there was the Macintosh that famously introduced itself using TTS, so it's not surprising that TTS has found its way to handheld devices like the Kindle. I have found it to be a useful feature.

The TTS system on the Kindle 2 is powered by RealSpeak Solo from Nuance Communications. The quality is good, and great strides have been made in the past few years with regard to making computer-generated male and female voices sound more natural. It is not a replacement for an audio book, but it does come in handy for times when I can't look at the Kindle but still want to continue reading. While driving is the obvious time when it would be bad to read the Kindle. I also have used the TTS when cooking and exercising.

The Kindle 2 can read text at three speeds. The middle setting works the best for me, but if I want to cruise through several newspaper articles quickly, the fast setting does a good job. As far as the voices go, I personally prefer the male voice. The female voice sounds more robotic to me, but I'm sure others will feel the same way about the male voice.

For all of its benefits, the TTS feature of the Kindle has not been without controversy. As soon as it was announced, the Author's Guild cried foul and claimed that TTS violated authors' copyrights on recorded performances of their work. The legal validity of this claim is debatable, but Amazon quickly moved to settle with the Guild by changing

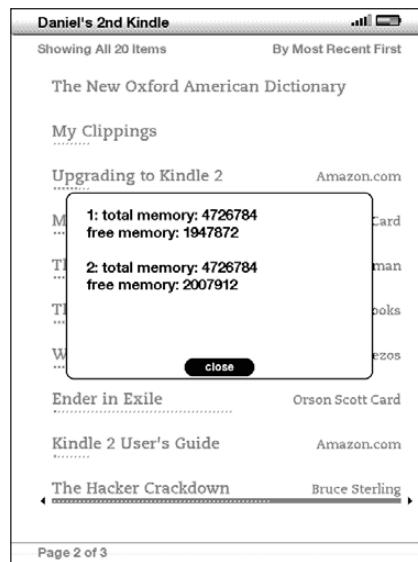
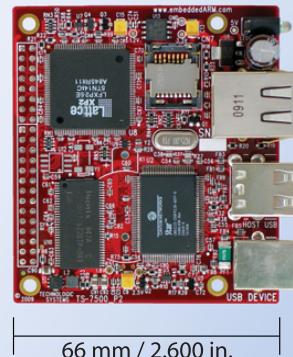


Figure 7. The meminfo screen shows current memory usage.

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TTS through a firmware update so TTS could be turned off at the discretion of the rights holders.

In honor of the 15th anniversary of *Linux Journal*, I had the Kindle 2 "read" the Linus Torvalds interview from the very first issue. It's not perfect, and it's unintentionally funny in places, but it does a good job overall. The .ogg file I captured is available at www.linuxjournal.com/site_files/

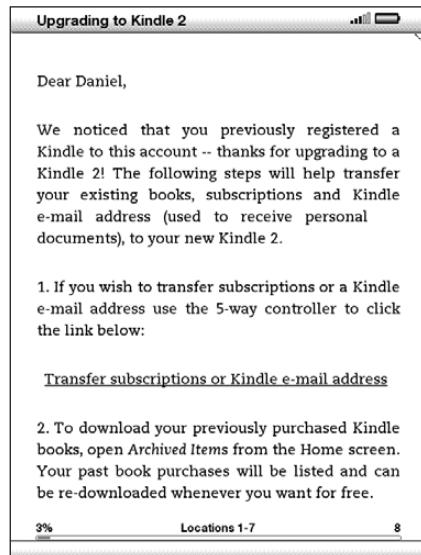


Figure 8. The Kindle 2 includes a helpful and personalized letter to walk you through downloading your files.

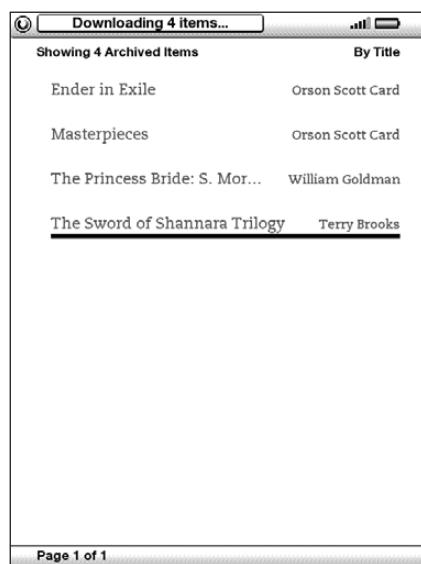


Figure 9. If you have an original Kindle, you will be prompted to download your previously purchased items.

[video/interview_with_linus.ogg](#) if you want to listen to it.

The second major new feature is synchronization of your page position, bookmarks and notes between devices. Now that there are multiple versions of the Kindle out there, and a Kindle iPhone application, it's a safe bet that people will read their Amazon ebooks on two or more different devices. When I first turned on the Kindle 2, part of the getting started process had me go to the Archived Items section of the Kindle interface and download the books I had purchased previously for my original Kindle. A week before the Kindle 2 started shipping, Amazon made a firmware update available for the original Kindle that added the synchronization functionality, so when I opened the books on the Kindle 2, they opened to the page I was reading when I last had them open on my original Kindle. All of my notes and bookmarks were there too. This made switching to the new device painless.

The unfortunate thing about all this synchronization goodness is it works only with items purchased from Amazon. Books from other sources cannot be synchronized wirelessly. I wish it weren't this way, but I can see Amazon's reasoning. The cell network access the Kindle uses is not free, after all, but I still don't like the synchronization not working for non-Amazon items.

Hacking the Kindle 2

Like the original Kindle, the Kindle 2 has several hidden features. One of these is the 411 information page. To display it, go to the main screen, choose Settings from the menu to go to the settings page, and then type 411. The 411 page then appears. I would include a screenshot, but the page is filled with things like the Kindle's serial number and other information that should not be made public.

Another thing the Kindle 2 has that the original Kindle had is a debug mode. To get to the mode, bring up the search box and enter ;debugOn, and press the Enter key. Then, bring up the search box again, and enter `help to show the various debug commands that are available. There's no documentation for what the listed commands do. And, if you break your Kindle messing around

My Kindle Wish List

I believe the Kindle 2 is the best ebook reader on the market right now. However, it's not perfect. Here is a list of six things I hope will be part of the Kindle 3:

1. A touchscreen: a device like the Kindle *needs* a touchscreen. When I hand the Kindle to people to try, nine times out of ten, they will try to tap on the screen to select an item. Every review I've read of the Kindle 2 talks about how much better the joystick is than the scroll wheel on the original Kindle. I say a touchscreen would have been better.
2. Folders or tags: there needs to be a folder or tag method for organizing files. Empirical ordering by author, title or date has its place, but for ease and speed of access, a good logical layout works best for me (especially when I create the layout).
3. Slide-out keyboard: the keyboard isn't used much on the Kindle. For the 95%+ of the time when I'm not using the keyboard, I would like it to disappear. Cell phones have had sliding keyboards for years. It shouldn't be too difficult to add one to

the Kindle and free up space for either a bigger screen or a smaller physical size.

4. Real keyboard keys: while I'm on the subject of the Kindle's keyboard, the chiclet keys are terrible. The Kindle 2 has the space—put some decently sized keys there. I realize both this and suggestion #3 will make the Kindle thicker, and I'm okay with that. The Kindle still would be thinner and lighter than nearly every book on the market. Call it the "pro" version and charge a premium. Better still, make the current version the "lite" version (and drop its price by \$100+) and sell the "pro" version for the current price.
5. Microphone: add a microphone to the Kindle 2 and make it possible for me to create voice notes. Let me attach them to specific passages in books just like regular notes.
6. Removable battery: bring back the removable battery. Don't get me wrong, I love the extended battery life, I just don't like that the battery is now not removable.

with them, Amazon probably will consider you to have broken your warranty.

That said, one hacker found that the `usbQa` and `usbNetwork` commands enabled him to tether his Kindle 2 to his computer. It's not the kind of tethering where the computer was getting its Internet access from the Kindle 2 (like what you might do with mobile phone tethering). Instead, the Kindle 2 was

able to connect to the Internet using the network connection of the computer. This is not terribly useful, but it's there if you want to experiment.

The Kindle 2 runs Linux, and a lot of the software it uses is licensed under the GPL or the BSD license. Some of the more interesting pieces of software include syslog-ng, u-boot, monit, lrzsz, iptables, gstreamer, BusyBox, dosfstools,

e2fsprogs, ALSA, mtd-tools, bzip2, libpcap, ncurses, ppp and strace. The presence of BusyBox in particular suggests that a command-line environment of some kind should be available—if BusyBox had the right features enabled when Amazon compiled it, which it didn't. One hacker discovered that statically compiled Linux ARM binaries work just fine on the Kindle 2, and he was able

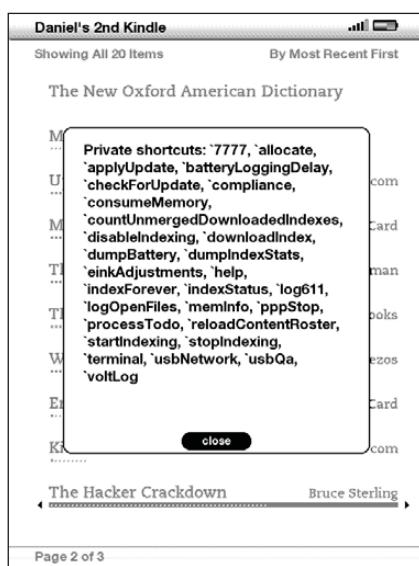


Figure 10. The debug mode 'help' screen—the backticks (`) are required.

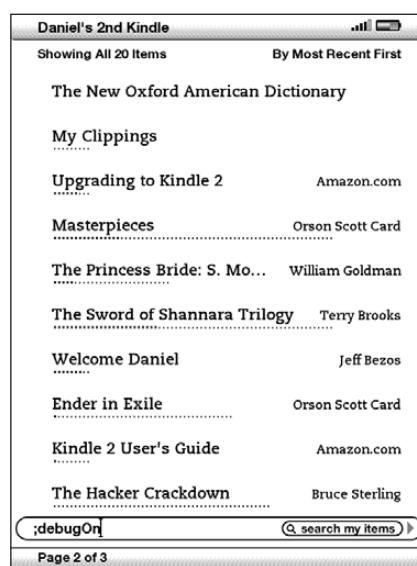


Figure 11. Turning on the hidden debug mode.

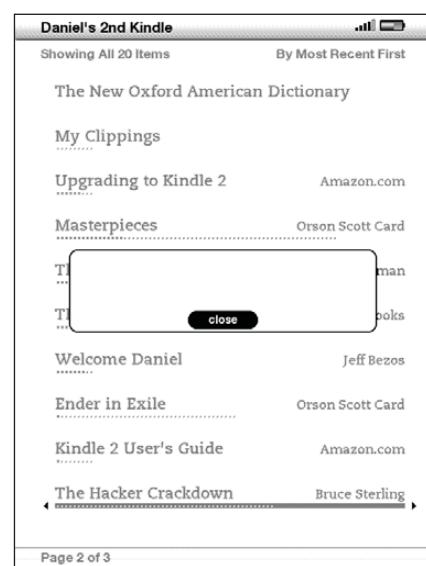


Figure 12. Some of the dialogs that appear when mucking around in Debug mode are less than helpful.

to replace the onboard BusyBox with one he had compiled for the Android platform, which had Telnet enabled. This let him Telnet into his Kindle when it was connected to his local network via the USB tethering trick.

The Kindle 2 is less hackable than the original Kindle (there's no external serial port, for example), but determined individuals have been able to poke and prod at the hardware.

On the software side, there's a cat-and-mouse game currently being played out that looks a lot like what went on a few years back with Apple and its iTunes/iPod DRM. People are posting scripts that help you use encrypted Mobipocket files purchased from other on-line sources, to which Amazon responds by serving DMCA takedown notices. The scripts then surface on different sites hours later. Amazon then changes its DRM, which breaks the scripts. Updated versions of the scripts surface the next day. And, the cycle keeps going.

There is one neat project all of this hacking has enabled that I'd like to mention in closing: Savory. This is software that runs on the Kindle that will convert .pdf and .epub files into Kindle-compatible .mobi files automatically. It also updates the built-in Web browser to accept .pdf and .epub as valid, supported media types. Battery life is impacted with this package installed, but not by much, and the ability to navigate to, download and automatically convert .pdf and .epub documents without having to make a trip to my desktop computer makes it worth it.

Conclusion

So, is the Kindle 2 worth it? Maybe. If you have an original Kindle, it's a tossup. There are a lot of nice improvements, but if the original Kindle is working for you, there really is no compelling reason to make this a must-have upgrade. If, on the other hand, you don't have a Kindle, the reasons and justifications for getting the original Kindle still apply: get one if you love to read and don't like (or can't) carry around all the books you want to read. The Kindle 2 is the best of the current crop of ebook readers, and if you've been wanting to get an electronic reader, you could do a lot worse than the Kindle 2. ■

Daniel Bartholomew lives with his wife and children in North Carolina.

Resources

Instructions on connecting to the Internet from your Kindle, through your computer: blog.fsck.com/2009/03/tethering-your-kindle.html

An unofficial firmware update tool for the Kindle 2: igorsk.blogspot.com/2009/03/kindle-2-tidbits.html

Telnet on the Kindle 2: blog.fsck.com/2009/03/a-productive-evening-so-far.html

DMCA Takedown Notice from Amazon: www.mobiteread.com/forums/showthread.php?t=41929

Savory: a native ebook converter for Kindle 2: blog.fsck.com/2009/04/savory.html

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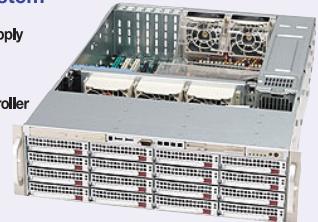
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Indamixx: an On-the-Go Recording Studio?

The Indamixx portable recording studio is built around a Linux multimedia real-time operating system and provides an unprecedented level of software integration and refinement for audio tasks. DAN SAWYER

You've wanted to be a record producer, right? Or, you've wanted to be able to set up and record impromptu interviews and panels at tradeshows and conventions? What if you could do it all, on Linux, with a couple decent mics and a device you can carry in your pocket? Ever imagined being able to produce original content everywhere?

You don't have to imagine anymore. Since November 2008, a little company called Indamixx has been putting out just such a marvel. Built on a Samsung Q1 Ultra chassis, this little handheld does its best to deliver on a very impressive list of marketing promises.

I unwrapped this lovely little toy box and had it virtually glued to my hip for the five weeks I reviewed it. It starts up fast; it works slick; the physical and virtual interfaces are very well put together, functional and fast. It did almost everything I asked of it, and its battery life was impressive on top of it all.

In the course of my review, I edited a half-hour radio drama, recorded a five-person roundtable podcast over Skype, did an extensive amount of blogging, wrote two articles for *Linux Journal*, did a couple photo shoots and composed a couple tunes, and took it round to a club for a shakedown.

The Good

In terms of advertised features, the Q1 was an excellent platform to begin with. Touchscreen-based with three USB ports and a monitor jack, it docks easily at a desk and moves quickly with you. The screen is clear and contrasty



Indamixx/Ardour

enough to do work on its own most of the time, at least for work where you don't need a lot of vertical resolution (the drawback of the ultra-widescreen aspect ratio).

It's very small, light and only marginally more difficult to lug around than an iPod. At first blush, it's a hell of a little gadget.

Appropriate for its intended task, it has a pair of built-in stereo microphones that do proper left/right separation and exhibit a serviceably low noise floor for casual interviews and note taking. I put those microphones to the test in a couple interviews and, even while driving, they exhibited good enough discrimination for transcription. Score one for the Indamixx.

Of course, those are all properties of the hardware layer, which is a commodity device made by Samsung and can be had off the shelf for about \$800. The real genius of this box is that the folks at Trinity Audio who designed it paid a lot of attention to detail in their choice of software packages as well. The Q1 is a pretty anemic hardware platform

from the spec sheet, but Trinity managed to pull out every spare processor cycle from this.

Pro-audio applications in all flavors of Linux—Ardour, energyXT, Rosegarden and so on—all run atop the recursively named Jack Audio Connection Kit (JACK), a real-time server layer that gives pro-audio apps direct, low-latency access to the DSPs and MIDI devices. Digital Audio Workstations (DAWs) built on Linux must play nice with JACK, and "playing nice" can be measured in two ways:

1. How easy is it to get real-time performance out of JACK?
2. How many of the distribution's applications come prebuilt for JACK compatibility?

The answer to #1 should be pretty easy, because a real-time kernel patch is available for most distributions, and if it isn't available for yours, you always can build it. But, it isn't all that easy. The processes your distro runs, the other kernel modules you load and a dozen other things about distro architecture can make the difference between a system that will serve you well and one that will drive you bonkers. Because of this, the various Linux distributions do so with varying degrees of success, from the just-plain-awful vanilla SUSE to the tolerable Ubuntu Studio to the excellent 64 Studio.

As for question #2, there is a similar gradient among distributions for

JACK compatibility with application packages, from the “just about nothing unless you compile it yourself” end to the “almost anything you could want” end of the spectrum.

So, how does the Indamixx’s OS, called Transmission, stack up? Not to put too fine a point on it, but it is hands down the best-engineered Linux distribution I’ve ever laid my eyes on. Trinity took the best-of-breed 64 Studio distro and made it better, getting every program to route through JACK, including such normal recalcitrants as Skype and Flash—and did it all so well that I very rarely encountered any xruns, even when recording while I browsed the Web, and even when hooked up to notoriously slow external USB pro-audio gear.

The Indamixx recognized the aforementioned pro-audio gear without batting an eye—both the mixing surfaces and the A/D converters, and pretty much the only thing I found myself wanting was more USB ports (advice: use a hub with this thing). It played nice with Samba (though not NFS) right out of the box. Its Wi-Fi found signals where both of my laptops have trouble locking on, and even with my stubby fingers, the built-in thumb-keyboard and touchscreen were a breeze to operate.

The power management features also worked without a hitch—from blanking to sleep to hibernation, I encountered none of the problems that portable users commonly encounter on Linux. Add that to the startup time of less than a minute, and you’ve got a device that seems ideal for its advertised ends:

- Recording and mixing.
- Building dance loops and remixes.
- DJing.
- Podcasting.
- Mastering.

The Indamixx’s list of software packages is no less impressive. The selection of programs is deliberate and lean. Everything one needs to accomplish, virtually any audio task,

The Capabilities

I found that the Indamixx can comfortably maintain real time on its internal hard disk while recording four tracks simultaneously or when playing back four with reverb and other complicated effects applied.

as well as some video and other graphics tasks, comes installed and built with a number of performance enhancements: GIMP, Blender, Ardour, a portable version of Firefox, the commercial DAW program energyXT, SHOUTcast and DJ mixing software, hundreds of LADSPA plugins, a properly functioning VST server (another rarity on Linux), the always-handy Skype and a boatload of remix samples and MIDI voices.

The Bad

The Indamixx is advertised as an all-purpose DAW and is heavily marketed to DJs and those who work with live music. That means the people most

likely to buy this device also are those most likely to use it in nightclubs and dive bars.

Such environments are filled with a number of hazards that, frankly, the designers of the Q1 and those who picked it as the Indamixx platform didn’t consider. Those hazards include such things as spilled drinks, smoke, ash and particulates from pyrotechnics, high humidity and high temperatures, high levels of vibration (from speakers) and so on.

In addition, there are ergonomic issues that make working with the Indamixx in a club situation somewhat less than optimal. Simply put, it doesn’t fit anywhere, and it’s easily

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How to Clean Your Gear

So, someone has spilled beer on your gear, or it's gotten so gummed up with tar and gunk that it's not working anymore. What do you do?

First, if the offender is a liquid, cut the power immediately. If the unit has batteries, pop them out. If it's plugged into the mains, pull the plug. The sooner you do this, the more likely you are to save the unit. Once this is done, you can proceed on a non-emergency basis.

Second, get yourself some deionized water. It's important that you use completely fresh water that's been filtered by deionization, rather than by any other process. This removes all of the electrical potentiality from the water (as well as the electrolytes), so it's safe to use to clean your gear.

Third, disassemble the equipment and bathe all of the affected parts in the water. Scrub (with a clean, static-free cloth) any tars, residues, sugars or anything else off the gear.

Fourth, seal each piece in a ziplock bag or airtight container with either uncooked rice or (preferably) silica gel to dry. Leave it there for several days.

Finally, reassemble the gear, taking care not to subject it to static discharge.

At this point, so long as you've put everything together properly, your gear should once again be in perfect working order, unless something fried during those first few seconds. This procedure works equally well for mixing boards, amplifiers, laptop computers, hard drives and rack gear.

knocked off the edge of a table. There is no custom mounting hardware available for it, which means its hazard risk is at maximum in a club environment.

Let's face it, the Indamixx is flimsy. Despite its solid feel, the Q1 Ultra is made of thin, brittle plastic—difficult to disassemble and upgrade despite being user-serviceable and easy to break during service. Similarly, its touchscreen is ill-protected and prone to scratching (not to mention breaking if dropped), and there is no custom hard case available for the unit that adequately protects the screen. Worse still, it's a hard-disk-based machine, and the hard disk is neither shock-resistant nor mounted with shock absorbers. This means that, when running, a fall from desk height onto a hard floor has a very good chance of irrecoverably crashing the heads. Given the purposes for which this unit is advertised, it isn't in the least bit moisture- or smoke-resistant. Not all the ports have protectors; there's no sealing grommet at the

seams, and the ventilation holes have no splash screen.

Of course, very few computers of any form factor are hardened against these kinds of hazards, and even fewer at this price point. Because of that, it might seem kind of petty to complain about those things, but the folks at Trinity Audio have advertised this remarkable handheld as being suitable for tasks that it simply can't stand up to long term, and that's not good for anybody.

The Ugly

A couple other minor points about this unit just aren't pretty, and they also have to do with the marketing literature. The Indamixx's sales brochure advertises the ability to record at 96KHz in 32-bit float format, and although this is technically true (that is, the hard disk will keep up with it), it implies that what you get in the box is what you need to do this, and that simply isn't true. The unit comes with no pro-audio interface, nor did it come with a list of

compatible hardware so that someone building a studio around this unit could select an appropriate A/D converter (at the time of this writing, a list of such devices can be found on the Web site, but I have no way of knowing whether the list is included with the product).

The other ugly point is the price. The unit retails for just under \$1,200, which is pretty steep.

The Verdict

I love the Indamixx. I wish I could afford one. I had more fun and got more work done with this little thing than I ever expected. It has, bar none, the best multimedia implementation of Linux I ever have seen—the care that has gone into the software design on this unit is nothing short of astounding.

The problem is, this unit is ill-adapted for the very environments I'd use it in most: bars, nightclubs, restaurants, film sets and other rugged on-the-go situations. It's not robust enough to do the very tasks for which it is otherwise ideal.

Because of that, I can't give it my unconditional recommendation, much as I'd like to. If you have the \$1,200 to spare and need to do a lot of audio work on business trips, planes or at conventions, this is the ideal machine for you. If you're looking for something that'll hold up well in hard-core production situations, you'd be better off buying the \$600 laptop model that Indamixx also sells and spending some of the balance on hardening the machine to make it safe for the environments where you're going to be working. Perhaps dropping some of the spare cash on a good pro-audio interface also would be a good idea. This solution won't give you something quite as portable, but it will give you almost all of the good points of the Indamixx's exquisite portability and software design without being constrained by its profound drawbacks. ■

Dan Sawyer is the founder of ArtisticWhispers Productions (www.artisticwhispers.com), a small audio/video studio in the San Francisco Bay Area. He has been an enthusiastic advocate for free and open-source software since the late 1990s. He currently is podcasting his science-fiction thriller *Antithesis* and his short story anthology *Sculpting God*. He also hosts "The Polyschizmatic Reprobates Hour", a cultural commentary podcast. Author contact information is available at www.jdsawyer.net.

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The Java API to Android's Telephony Stack

Start writing your own Android telephony applications using the Android Java API, and discover the under-the-hood workings of a cellular telephony software stack.

Alexander Siroткин

A large, stylized orange letter 'A' is positioned at the beginning of the article's main text.

*S*a *Linux Journal* reader, you've probably stumbled across Google Android here and there. You've probably read an introductory article or maybe you even downloaded an SDK and coded an application or two. If you haven't, I encourage you to do so, as this article is not an Android overview. I'm not going to talk about the Android architecture and application development; plenty of good articles already exist on those subjects. See this article's Resources for some links to Google video lectures about the Android architecture and Android application basics. However, if you have some basic knowledge of Android and would like to learn a bit about cellular telephony and how it is implemented in Android, this article is for you.

Android is all about applications. Almost every article and discussion on this subject revolves around the SDK, the Dalvik Java VM and the Android Market. In fact, it is quite difficult to find an Android article that doesn't mention applications. With all this hype, it's easy to forget that the Google phone is, after all, a phone, which (surprise, surprise) is supposed to make phone calls. So, this article takes a different route and instead of focusing on applications, it focuses on Android telephony—from the application API down to the cellular baseband hardware. This part of Android is not very well documented, but fortunately, Google has released most of the code under the Apache open-source license.

Before I start talking about APIs, daemons and all the really interesting stuff, it's worth mentioning that although it seems like Android has all the hype, at least as far as Linux-based mobile phones are concerned, when you look at the facts, you will discover that actual Android adoption is far more modest than what Google would like you to believe. Currently, only one company (HTC) manufactures Android-based phones, and it has two variants sold by T-Mobile. A few other companies (Samsung, for instance) have announced that they are going to launch an Android-based phone some time during 2009. There are actually a few dozen other Linux-based mobile phone models on the market that are based on a competing platform, described in more detail below.

Mobile Phone Hardware Architecture

Before going into software, it is important to understand the underlying cellular telephony hardware architecture. Unfortunately, there are no standards in this area, and every model from every company may look completely different. Still, there are some common ideas and industry trends in cellular reference designs; a block diagram of cellular phone basics is shown in Figure 1.

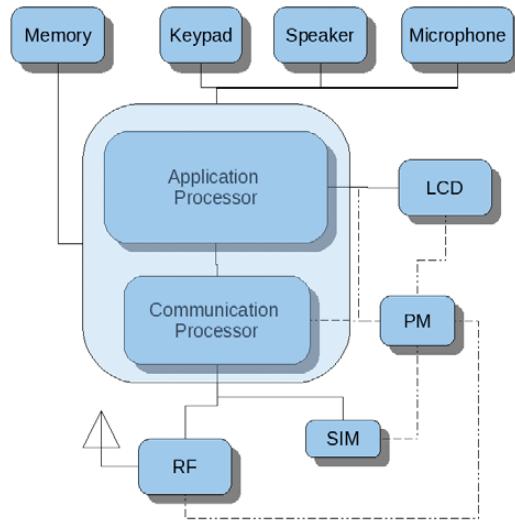


Figure 1. Simplified Cellular Phone Hardware Block Diagram

Figure 1 omits many crucial hardware components that have nothing to do with software architecture and, therefore, are not very relevant in the context of this article—after all, the goal here is to understand the telephony software stack.

Sometimes the application and communication (or baseband) processors are, indeed, different chips. However, more often than not, both CPUs reside on the same die or at least the same package. This is the case with the HTC/T-Mobile G1, which is based on a Qualcomm MSM7201A multicore CPU and includes an application processor (ARM11), a communication processor (ARM9) and some other cores, including a GPS. Sometimes a single CPU is used for both application and baseband tasks, usually in simple low-end phones. The distinction between application and communication processors is especially important in the context of software: when there is only one core used for both application and communication processing, the software stacks are quite different.

The application processor usually controls the screen and keyboard and runs the software stack that interacts with the user, including various applications. It usually runs some generic operating system, such as Linux, Windows Mobile or Symbian. The communication processor runs a cellular protocol stack on top of some RTOS, such as Nucleos or Thredx. Although the application software can be open source in some cases, the cellular protocol stack always is distributed as binary only. The PM chip is responsible for power management, and the RF for conversion of baseband to radio frequencies. Other peripherals, such as the LCD, keypad, speaker and microphone do not need further explanation.

It is important to note that the communication processor is

With all this hype, it's easy to forget that the Google phone is, after all, a phone, which (surprise, surprise) is supposed to make phone calls.

responsible for cellular communications only (both voice and data). Wi-Fi, Bluetooth and other communication protocols are beyond the scope of this article, as they are conceptually different and often better documented.

Google Android

Android is a software stack for mobile phones. It includes a modified version of the Linux OS, middleware (which is the topic of this article) and some applications. The SDK is available free of charge and can be downloaded from the Google Web site. The Android sources also are available and can be fetched from a GIT repository, although some important parts are missing.

Official Android Telephony

As shown in Figure 2, Android consists of a runtime, libraries and application framework modules.

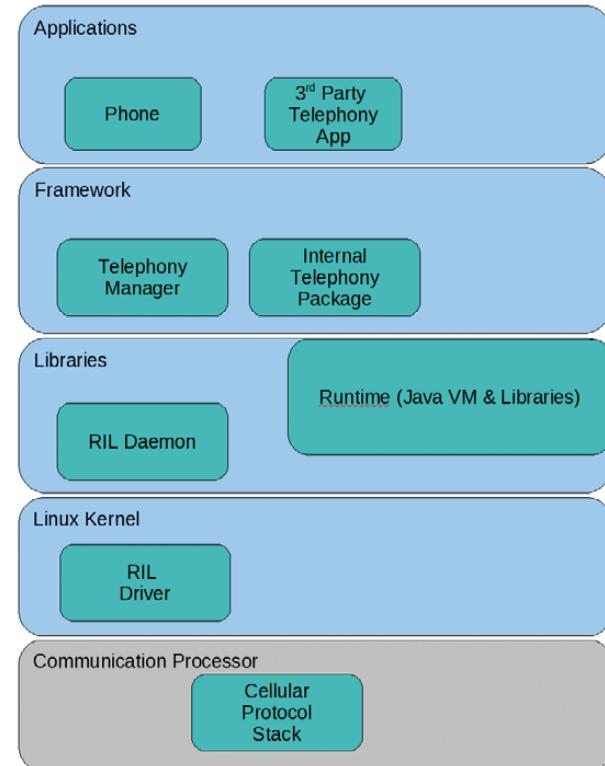


Figure 2. Android Architecture Block Diagram

Figure 2 shows only the modules that implement telephony functionality; for a more detailed diagram, refer to the Google Android overview page.

Telephony manager, which is part of the Android application

GSM AT Commands

AT commands are the most common interface between cellular application and baseband processors, used by the majority of the cellular software stacks, including Android. They are defined in the 3GPP standard 27.007. They can be divided roughly into the following groups:

- Call control commands, such as ATD to dial a number.
- Network service commands, such as AT+CREG for network registration.

- Mobile control, such as AT+CPBR to read a phone book.
- SMS commands, such as AT+CMGS to send an SMS.
- GPRS commands, such as AT+CGDCONT to define PDP context.

Many other commands exist, including some nonstandard vendor-specific commands. For a more detailed description, refer to the latest standards document.

framework, provides a telephony API to user applications. It consists of the android.telephony and android.telephony.gsm Java packages. This official telephony API is fully documented in the Android developer reference guide, so I don't describe it here in detail. It is far more interesting to check what important functionality is not included in this API, which turns out to be quite a lot. The current Telephony Manager API is mostly limited to providing phone and network status information, such as call state (idle, offhook or ringing), network operator name, roaming state and so on. The only parameters you can change are network operator name and selection mode, using the setOperatorName() and setSelectionMode() calls, respectively. And, the only action you can perform is SMS, using sendDataMessage() and sendTextMessage(). This API is rather spartan to say the least, and it lacks many important functions. For instance, it is hard not to notice that all voice-call-related functionality is missing, yet some (platform) applications, such as Phone, manage to implement it.

This API is rather spartan to say the least, and it lacks many important functions.

Not only is this API not sufficient to create any useful telephony applications, it also is rather inconsistent. There is no clear architecture behind the class structure, and it is not obvious how support for other RATs (radio-access technologies) apart from GSM, such as CDMA200 and LTE, will work.

The RIL Telephony

The first thing you discover when you look at the Android telephony API in detail is that it is not fully open. There is a lot of important functionality in the com.android.internal.telephony package. For instance, the Phone application uses this internal API to make/answer a call and access the SIM. This API is not documented. It can and probably will change in the future, and generally, it is not intended for use by applications that are not part of the Android platform—so much for the "All applications are created equal" motto. Fortunately, this API is documented pretty well in the source code of the

Base framework module, which can be found under the frameworks/base/telephony/java/com/android/internal/telephony directory inside the Android sources.

The architecture block diagram shown in Figure 2 implies that privilege—that is, platform telephony applications use the com.android.internal.telephony package, although mortals are stuck with android.telephony.

This internal framework module communicates via UNIX domain sockets with the RIL (Radio Interface Layer) daemon rild, which is written in C as one would expect (not Java). The majority of the telephony functionality of the RIL daemon is implemented in the RIL library. Both the RIL daemon and the library sources, along with a reference RIL driver, can be found under the hardware/ril directory. The RIL daemon communicates using AT commands with either the RIL kernel driver (via the read/write interface when it is running on real hardware) or with the SDK emulator (via the socket interface). The RIL kernel driver is probably just a dumb pipe that forwards AT commands to the baseband processor via the appropriate hardware interface. Unfortunately, this part of Android telephony is neither documented nor open source. There is only a so-called reference RIL implementation in the hardware/ril/reference-ril directory. So, one has to guess what exactly goes on down there on real hardware. The reason this part is not open source is probably the same reason as the one that prevents some companies from releasing Wi-Fi firmware—regulations in many countries do not allow for manufacturers to provide direct access to radio hardware to end users.

Going back to the internal telephony API of the com.android.internal.telephony package that platform applications such as Phone use, you will find that the most important methods are in the Phone and SimCard interfaces as well as the Call and Connection abstract classes. The source code below shows some of the most important methods.

The Phone interface has methods that are used to place, accept or reject a call:

```
public interface Phone {  
    Connection dial(String dialString) throws CallStateException;  
    void acceptCall() throws CallStateException;  
    void rejectCall() throws CallStateException;  
    void setMute(boolean muted);
```

```

void startDtmf(char c);
void sendDtmf(char c);
void stopDtmf();
...
}

```

A Call object is created when you answer a call, and the Call class methods implement call-related functionality allowing you to, among other things, hang up:

```

public abstract class Call {
    public abstract void hangup() throws CallStateException;
    public boolean isRingng();
    public abstract boolean isIncoming();
    ...
}

```

The Connection class is related to the Call class shown above. A Call can have a number of associated Connection classes accessible via the getConnections() method, while the Connection class has a reference to the corresponding Call, returned by the getCall() method). To be honest, I didn't manage to understand from the Android source code when and why there would be multiple connections in one call. Some telephony routines work with the Call class—for instance, those used to answer the call. Others work with the Connection class—for instance, it is returned by the dial() method of the Phone class. As you can see from the list of important Connection methods, their functionality is similar:

```

public abstract class Connection {
    public abstract void hangup() throws CallStateException;
    public boolean isRingng();
    public abstract boolean isIncoming();
    ...
}

```

Finally, the SimCard interface provides an access to a SIM card via methods that allow users to supply a PIN (Personal Identification Number) and a PUK (Personal Unblocking Key), which is used to unblock the PIN:

```

public interface SimCard {
    void supplyPin(String pin, Message onComplete);
    void supplyPuk(String puk, String newPin, Message onComplete);
    void supplyPin2(String pin2, Message onComplete);
    void supplyPuk2(String puk2, String newPin2, Message onComplete);
    State getState();
    ...
}

```

The SIM state, returned by the getState() method, can be either ready, PIN/PUK required or network locked.

If you are interested in the Phone interface implementation, you should check the PhoneBase class that implements some of its methods. The rest, which are RAT-dependent, can be found in GSMPHONE, which extends the PhoneBase class and is part of the com.android.internal.telephony.gsm package. The SimCard interface and the GsmSimCard class, as well as Call and GSMCall, follow the same approach. GSM



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FEATURE The Java API to Android's Telephony Stack

currently is the only RAT supported by the Android platform, but Qualcomm has announced that it is working on CDMA2000 support. More technologies, such as LTE (Long Term Evolution), may be supported in the future.

Another important class is `TelephonyIntents`, which defines intents—that is, events (in Android parlance) that the telephony framework can produce:

- `ACTION_SERVICE_STATE_CHANGED`: the phone service state has changed.
- `ACTION_SIGNAL_STRENGTH_CHANGED`: the phone's signal strength has changed.
- `ACTION_ANY_DATA_CONNECTION_STATE_CHANGED`: the data connection state has changed for any one of the phone's mobile data connections.
- `ACTION_DATA_CONNECTION_FAILED`: an attempt to establish a data connection has failed.
- `ACTION_SIM_STATE_CHANGED`: the SIM card state has changed.

The Phone application (in the `PhoneUtils` class of the `com.android.phone` package) uses these methods to place or answer a call in the following way:

```
public class PhoneUtils {  
    ...  
    static boolean answerCall(Phone phone) {  
        ...  
        Call call = phone.getRingingCall();  
        phone.acceptCall();  
        ...  
    }  
    ...  
}  
  
static int placeCall(Phone phone, String number, Uri contactRef) {  
    ...  
    Connection cn = phone.dial(number);  
    ...  
}
```

The above code sample demonstrates only the most basic telephony functionality; however, along with the API outlined above, it should give you a good starting point for writing Android telephony applications. If you decide to do so, you probably won't be able to avoid having to dig in to the Android sources for more details. I hope having a bit more of an in-depth understanding of how cellular telephony works under the hood of the high-level Java API will help you in this endeavour.

Note that this article is based on the Android 1.1 SDK r1 and the Android main git branch snapshot taken on March 24, 2009. Because Android is being developed constantly, some of the APIs mentioned in this article may have changed since that date.

LiMo Foundation

The LiMo Foundation is an industry consortium that defines an open, Linux-based software platform for mobile phones. So

far, this sounds very much like Google Android, but when you look closer, you discover many important differences. First, LiMo is a consortium of many companies, while Android is a pure Google affair. Among LiMo's members are cellular operators, mobile phone manufacturers, semiconductor companies and software vendors—pretty much the whole mobile industry. Member companies include NEC, NTT DOCOMO, Samsung, Vodafone, Motorola and many other large telecom companies.

Google and the Android Open Handset Alliance (OHA), on the other hand, are newcomers in this market, and they will have to persuade handset manufacturers to adopt their platform, which, in some cases, means ditching their own platform in favor of another one. The LiMo Foundation was created long before OHA, which explains why there are dozens of LiMo-based phones on the market, compared with only two Android ones. Note, however, that the OHA members list is impressive as well, and it continues to grow; many companies are members of both LiMo and OHA.

Another important difference is that the LiMo Foundation does not provide an SDK. As a consortium, it is responsible for specifications only, and it defines a very clear and comprehensive specification of all the components of the LiMo platform, including a full telephony API both for applications and cellular modem vendors, which is once again something that Google Android lacks. The API was defined by companies having significant experience in this field, and it is not surprising that it includes all the telephony features one would expect, such as support for dialing/call answering, SMS, network selection, SIM access and more. It is up to LiMo's member software companies to produce LiMo-compliant SDKs. None are available at the time

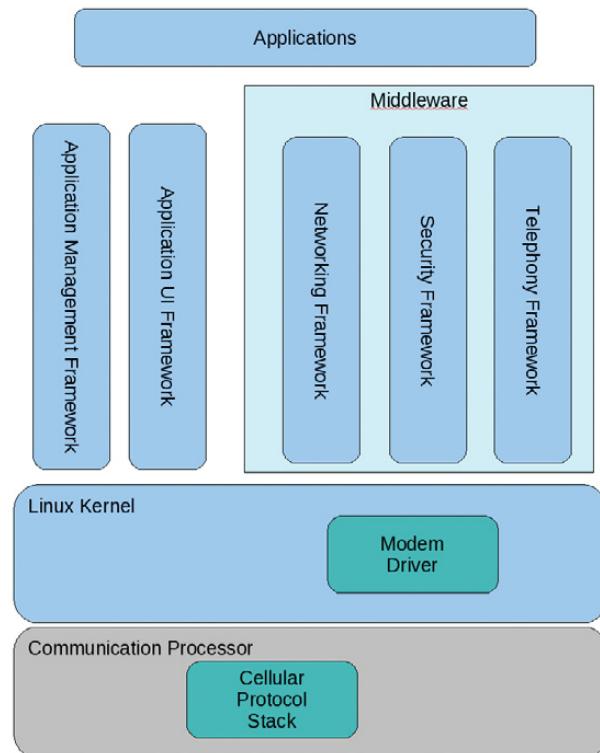


Figure 3. LiMo Architecture Block Diagram

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of this writing, but a few companies made announcements during MWC09 (Mobile World Congress), and we should expect the first versions some time during 2009.

The LiMo platform architecture shown in Figure 3 consists of an application manager and User Interface (UI) frameworks, and middleware running on top of the Linux kernel which provides access to all hardware peripherals, including cellular modem and device drivers.

Contrary to Android, applications are written in C/C++ instead of Java, and the UI is based on GTK+. The LiMo platform provides applications with all the services that one would expect from a mobile phone software stack, such as UI, application management, telephony, networking and messaging, IPC, multimedia, database, security and more.

For more details about the LiMo architecture and API, check the relevant whitepapers on the LiMo Web site.

Even though LiMo currently dominates the Linux-based phone market, Google Android has created a huge momentum that may change this situation. It also is possible that, in the end, each software stack will be used in its own niche: Android in the high-end smartphones and LiMo in more conventional devices. ■

Alexander (Sasha) Sirotkin has more than ten years' experience in software, operating systems and networking. He currently works on the LTE (Long Term Evolution) Project at Comsys Mobile and lives with his wife and kid in Tel-Aviv, Israel. Alexander can be reached via e-mail at [sasha.sirotkin \[AT\] gmail.com](mailto:sasha.sirotkin@comsysmobile.com).

Resources

Short Android Architecture Overview: developer.android.com/guide/basics/what-is-android.html

An Introduction to Android: sites.google.com/site/io/an-introduction-to-android

Anatomy and Physiology of an Android: sites.google.com/site/io/anatomy--physiology-of-an-android

Inside the Android Application Framework: sites.google.com/site/io/inside-the-android-application-framework

Android SDK: developer.android.com/sdk/1.1_r1/index.html

Android Source: source.android.com/download

Open Handset Alliance: www.openhandsetalliance.com

LiMo Foundation: www.limofoundation.org

LiMo API: www.limofoundation.org/en/technical-documents.html

3GPP Standards: www.3gpp.org

GSM AT Commands: www.3gpp.org/ftp/Specs/html-info/27007.htm

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GENSTOR SYSTEMS, INC. www.genstor.com	67	SynSeer fosshealth.eventbrite.com	35, 79
HACKER HALTED USA www.eccouncil.org	43	TECHNologic SYSTEMS www.embeddedx86.com	53
KING STAR COMPUTER, INC. www.kingstarusa.com	55, 71	USENIX SECURITY SYMPOSIUM www.usenix.org/events/usenix07	31
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HACKING Your Portable Linux Server

TURN A WESTERN DIGITAL MYBOOK II INTO A PERSONALIZED, PORTABLE LINUX SERVER.

In the past few months, a small community has been budding around the Western Digital MyBook II, a popular paperback-sized external hard drive. It quickly was discovered that the Ethernet-capable version was powered by an embedded Linux system, and a word-of-Web process started to break its security to gain SSH access, install additional services, tune functionality and more. It resembles the phenomenon spawned by the hacking-friendly Linksys WRT54G, albeit on a smaller scale.

Thrilled by what I was seeing, I started to consider building a small appliance of my own, and Western Digital's sudden revamping of its product line brought the eBay prices of older models below the \$100 mark, which converged nicely with my manager's request for a daily backup scheme enabling downtimes of less than a day should the worst happen to my laptop.

So, off I went, intent on hacking out my own Linux-based NAS. I acquired two units: the smaller, single-drive 500GB model (less than \$100 on eBay at the time of this writing) and a larger, RAID-capable, twin-drive model spanning one terabyte (\$300 for a used unit). Given the ever-falling prices of hardware and the expanding product offering, you should be able to purchase these at lower prices or with larger capacities. It also is worth noting that nothing prevents carefully opening up the device's innards and replacing the enclosed SATA drives with larger-capacity ones. One final bit of shopping advice: the drives addressed in this article are Ethernet-capable World Edition models, all of which have entirely white cases.

FEDERICO LUCIFREDI

THE HARDWARE

Upon first inspection, the device resembles a small book, with a perforated, Morse-code patterned edge that enables venting—if you actually decode the message, you will find a few words and a couple typos in it. The unit is rather silent and generates no more noise than the average hard drive. The front of the device sports two concentric LED rings, circling a single button used to power on and off the device. In addition to showing the on/off state of the device, the LEDs also are used to visualize disk activity as well as to provide a stylish disk capacity gauge (Figure 1).



Figure 1. The Single-Drive Device Lurking on the Author's Desk

On the inside are one or two 500GB 7,200 RPM SATA drives and a small board housing an Oxford Semiconductor OXE800 ARM CPU with an ARM926EJ-S core, a 32MB Hynix RAM chip and the Via Cicada Simpliphy vt6122 Gigabit Ethernet chipset. The device also includes an externally accessible USB port to supplement the RJ-45 Ethernet connector, and it supports AES-128 encryption in-hardware. Despite its limited RAM capacity, Linux's conservative use of resources puts little bounds on the uses the device reasonably can be put to by your creativity. Do not plan to saturate the Gigabit Ethernet link, however, because the CPU will not carry you much beyond 5MB/sec—a limitation that does not affect single-user backup or applications involving several users.

The drives are ext-3 formatted in the World Edition series, as NAS access shields the predominant Windows and Macintosh user population from the actual filesystem choice—



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a detail that is exceedingly convenient, as it allows you to pull drives from the device and mount them in any Linux host for recovery should the support board ever fail.

FIRST PACKETS

Initially, you need to boot in the "World of Warcraft" partition of your system—the one running one of those proprietary operating systems—and install the Western Digital MioNet Access tools. You will need these only for the initial step—to find out what IP address your as-of-yet uncommunicative device has received from DHCP; you will not need the WD tools afterward. If you have a network sniffer set up, it may be faster for you simply to catch the DHCP assignment as it happens and save the time of registration and download. You also can check your DHCP server tables, if you have access to them, or simply read the data off the mounted Windows share that will be set up once you install the tools. Either way, once you are in possession of the IP address the device is using, you will point a Web browser to it and configure the settings that the Web interface exposes. You will be asked to provide authentication, which will match the credentials you created during the WD setup process, or, if you used a more exotic process, it will use the system defaults ("admin", with a password of "123456").

The device's built-in WD Shared Storage Manager (Figure 2) is a very lightweight and useful application, which you will leave enabled, even in this Linux-centric setup, as a convenient way to create users and carry out the most common configuration tasks. I recommend you take the time to configure most settings exposed here as part of your initial customization, as the convenience simply cannot be outdone. At a minimum, you should iterate over the General Setup section and configure your device name and workgroup (these configure Samba), date and time, and review your network settings. As preparation for the next step, you need to create a user (File Sharing→User Management) that you will use to log in at the console, as access via your existing Web administrator account will not be permitted.



Figure 2. The built-in Web interface provides easy access to basic Samba configuration.

One more change you should consider at this point is whether to set up RAID. The device supports two modes of operation: data striping (RAID 0), which has performance

advantages and offers the total capacity of both drives combined, and data mirroring (RAID 1), which provides the storage capacity of only one of the drives but protects you by creating two fully redundant copies of your data. The default setting (Drive Management→Change Drive Type) is data striping—should you want to change it, this is the time to do it. Once a RAID rebuild is started, all data on the shared, nonsystem part of the drive will be lost. More important, although the drive shares will become writable in a few minutes while the rebuild is still underway, wait until it has completed entirely as you will need to tinker with the device's firmware upgrade path next (and triggering reboots while the RAID array is rebuilding is a surefire way to tempt fate into bricking your device). Just let it run overnight and come back to it the next morning. You can see whether the rebuild has completed by checking the drive status in the Shared Storage Manager; it will switch back from synchronizing to OK.

VOIDING WARRANTIES

To start unlocking the multifaceted abilities of this wonderful device, you first need to obtain console access. To be clear, this voids the device's warranty, as Western Digital obviously is not in the business of supporting Linux servers in all their possible configurations and software options, and that kind of flexibility is precisely what we are after. Bear in mind that although these steps were researched and verified conscientiously, the author and *Linux Journal* accept no liability for rendering your device inoperable as a result of these instructions—proceed at your own risk.

The WD Hacking community was spawned by Martin Hinner's creation of a backdoor process that uses the drive's built-in firmware update process to reset the device's root password, spawn the SSH daemon and generate the SSH host keys. Just like everyone else, let's head to Martin's Web page (see Resources) and follow the instructions found there. In effect, all you have to do is navigate to a URL on your device. The URL includes a GET parameter for the upgrade script to run. The parameter references a script on Martin's site, but this script, rather than performing an upgrade, generates SSH keys, clears the root password and starts the SSH daemon.

Once the "upgrade" is initiated, you will not receive feedback on the Web page that it has completed, and you probably should not do anything to your device in this interval, lest you rouse those bricking fairies. Simply wait three minutes, then start attempting to log in via SSH with the user (not administrator and not root) account you created earlier in the Shared Storage Manager. As soon as you see the SSH daemon respond with a login prompt, you will know the break-in succeeded. If you set up your user account correctly, you will be able to log in. If you are having trouble logging in, take care that your user name is spelled in CAPS (`ssh USER@ipaddress`), as you will note that the user management Web interface creates all accounts in that fashion. One more troubleshooting tip: the latest firmware revisions actually output a message that the update has failed, although the SSH daemon has, in fact, been spawned successfully and is ready for your connection.

Once successfully logged in to your device, you can escalate your privileges by switching user to root (`su -`) as the superuser password is now blank. You will need to carry out a few tasks—the first one of which is adding the SSH daemon to

the default startup list to ensure that your newly gained access lasts past your next reboot. Head to /etc/inittab, and add the following after the system startup section:

```
# Start a few good daemons
::sysinit:/usr/sbin/sshd
```

After making your changes, make sure they have been written to disk by doing a "sync", and fix a few details of your user account, such as granting yourself a home directory and possibly a lowercase user name. Do all your /etc/passwd and /etc/shadow housekeeping before rebooting to verify that the SSH daemon is now spawning by default and that your user accounts are working as intended.

GRAND TOUR

You're past the most difficult point; now you can proceed to explore the system and tweak it to your heart's content. Unless you plan to use the MioNet service, some recommend switching its daemon off, as it is a Java process that weighs on both CPU and RAM. As the MioNet service enables wide-area file sharing, I elected to turn off the service, but to do so cleanly, in case I decided I needed the functionality after all. Edit /etc/init.d/post_network_start.sh, and comment out line 17 of the script:

```
$SCRIPTS_PATH/crond.sh start
# $SCRIPTS_PATH/mionet.sh start
touch $POST_NETWORK_STARTED_FILE
```

This stops the daemon from being spawned automatically at boot, but if you need its services, you can start it up from the Shared Storage Manager interface (General Setup→WD Anywhere Access) as needed, giving you the best of both worlds.

The system is built around a 2.6.17.14 kernel, with BusyBox centralizing many of the command-line tools. There are no man pages, but the system is an otherwise reasonable minimal Linux instance, including the majority of the common management levers (ps, top, free, ifconfig, wget and so on) as well as a development toolchain with all the trimmings (gcc 3.4.2, gmake and so on), enabling you to build any software that may be missing. The mounts show a good picture of the device:

```
# df -h
Filesystem      Size  Used Avail Use% Mounted on
rootfs          2.8G  277M  2.4G  11% /
/dev/root        2.8G  277M  2.4G  11% /
/dev/md3         950M   19M  884M   3% /var
/dev/md4         455G  199M  455G   1% /shares/internal
```

It also is worth mentioning that on the dual-drive unit, the system partitions are mirrored by default, regardless of the RAID state of the share space:

```
# cat /proc/mdstat
Personalities : [linear] [raid1]
md1 : active raid1 sdb1[1] sda1[0]
      2939776 blocks [2/2] [UU]
```

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```
md2 : active raid1 sdb2[1] sda2[0]
      104320 blocks [2/2] [UU]

md3 : active raid1 sdb3[1] sda3[0]
      987904 blocks [2/2] [UU]

md4 : active linear sdb4[1] sda4[0]
      1945407104 blocks 64k rounding

unused devices: <none>
```

Another important detail is the behavior of the power button: regulated by a small daemon also controlling the LEDs, it will bring the device down performing a proper reboot if pressed for two seconds, or it will cause a soft shutdown if held for four seconds—train yourself to recognize the light schemes by looking at the device when you issue software reboots (the device has a hard reset button on the back were it to become seriously wedged). Besides looking wicked cool, the LED rings visualize both disk activity and available disk space, as well as RAID failures, joining form and function.

NETWORK AND DISCOVERY

If you followed my advice to set the device name and work-group earlier, your hostname is taken care of already. The device boots in DHCP mode by default, which can be altered easily for those who want a tiny, power-conscious but rather homebound server at their disposal. I find the greatest promise of the WDMBII in its easy mobility, however, and that poses the question of how to recognize its location quickly in a new setting—nothing that a good bit of scripting cannot fix.

Besides looking wicked cool, the LED rings visualize both disk activity and available disk space, as well as RAID failures, joining form and function.

The first approach to this is to have the device notify you of its IP address as it boots. I personally leverage instant messaging for these sorts of system notifications and have an “automation” group in my contact list featuring several borg-looking avatars that are authorized to send me all manner of alerts when the situation warrants. The key to this script is the SendXMPP tool (see Resources), which provides the ability to send instant messages with ease from the console. SendXMPP carries a few Perl module dependencies that you need to download from the CPAN archive and build. Retrieve the tarfiles via wget, extract and follow the customary perl Makefile.PL; make; make install procedure as root—the CPAN shell does not seem to work in the strict RAM confines of the WDMBII. After building two or three modules, you will be able to include the following one-line wizardry in /etc/init.d/post_network_start.sh (line 20):

```
# $SCRIPTS_PATH/mionet.sh start
```

```
touch $POST_NETWORK_STARTED_FILE

# Announce IP address of operation to admin
OUT=`ifconfig | grep -A2 "eth0"`;
echo -e "(lander) now operational: \n$OUT" \
| /usr/local/bin/sendxmpp -r lander-notifier \
-f /root/.sendxmpprc lucifred@jabber.org
fi
```

The script parses the current network configuration and sends it with appropriate text wrapping and an XMPP resource (-r) describing the device to one of my notification accounts. The user ID and password are retrieved from /root/.sendxmpprc (-f). Once the script is installed, the device will notify me of its IP address at every bootup in any network where DHCP is enabled and access to the Jabber server in question has not been restricted. The result message is very effective in allowing me to locate the device and possibly even troubleshoot occasional connectivity glitches:

```
(lander) now operational:
eth0      Link encap:Ethernet
          HWaddr 00:90:A9:15:DD:73
          inet addr:164.99.120.96
                    Bcast:164.99.121.255
                    Mask:255.255.254.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
```

This approach will serve most road warriors willing to put up with connecting to IP addresses. But, power users controlling their own domains can do even better. By setting up a dynamic DNS subdomain, one can enable the device to update at boot a fully qualified domain name, valid to the Internet at large. The intricacies of DNS zone configuration are beyond the scope of this article, but the Perl script to leverage a properly configured domain remains relatively simple:

```
# Variables to configure the script's operation
my $hostname = 'ooga';                      # Device hostname
my $domain   = 'dynamic.booga.org.';          # Domain name
my $nameserver = 'ns1.booga.org';             # Primary nameserver
                                              # for your zone
my $keyname  = 'md5Key';                      # Name of the key
my $key      = 'se64bAsE64BASE64BasE64==';    # HMAC-MD5 TSIG key
my $interface = 'eth0';                       # Interface whose IP
                                              # is to be published
```

Refer to the Resources section of this article for a reference to the Web page where the author maintains the script. This more extensive solution makes our briefcase-friendly, quick-booting mini-server a full-fledged participant in the Internet.

ADDING SERVICES

The most obvious workload for our portable server is file-centric: well equipped with SMB support from Samba and NFS support built in to the kernel, as well as the lighttpd Web server and the rsync client, the system is ready to shine in this space. Enterprising users have built HOWTOs describing how to expand further the array of services to FTP and even BitTorrent, but I should not forget to mention that the system

has a healthy complement of essential daemons: ntp, cron and even Apple's mDNS are at your disposal out of the box.

The built-in toolchain enables the compilation of packages natively, but cross-compilation also is a possibility for jobs requiring more RAM than the device has available. It is, however, possible to find prebuilt packages for a number of services, as the device shares the ARM core of many others, its closest cousin being the Gumstix micro-board (check the many Gumstix sites for suitable binaries before starting a large cross-compiled build).

CONCLUSION

The WD Mybook II World Edition is clearly a device warranting the attention of hardware hackers looking for a small, cheap, low-power platform on which to build their projects. Western Digital's wisdom in not stripping the system portion of the device should be recognized in that it has provided us with a wonderful target for our tinkering. Although sporting only 98 BogoMIPS, its hardware has unusual capabilities (hardware AES encryption and native support for Java bytecode among them) that provide further application levers for our appliance-building projects. I introduced here the hardware, its capabilities, how to breach its security and how to enable it with top-class network configuration at bootup on nearly any network. I hope you, the reader, will follow me and others in this exploration of what our imaginations can make of this small hardware wonder. ■

Federico Lucifredi is the maintainer of "man" as well as the Systems Management Product Manager for the OpenSUSE and SUSE Linux Enterprise product lines at Novell. He loves to tinker with old hardware and build contraptions that puzzle his colleagues.

Resources

Enabling SSH Access on MyBook World Edition, by Martin Hinner: martin.hinner.info/mybook/sshaccess.php

How to Set Up My Book World Edition II, by Paul Henman: henman.livejournal.com/1161953.html

SendXMPP: sendxmpp.platon.sk

CPAN (Comprehensive Perl Archive Network): www.cpan.org

Daemon-less Wide-Area DNS Update, by Federico Lucifredi: primates.ximian.com/~flucifredi/dns-update.html

Using SSH and FTP on Western Digital MyBook Word, by Edouard Brière: www.nanalegumene.net/using-ssh-and-ftp-on-western-digital-mybook-world

BiTorrent on Mybook World: done, by Edouard Brière: www.nanalegumene.net/bittorrent-on-mybook-world-done

Binaries for Gumstix Board: www.nslu2-linux.org/wiki/Optware/Gumstix

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THE CONKEROR WEB BROWSER CONQUERS SMALL SCREENS

Small screen? Crummy touchpad? Not a problem for Conkeror.

DAVID A. HARDING

Conkeror is a Web browser with an Emacs-style look, feel and configuration. It uses Firefox's HTML rendering engine and works with most Firefox extensions, but it provides a keyboard-driven interface and makes excellent use of screen space. It's a fitting Web browser for Netbooks with their imprecise touchpads and small screens. Conkeror uses the same free software license as Firefox.

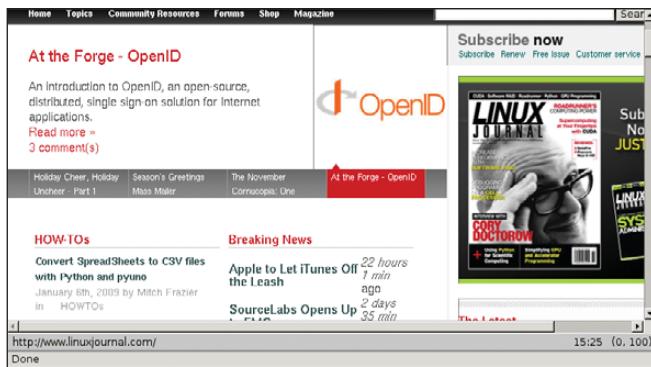


Figure 1. Conkeror Web Browser

Installing Conkeror

Users of Debian Lenny, Debian Sid and Ubuntu Jaunty should install the conkeror and conkeror-spawn-process-helper packages. Users of other distributions should install the XULRunner package (xulrunner-1.9 or xulrunner). If you installed the Firefox package, that package installed XULRunner for you. After you install XULRunner, download a Conkeror snapshot and unpack it into your usual software directory—you don't need to compile anything. See Resources for a link to the Conkeror

snapshot download.

To put the Conkeror launcher in one of your regular executable directories so that you can start Conkeror from a command prompt or application launcher, create a symbolic link from the conkeror/contrib/run-conkeror file to one of your usual executable directories. For example:

```
$ ln -s /usr/local/share/lib/conkeror/contrib/run-conkeror \
/usr/local/bin/conkeror.
```

If your distribution doesn't include Firefox, download XULRunner from Mozilla and unpack it into your usual software directory. Then, download a Conkeror snapshot and unpack it also into your usual software directory. See Resources for links to the downloads.

You must perform an extra step to make the Conkeror launcher work. First, copy the xulrunner-stub file from the XULRunner directory into the Conkeror directory. Then, create a symbolic link from that file to one of your usual executable directories. For example:

```
$ cp /usr/local/share/lib/xulrunner-1.9/xulrunner-stub \
/usr/local/share/lib/conkeror/xulrunner-stub
$ ln -s /usr/local/share/lib/conkeror/xulrunner-stub \
/usr/local/bin/conkeror.
```

Browsing the Web with Conkeror

You don't need to configure Conkeror to get started; simply start the conkeror executable you installed. Conkeror's start page lists which keys perform which actions (keybindings). The first keybinding listed, g, goes to the URL you specify. For example, load the *Linux Journal* home page by pressing g and

typing linuxjournal.com. Follow links by clicking them, as you would do in Firefox, and press B to return to previous pages or F to advance to later pages.

Return to the basic list of keybindings on the start page by pressing C-h i. In Conkeror and Emacs, C- stands for, "hold Ctrl and press the next key". For example, C-h i stands for "hold Ctrl, press h, release Ctrl and h, and press i". Conkeror uses other Emacs keybinding abbreviations also: M- means hold the Meta key (the Alt key on PC keyboards and the Option key on Macintosh keyboards); S- means hold the Shift key. For a complete list of Conkeror keybindings, press C-h b.

Although you can follow links by clicking them, you should learn to follow them using the keyboard to get the most out of Conkeror. To follow a link with the keyboard, press f. Conkeror places a small number next to each link (Figure 2), including link images. Enter a number to follow its link or type letters from the name of the link you want. As you type letters, Conkeror removes the numbers from links that don't match those letters and renames the remaining links. Even on a slow computer, this happens instantly. If only one link matches the letters you entered, Conkeror automatically follows it.



Figure 2. Following Links in Conkeror

For example, let's assume the three link names: foo, bar and baz. Typing f and 3 follows the third link, baz. Typing f and baz also follows the baz link. Typing f and b removes the number next to foo, so that you can press 1 to select bar or 2 to select baz.

As in Firefox, you can start a search within Conkeror. Press g, type "google", type your search term, and press Return to go to the Google result for your search term. Replace "google" with "lucky" to go straight to the first Google result, or replace it with any of the following words to use another search engine: "wikipedia" "sourceforge" or "dictionary". When you search Google, Conkeror asks Google to guess what you're searching for and displays the best matching results in a list. Press Tab to select the top result, use the keyboard arrow keys to select an alternative result, or simply finish typing your search terms and press Enter. This also works for Wikipedia searches.

Using Conkeror's Buffers

Firefox uses tabs to keep separate Web pages in the same browser; Conkeror uses buffers to do the same thing. To open a link in a new buffer, press C-u f and select the link using the

link-following instructions above. For example, say you're back on the page with the foo, bar and baz links. To open baz in a new window, press C-u f and type baz. Press C-u before any command that opens a Web page to load that page in a new buffer. For example, C-u g goes to a URL or loads a search result page in a new buffer, and C-u C-h i loads the start page in a new buffer. Also, links that try to open a new window will be opened in a new buffer.

Return to the previous buffer by pressing M-p (Alt-p on PCs and Option-p on Macs); advance to the next buffer by pressing M-n. Press C-x b to display a list of open buffers (Figure 3). Each buffer in the list has a name—its URL plus its title. Select a buffer name from the list using the keyboard arrow keys or narrow the list by typing part of a buffer's name. Press Enter at any time to show the selected buffer.

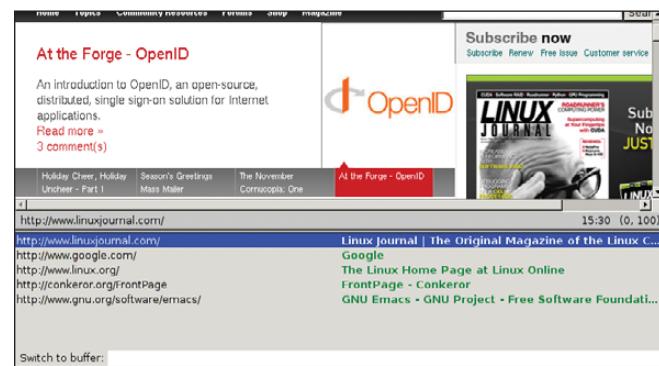


Figure 3. The Buffer List

Close a buffer—in Conkeror's terminology, kill a buffer—by pressing C-x k to display the list of buffers. Select a buffer the same way you did above, and press Enter to kill it. Conkeror selects the current buffer by default, so you can kill it quickly by pressing C-x k <Enter>. When you close the last buffer, Conkeror exits. Close Conkeror and all its buffers automatically by pressing C-x C-c.

Some Other Keybindings

Power users of any Web browser often edit the URL to go to a different part of the Web site they're visiting. Press C-x C-v to edit the current URL in Conkeror. Combine this with C-u to open the modified URL in a new buffer: C-u C-x C-v.

Bookmarking a URL in Conkeror lets you return to it using Tab completion when you change URLs. Press b to bookmark the current URL, choose a name for the bookmark (Conkeror fills in the page title by default), and press Enter. Press g to go to a new URL, type in a few letters from either the bookmark title or the bookmark URL, and press Tab. Conkeror shows you a list of bookmarks that match the letters you typed; use the keyboard arrow keys to select a bookmark and press Enter to go to it.

Sometimes when you try bookmarking a page, Conkeror asks you to choose a frame. It places a number next to each frame on the page and lets you choose a frame by entering its number. If you want to bookmark the URL containing all the frames, enter the number 0.

Access all of Conkeror's commands—even those that aren't bound to a keybinding—by pressing M-x, typing the command

FEATURE The Conkeror Web Browser

name and pressing Enter. Press Tab to complete any command name; for example, press M-x, type print, and press Tab to make Conkeror select the print-buffer command. If you press M-x and Tab without typing anything, Conkeror lists all of its commands. I suggest you review this list to get an idea of everything Conkeror can do.

Conkeror's Modes

Conkeror includes special scripts, called modes, that change its behavior on specific sites—for example, the simple XKCD mode for the xkcd.com comic-strip site. When you visit xkcd.com in Firefox, it displays the comic's title when you move your mouse over the image. When you visit xkcd.com in Conkeror, it activates XKCD mode (Figure 4) and displays the title below the image in a special font—you don't need to move your mouse over the image.



Figure 4. XKCD Mode in Action

The Gmail mode redefines many of Conkeror's default key-bindings so that you can use the default Gmail keybindings. Other modes include a Google Maps mode, a Reddit mode and a YouTube mode.

When you visit a site that has a mode, for example Google Maps, Conkeror loads that site's mode. When you leave the site, Conkeror automatically unloads the mode. You can try using modes on other sites by loading the mode's command through the M-x menu. For example: M-x xkcd-mode. However, most modes don't make sense on alternative sites.

Advanced Configuration, Advanced Features

Firefox has a pretty Preferences configuration screen. Conkeror doesn't. But, you can change any browser setting in Conkeror on the about:config page. Press g, type about:config, and press Enter to go to the page and double-click the settings you want to change. Conkeror shows changed settings in bold. Use the search bar that appears on the top of the page to find specific settings quickly. For example, enter proxy to find all the proxy settings.

Although you can find and change settings easily in about:config, some users prefer a dynamic Emacs-style configuration file. This file can change about:config settings, define keybindings, add new commands, load external modules and define events using JavaScript. You can turn any file into a Conkeror configuration file, but the file must exist before you try using it. For example, add the following line to the file .conkeror.rc to prevent Conkeror from displaying a warning

message before showing the about:config page:

```
user_pref("general.warnOnAboutConfig", false);
```

After creating the configuration file, you must tell Conkeror where to find it. Go to the Conkeror start page by pressing C-h i, scroll to the Conkeror RC File section, and enter the full pathname of the configuration file in the text box. For example, I entered the following text: /home/harding/.conkeror.rc. Press the Set RC File button. You need to do this only once.

Just below the Set RC File button, Conkeror lists several example directives for you to put in your configuration file. For instance, one line tells Conkeror how to use a custom search engine when you press g. You also can add new commands and new keybindings to Conkeror. For more examples, follow the Conkeror Wiki link in the Resources section of this article.

The next section tells you how to use Firefox extensions in Conkeror, but some Firefox extensions don't want to work with a browser that isn't named Firefox. Most Firefox extensions work in Conkeror if you tell the extension you're really using Firefox. I suggest you put the following line in your configuration file to make Conkeror ignore compatibility problems:

```
user_pref("extensions.checkCompatibility", false);
```

Using Firefox Extensions in Conkeror

Most Firefox extensions work in Conkeror, but if you're used to Firefox extensions, installing an extension in Conkeror may feel like a step backward. First, find the extension on the Mozilla Web site (or another Web site), and download it to your computer. (Firefox extension filenames end in .xpi.) Then, press M-x, type extensions, and press Enter to start the extension manager. Choose the Extensions tab, click the Install button, use the file navigator to select the file you downloaded, and click Open. As in Firefox, you must restart Conkeror to load the extension.

Using an External Editor

Conkeror lets you edit HTML text boxes in an external text editor—for example, Emacs (Figure 5). Conkeror copies the text box's contents to a temporary file, opens your text editor on the file and reads the changed file back into the text box when you close your editor. To use this feature, you must compile Conkeror's small helper program, conkeror-spawn-helper. (If you used the instructions above to install the two Conkeror packages in Debian or Ubuntu, you may skip this paragraph.) Go to the Conkeror source directory you installed and run the following command: make. You don't need to run make install, because make compiles the program in the directory Conkeror uses.

Next, you need to tell Conkeror which text editor to use. Conkeror looks for the editor command in the \$EDITOR environmental variable, but if \$EDITOR isn't set, Conkeror starts Emacs. Most distributions let you set the \$EDITOR variable by adding the following line to your ~/.xsession and ~/.xinitrc files:

```
export EDITOR=my_editor
```

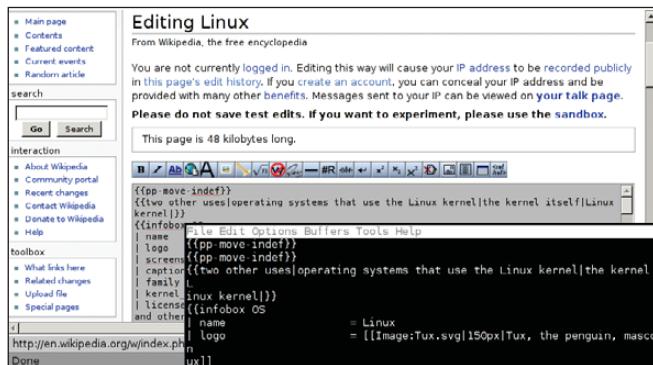


Figure 5. Editing a Wikipedia Article in Conkeror

Replace `my_editor` above with the name of the editor you want to use—for example, for the graphical VIM editor, gvim; the GNOME editor, gedit; or the KDE editor, kate. If you want to use a console editor, prefix the environmental variable's value with the name of a terminal emulator—for example:

```
export EDITOR="xterm -e vim"
```

However, if you use external editors in other programs, you may not want to do everything in a graphical editor. To make Conkeror alone start a specific editor, add the following line to your Conkeror RC file and don't set the \$EDITOR variable:

```
editor_shell_command = "my_editor";
```

After all that configuration, using the external editor should seem simple. Use the Tab key or the mouse to place the input cursor in a text box and press C-i. You can edit small boxes—for example, a box for your name—or large boxes—for example, the edit box in a Wikipedia article. Conkeror grays out the text box while you edit. When you finish editing by closing your text editor, Conkeror restores the original background color.

Documentation

The Conkeror start page links to its built-in tutorial, which you activate by pressing C-h t. The tutorial teaches you how to browse the Web with Conkeror.

Similar to Emacs' help, Conkeror's help can describe its own commands. The C-h f keybinding describes commands, and the C-h k keybinding describes keybindings. For example, to find out what the print-buffer command does, type C-h f and print-buffer. Conkeror will tell you that, “print-buffer is an interactive command in commands.js [to] print the currently loaded page.” Similarly, press C-h k and f, and Conkeror tells you “f is bound to the command follow in bindings/default/content-buffer/element.js.”

For complex problems, Conkeror can help you search its wiki. Press g, and type `conkerorwiki`, and enter your search terms. Conkeror searches its wiki, which includes troubleshooting information and lots of ways to get the most out of Conkeror. Of course, you always can go directly to the Conkeror wiki using the link in Resources.

Conclusion

I hesitated before trying Conkeror the first time. As a longtime vi user, I wasn't interested in anything based on Emacs. But, I did need a Web browser that could make the most of my Netbook's 5"-tall screen and crummy touchpad. Conkeror fit the bill, and I tried it. It impressed me. Although Conkeror may seem complicated in its sophistication, I spent most of my time going to pages, following links and editing text boxes—three things Conkeror makes easy and quick. After I slowly learned to use its other features, I found no reason I shouldn't enjoy the advantages of an advanced keyboard-driven Web browser on my desktop as well.■

David A. Harding lives in New Jersey and works as a freelance technology writer. He has a Linux Professional Institute system administration certification and can often be found organizing local GNU/Linux events.

Resources

Conkeror Home Page and Wiki: conkeror.org

Download Conkeror Snapshot: repo.or.cz/w/conkeror.git?a=snapshot;h=master;sf=tgz

Download Mozilla XULRunner: releases.mozilla.org/pub.mozilla.org/xulrunner/releases/1.9.0.1/runtimes

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2.6 Kernel

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Bug Labs: Hacks and Apps

Use Bug Labs' modular, open-source system for building devices and find out what you can do with a fully integrated device development platform. ALICIA GIBB

You may have read about Bug Labs, the open-source modular gadget company, in Mike Diehl's article in the August 2008 issue of *Linux Journal* (see Resources). We're back to tell you a bit more! In this article, I fill you in on some general information about BUG, including our latest news, and then provide some ideas about what you can do with BUG.

BUG is a modular, open-source system for building devices. Four modules can be snapped into the BUGbase, which has an ARM 1136 MX31 embedded processor. BUG runs a 2.6.27 version of the Linux kernel and a distribution customized from Poky Linux, which is derived from the OpenEmbedded distribution. OpenEmbedded is a distro specifically for embedded systems. It cross-compiles the JVM and other language runtimes. In addition, thousands of other packages (applications, libraries and so on) are available and can be compiled for BUG using the BitBake program.

At BUG, open source doesn't mean only source code, but also flexibility and the power to choose. As Mike Diehl wrote in his previous article, it's easy to ssh into BUG. After logging in, you'll be at the BusyBox shell, and from there, you can get into the filesystem, install and run software, killall and more (though we don't recommend that last one).

We want users to be able to choose the language they prefer, the interface they favor and the modules that accomplish their goals. The modules currently for sale are the BUGview (full-color touchscreen LCD), BUGmotion (motion sensor/accelerometer), BUGlocate (GPS), BUGsound (audio) and BUGvonHippel (our breakout board with serial, general I/Os, I2C, SPI, DAC, ADC and more). BUGvonHippel was named after Dr Eric von Hippel of MIT for his contributions in the Open Source movement and his book called *Democratizing Innovation*.

We want users to be able to choose the language they prefer, the interface they favor and the modules that accomplish their goals.

Coming out in the next few months will be the BUGwifi (which also includes Bluetooth), BUGbee (802.15.4 protocol) and BUG3g GSM (3G), to be followed by the BUGprojector (pico) module. Additional specifications for our current modules are located on our Web site (see Resources).

To connect all these modules and communicate with the kernel, we export I2C, SPI, UART, I2S, camera and display interfaces in our own BMI (Bug Module Interface) wrapper to make the device as flexible as possible. You then can put any

module into any slot (and yes, they're hot-swappable), creating your own open-source gadget or prototyping platform, bottom-up style.

BUGs are also flexible with what language you can use to code. We support Java, C, Python and Ruby on BUG, but you can write in any language you want, so let us know when you've got brainfork working.

Although we encourage other languages, you also should be prepared to dig around for packages or write a few libraries. One of our developers recently wrote a tutorial on our Community Blog (see Resources) for building C/C++ programs on the BUG. This example uses a Python program called BitBake, along with build description files called recipes, to generate executable programs and other artifacts meant for a specific computer architecture. Recipes are the metadata about how a program is built and provide a way for all packages to be deployed consistently. Finally, this allows for the BitBake program to create an image containing the entire operating system.

When installing new packages on BUG, you can use the ipkg program to install from BUG's shell. Ipkg is analogous to yum or apt-get in other Linux distributions and provides a simple way of installing new software on BUG. We maintain a repository of programs for BUG on our Web site (see Resources).

What else can you do with BUG? Technically speaking, you can do anything you want with a BUG; it's a fully programmable embedded computer. We realize that's a little vague. Because BUG is open-source, imagine morphing any handheld device into your own open-source version running on Linux, allowing you more options than its closed-source counterpart.

Another use is the ability to create hardware without having to solder or go through numerous manufacturing headaches. You can use the BUG as a prototyping system to create and re-create solutions to your problems. And, of course, you can create a new device that isn't available from your local Best Buy or Radio Shack.

Our apps page (see Resources) includes Java apps uploaded by our community and the Bug Labs team. Looking through the current applications is the best way to get an idea of what can be done with BUG. Although many of these apps are proof of concept, these examples show off some of BUG's possibilities. Finally, BUG has a growing community of users who have defined new BUG capabilities both within hardware and software. A handful of community members even have created their own modules, made with our schematics and CAD files found on our Resources and Documentation wiki (see Resources).

Each module has a Hello World app as well as many proof-of-concept applications. These are useful for seeing what each module is capable of. For example, BUGmotion can store the data it gets from three different axes (X, Y and Z) and detect motion in various programmable ranges. Simply by using this module with a BUGbase, you could program BUG and toss it into your luggage before a flight to chart the data from each axis as it gets jostled around. Keep in mind the rechargeable battery life is currently three to four hours without AC power.

BUGview is useful, for example, if you'd like to check out a terminal directly on your BUG, although the keyboard is difficult to type on without tiny fingers, so we recommend using a Bluetooth keyboard via the BUGwifi or USB via BUGvonHippel.

You also can program BUGview to act as one large button that can send data to other modules and change color as feedback that the button has been pressed.

BUGlocate can be used to gather data about wherever your BUG is or stowed in your car to monitor your teenager's driving patterns (though that seems a bit Big Brother for us).

BUGsound can play files saved on the SD card. Coupled with the accelerometer, it can make different noises when held in different positions. Search for the Phunk app on our apps page for more details.

BUGwifi opens up many options, from connecting different devices via Bluetooth to sending messages to your Twitter account when motion is sensed.

BUG3g GSM also will broaden the horizons of data transferring capabilities. Data can be sent to or from your phone or other devices. Imagine your doctor writing you a prescription on a BUG and having the data immediately sent to your patient file and your pharmacist—with encryption of course!



Figure 1. Instant root Access in the BUG's Terminal (Photo Credit: Brian Ballantine)

A lot of interesting apps come about due to networking capabilities. BUG comes with its own Web server and allows you to query each module's data by accessing the corresponding Web service. For example, you can connect your BUG to

your network, put `http://10.10.10.10/service/picture` (default IP address of BUG) in your browser, and see a JPEG format picture taken with BUGcam2MP. BUG uses RESTful Web services and HTTP operations to manipulate the resources it provides. Making data available in this way is important as applications rely more and more on different devices communicating.

In addition to using the existing Web services, you can implement your own Web service or Web front end using Java servlets. For example, we recently made a BUGbot—BUG with wheels attached. We created a Web page served from the BUGbot that could control the direction and speed of the device. We then used the BUGbot to drive around the office snapping pictures. The BUGbot was easy to make. We attached a motor shield to the BUGvonHippel module, hooked that up to some wheels, put a tripod on the wheels and a BUG on the tripod. With the Wi-Fi module (BUGwifi) attached, this BUGbot also can upload the captured images to Flickr or Twitter.

Many familiar libraries have been ported to BUG, allowing for the type of functionality you'd expect on any Linux machine. For example, the popular open-source computer vision library OpenCV runs on BUG. OpenCV allows for

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applications to gather and analyze data from images and video streams. With OpenCV, you can use BUG for blob detection and tracking for physical computing applications. OpenCV also enables BUG to do face, figure and motion detection for security applications.

Our sysadmin at BUG got a SIP phone running on his BUG and wrote about the possibilities with IPv6 and BUG on our Community Blog: IPv6 allows for host-to-host communication. Host-to-host can mean BUG-to-BUG, PC-to-BUG, BUG-to-PC, BUG-to-(other device), (other device)-to-BUG, BUG-to-(some Web service) and, of course, (some Web service)-to-BUG. Maybe more. The BUG SIP phone consists of a BUG and the BUGvonHippel module with a headset attached through the USB port on the BUGvonHippel. To have a BUG SIP phone, you'll need a SIP software client, a SIP provider and the open-source Asterisk PBX. With enough network bandwidth, the quality is clear with little to no lag time.

While we're on the topic of data communication, R-OSGi was created by Jan Rellermeyer and Michael Duller, and it stands for Remote OSGi. This application allows servers to connect via remote access transparently. Bundles are able to move through the network as if they were a local service. This application is not only important to BUG, but to the Java community as well. A Bug Labs developer used R-OSGi to create a camera app that could bind to any camera on the local network dynamically. R-OSGi allows this to occur in a general way, so that any application's dependencies can be provided transparently by another R-OSGi-speaking device.

Music server is an application that uses BUGwifi and BUGsound. Music files are stored on the BUG's miniSD card and can be accessed via an IP address. You can point your phone or another computer to the BUG's IP address and choose a song to play from across the room or possibly (configured correctly), across the continent. Integrated audio/MP3 support doesn't exist in phoneME, so it uses madplay, a command-line MP3 player. Songs can be played directly through the audio module connected to speakers or headphones—the audio module contains a line-in, line-out, mic and headphone jack.

Another useful app that was created by a member of our community is the GPSAlarmClock. This app is programmed to make a sound when a destination is reached rather than a certain time. This uses the PositionHelper class with an OSGi service to help with its accuracy. The GPSAlarmClock can be helpful if you have a long train commute or road trip (provided you're not driving).

Chris Wade, an active community member also known as cmw, ported Quake to his BUG. He hacked it together using QuakeSDL. The full instructions are available on his Web site (see Resources), but it's as simple as downloading the binary and extracting it, then executing it. He recently added mx31 support to QEMU, which allows us to run the BUG in a fully virtualized environment. Unfortunately, QuakeSDL doesn't support joysticks, so Wade took matters into his own hands by hacking the guitar from *Guitar Hero* to run as a joystick for Quake. Rumor has it *Ms PacMan* is coming next.

Bug has been learning a lot from the Open Source community, so we understand the importance of giving back to that

community. We give back in a few ways. We're active in the OpenEmbedded community, and our art director even created the new look for the OpenEmbedded Project. Our head of software is an Eclipse contributor, and many of our engineers participate in the Eclipse community. We expose and discuss all of our code (all available in our svn repository), projects and hacks openly in hope that someone else runs across answers to their questions. We open-source all the driver work we do, contribute code to the Concierge OSGi Project and submit defect reports for a number of open-source projects. We also have given back to various Linux project communities, such as the Linux wireless community Libertas. Many of our engineers can be found posting and responding to discussions about FOSS Java on ARM with topics on OpenJDK with Tarrent and the phoneME JVM in Jalimo.

Another way Bug Labs gives back is through our Test Kitchen. This is a small electronics lab located at our office in New York, open to the public from 12pm–7pm, Monday–Friday. Folks are welcome to bring their own projects (whether it involves BUG or not), use the various microcontrollers in the lab or just show up to play with a BUG. We also encourage groups like Make:NYC and other similar groups to use the Test Kitchen for their events. The purpose of an open space for hacking and tinkering is to promote collaboration and creativity, share thoughts and learn from each other. We ask that you schedule a time when planning to come in by sending e-mail to alicia@buglabs.net.

If you have any further questions about BUG, we're on IRC daily at #buglabs on Freenode. Our dev team is ready to help, and our community members probably will chime in with their advice as well. Check back with us often; updates occur regularly.■

Bug Labs Team Member Alicia Gibb is a researcher and rapid prototyper. As Bug Lab's Gadget Wrangler, she administers the Test Kitchen for exploring the innovations available with modular technology components. She recently took a UNIX class where the guy/girl ratio was 2:6. Back up. Reread. Girl Power!

Resources

"The BUG: a Linux-Based Hardware Mashup" by Mike Diehl, *LJ*, August 2008: www.linuxjournal.com/article/10125

Bug Labs: buglabs.net

BUG Community: community.buglabs.net

BUGrepository: repo.buglabs.net

BUG Wiki: buglabs.net/wiki

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The Last Silos Standing

Too many businesses still aren't getting the clues from open code.

DOC SEARLS

For the many years I wrote Linux for Suits and the SuitWatch newsletter, I always insisted that Linux and business were joined by *and* logic rather than *or*.

I still believe that's true. But, I also believe that many businesses—especially the big ones—still don't get Linux, free software, open source or even the Internet itself. That's because they remain, in the immortal words of Walt Whitman, "demented with the mania of owning things".

Oddly, the things they want to own most are not things at all, but customers. These companies still harbor the illusion that customers can be "acquired" like slaves and "managed" like cattle. The nicest ranches for customers are politely called "walled gardens". I prefer an equally agricultural metaphor: silo.

The definition of silo I like best is "a tall cylindrical structure, usually beside a barn, in which fodder is stored". (That's from the *Free Dictionary*.) Fodder, in the case of business, is customer data. That data includes specifics, such as name, address, purchase history and call records. It also might include customers' stated or inferred preferences, status with the company (frequent flyer grades, for example) and other variables.

The crowning irony of business silos is that they are built to maximize BI (Business Intelligence), yet they are blind to how they're not working. This form of inward-gazing ignorance is familiar to techies who have watched many silos come down in the computing and networking fields. Mainframes, closed on-line services and proprietary e-mail systems all come to mind. The Internet and its open protocols killed all those things,

yet the lessons remain lost on every business that continues to believe that good "intelligence" about what customers actually want can be found inside the company's customer data silo.

For evidence I offer three examples: call centers, loyalty cards and mobile phones. All three are shining examples of a form of architecture that has been discredited, if not defeated, by the successes of Linux, FOSS and the Internet.

Look up "call center hell" in Google, and you'll get millions of results. (This morning, 8.65.) Two of the three top search results on Twitter are by people working in call centers. Most of these are "hold centers", because putting callers on hold is what they do best. Conversation is not their forte. If you ever reach a human being at the end of a choice maze, you too often interact with a script rather than a human being. After an accident involving my rental car a couple years ago, the woman at the other end of the line reacted to my anger at her uncooperativeness by admitting that her options were limited, literally, by a script. There were only certain things she was allowed to say or hear. When the conversation stepped outside those lines—as it had to, since the accident was novel in several ways—both of us went nonlinear. The call crashed as badly as the four cars (including one cop car) involved in the pile-up.

Loyalty cards are the silliest thing since Green Stamps. By the middle of the last century, nearly every store gave away green stamps, achieving zero differentiation from every other store and adding friction to the entire economy in the process. Today, instead of collecting stamps and sticking them

in books (to redeem later for a crappy grill or something), we collect cards that fatten our wallets without making us richer. Loyalty cards require retailers to maintain dual pricing for merchandise and add friction at the checkout counter, where too often the only benefit to the customer is a coupon for something they just bought. Worse, loyalty programs can't tell when or why people don't shop at a store. My family likes to shop at Trader Joe's, because that store avoids the hassles of both loyalty cards and coupons. There is nothing in other stores' loyalty programs that welcomes hearing this useful information.

Perhaps the worst business silos are the Siamese ones formed by cell-phone equipment makers and carriers. Although PCs—even closed ones with Apple and Microsoft operating systems—are open to endless varieties of third-party applications, we see nothing of the sort from the cell-phone business, with the notable exception of the iPhone, which is (as I write this) enjoying its billionth application download. That download, of course, will come from exactly one source: Apple's iTunes. One might consider this a step in the right direction—it's kind of like the one Windows 95 took by making it easy for countless developers to write applications that would run on even-more-countless PCs. The next step, however, has to come from outside the silos of both the equipment makers and the phone system carriers. More eyes make bugs shallower, as we say.

Time to debug some business silos. ■



Doc Searls is Senior Editor of *Linux Journal*. He is also a fellow with the Berkman Center for Internet and Society at Harvard University and the Center for Information Technology and Society at UC Santa Barbara.

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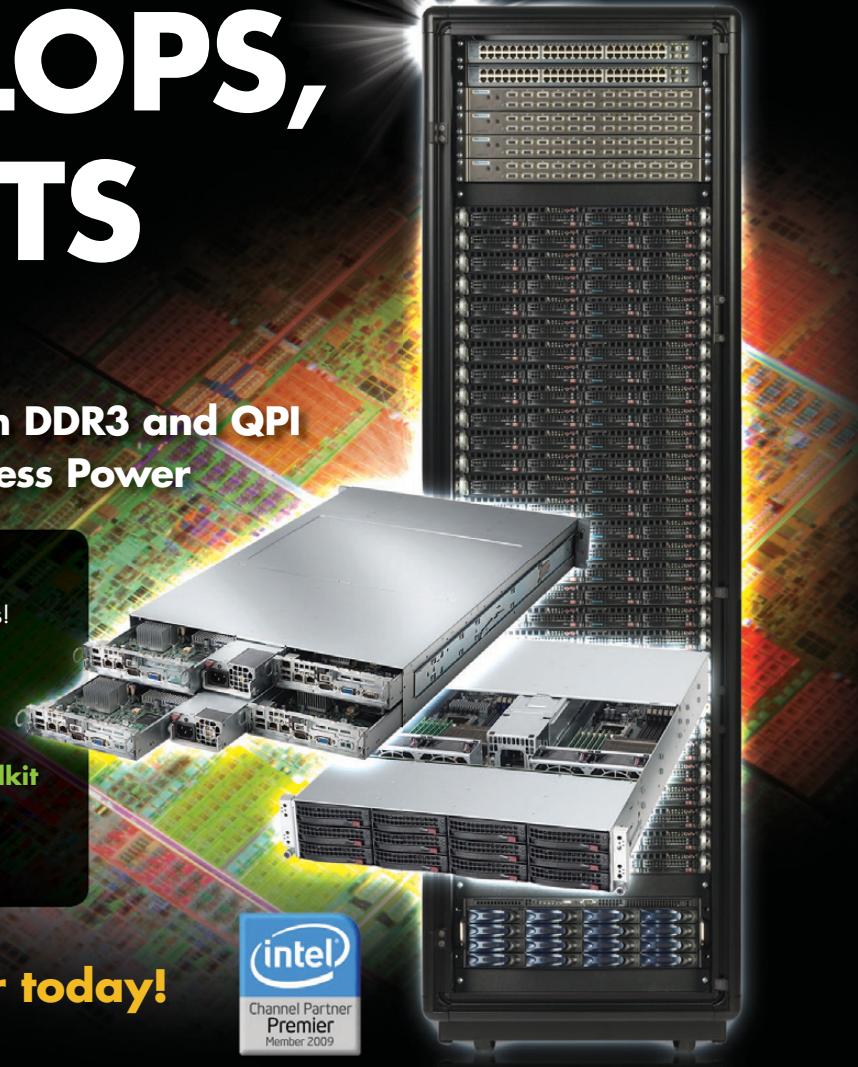
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