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CONTENTS

MAY 2008
Issue 169

FEATURES

42 Beyond Telecom: Bob Frankston on the Future We Make for Ourselves
What if the "last mile" was the end of the road for telecom as we know it? We interview tech pioneer Bob Frankston, who sees the Internet as a "demo", and a future where networking is something we do for ourselves.
Doc Searls

48 Telephony Shoot-Out
A little detective work uncovers the right VoIP solution for Podcast recording in Linux.
Dan Sawyer

54 Turn Your Computer into a Phone with Skype
A beginner's guide to installing and using Skype on Linux.
Federico Kereki

ON THE COVER
- AVSynthesis—Blend Sound and Images, p. 68
- Cooking with Chumby, p. 60
- VoIP Programs Compared, p. 48
- Skype for Beginners, p. 54
- Interview with Bob Frankston, p. 42
- Set up a Quick-and-Dirty Secondary Mail Server, p. 34
- Reviewed: Teak 3018 Network Appliance, p. 38

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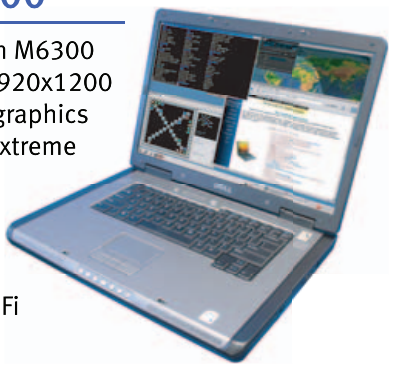

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CONTENTS

MAY 2008
Issue 169

COLUMNS

18 REUVEN M. LERNER'S AT THE FORGE
OpenID

22 MARCEL GAGNÉ'S COOKING WITH LINUX
Jumbled Words

26 DAVE TAYLOR'S WORK THE SHELL
Handling Errors and Making Scripts Bulletproof

28 MICK BAUER'S PARANOID PENGUIN
Customizing Linux Live CDs, Part I

34 KYLE RANKIN'S HACK AND /
Last-Minute Secondary Mail Server

96 DOC SEARLS' EOF
The Multiple Play

REVIEW

38 AN IDEAL APPLIANCE?
Dan Sawyer and D.N. Crowe

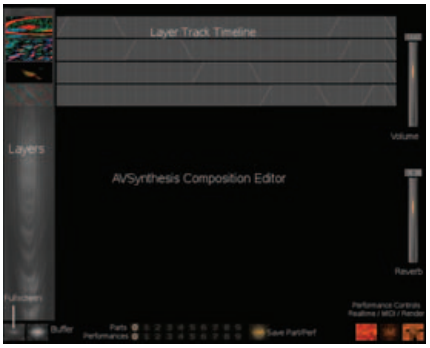
IN EVERY ISSUE

8 LETTERS
12 UPFRONT
36 NEW PRODUCTS
81 ADVERTISERS INDEX

INDEPTH

60 ADVENTURES WITH CHUMBY
In the kitchen with the Chumby device.
Daniel Bartholomew

68 AVSYNTHESIS: BLENDING LIGHT AND SOUND WITH OPENGL AND CSOUND5
Make your own abstract experimental films with the combined powers of two of the finest audio and video environments for Linux.
Dave Phillips



76 FRESH FROM THE LAB
New software—Zero Install System, deco and orDrumbox.
John Knight

80 RUNNING UBUNTU AS A VIRTUAL OS IN MAC OS X
How difficult is it to download, install and run Ubuntu Linux within the two popular virtualization environments for Mac OS X, VMware Fusion and Parallels Desktop, and is it a usable alternative to dual booting?
Dave Taylor

84 MOBILE IPV6 WITH LINUX
An MIPv6 primer.
Salah M. S. Al-Buraiky

14 CHUMBY

Next Month

READERS' CHOICE AWARDS

We recently surveyed you about your favorite Linux tools, and next month, we'll show you the results. How do your preferences compare with those of the larger reader community? Get ready for some surprises!

And, that's not all. Dan Sawyer will help you narrow down the plethora of Firefox extensions and add-on applications, so you can get the ones that will extend functionality, enhance privacy and more. Kyle Rankin will present a series of handy "lightning" hacks in his Hack and / column, and in another article, will walk you through remastering Knoppix—without remastering it. We'll also review CeltX, an open-source project that's stealing the script-writing scene, we'll examine the sound capabilities of the OLPC's XO laptop, and much, much more.

USPS *LINUX JOURNAL* (ISSN 1075-3583) (USPS 12854) is published monthly by Belltown Media, Inc., 2211 Norfolk, Ste 514, Houston, TX 77098 USA. Periodicals postage paid at Houston, Texas and at additional mailing offices. Cover price is $5.99 US. Subscription rate is $29.50/year in the United States, $39.50 in Canada and Mexico, $69.50 elsewhere. POSTMASTER: Please send address changes to *Linux Journal*, PO Box 980985, Houston, TX 77098. Subscriptions start with the next issue. Canada Post: Publications Mail Agreement #41549519. Canada Returns to be sent to Bleuchip International, P.O. Box 25542, London, ON N6C 6B2

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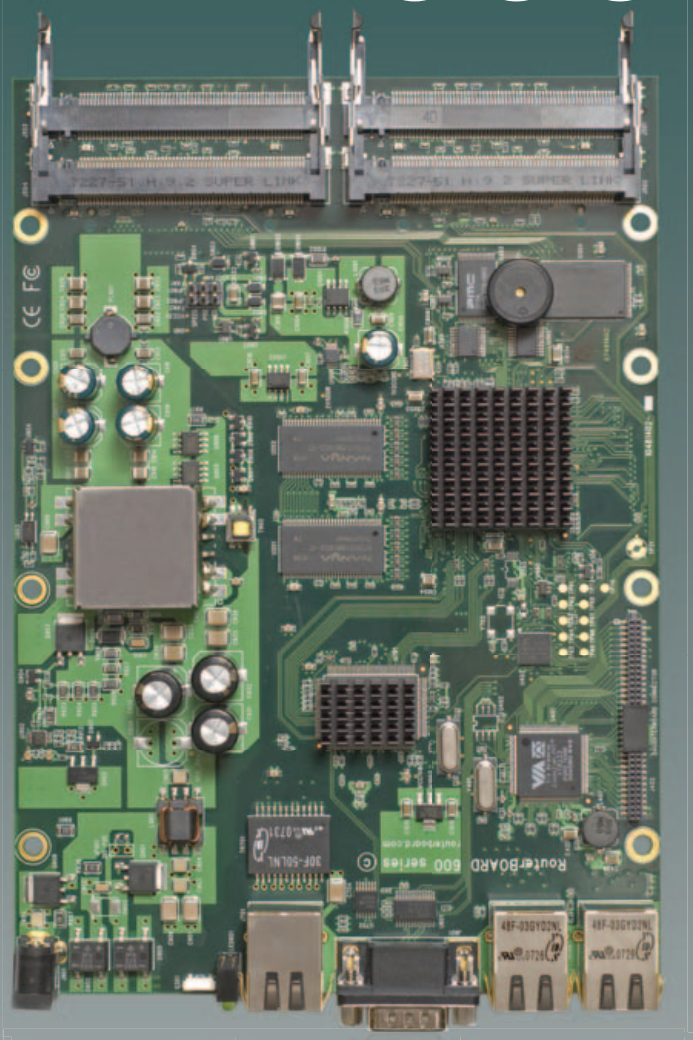

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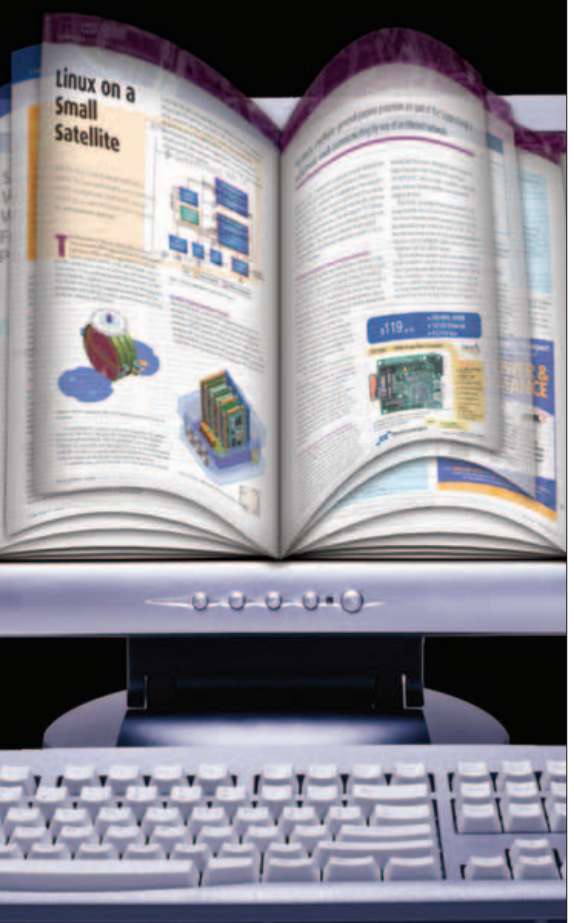

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Executive Editor	Jill Franklin jill@linuxjournal.com
Senior Editor	Doc Searls doc@linuxjournal.com
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Contributing Editors
David A. Bandel • Ibrahim Haddad • Robert Love • Zack Brown • Dave Phillips • 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
Director of Sales	Laura Whiteman laura@linuxjournal.com
Regional Sales Manager	Joseph Krack joseph@linuxjournal.com
Regional Sales Manager	Bruce Stevens bruce@linuxjournal.com
Circulation Director	Mark Irgang mark@linuxjournal.com
System Administrator	Mitch Frazier sysadm@linuxjournal.com
Webmaster	Katherine Druckman webmaster@linuxjournal.com
Accountant	Candy Beauchamp acct@linuxjournal.com

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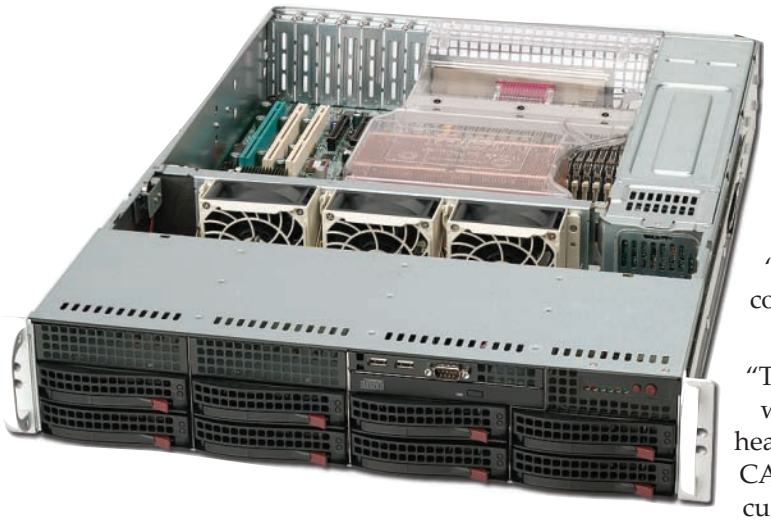
PC Magazine — February 2008



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letters

Is Hardware Catching Up to Java?

In the past month, the development team I lead and I went though the same search for the appropriate language or SDK with which to write software destined to run on multicore systems (in my case, 8-core/32-thread processors from Raza Microelectronics as well as future Intel 8-core CPUs) as well as single-core systems.

So Nicholas Petreley's article "Is Hardware Catching Up to Java?" in the November 2007 issue was of great interest, though in the end we came to different conclusions.

Nicholas picked Java because it has some multithreading support built in, though he admits that is far from being a slam dunk for issues related to garbage collection.

I don't think GC's implementation is what is most important. I think what is most important is being able to write multithreaded software with as few bugs as single-threaded software. In my experience, once you get past the simple, large-scale pieces of the software that can be run on separate threads, you hit a wall. For example, it is usually easy in server software to run each client's requests in a different thread. That is easy because the number of places where two client threads interact, and the amount of data they share, is limited and well defined. (Well, if it isn't, it's going to crash.)

But, how do you get beyond that and do things like running a for loop (in C or Java) in parallel and knowing the implementation is right, and will remain right, over the next five years as new software developers alter the rest of the software?

Java cannot help you there, not more than C, C++ or Python, because they all share something: shared state. In all these languages, the default is that data is shared. Any thread can write to anything to which it has a pointer. There is no guarantee beyond documentation and code reviews and the good intentions of future developers that the data your threads use isn't changing in ways that will crash them.

My conclusion of my search was that the proper language for multicore software was a single-assignment language: Erlang or Haskell. In these languages, the default is that software cannot alter a value after it is assigned. Thus, data structures can be shared between threads without laying down rules about how it can be used or not used (locks, lock-free algorithms and so on). In these languages, the variables that act like normal Java or C variables are the exception, and are defined differently from the rest. In fact, in Haskell, they are extremely well marked—to the point that any function that accesses them (even to read) is marked as well.

In the end, we decided to develop in Haskell, using its C interface to connect it with our existing C code. I've previously worked with developers who swore by Erlang (and thought at the time that we were nuts to code in C++).

PS. You mentioned Python. Python (more precisely, the CPython interpretor, the one everyone uses and for which we have all the nice plugins and tools support) has an Achilles' heel: the global interpretor lock (GIL). It may be multithreaded, and stackless Python is perfect for multithreaded server software. But, the GIL means the Python code cannot run on more than one core.

--

Nicolas Dade

The Number 77

I have known Dave Taylor for many, many years, having interacted with him at various USENIX conferences. His discussions of shell programming in his Work the Shell column are useful to all of us.

Unfortunately, he should have chosen another application area instead of numerology for his recent article in the 2008 January issue of *Linux Journal*. By writing such articles, even more people are led to believe that there is validity in traditional numerology. There isn't.

Systematics (**www.systematics.org**) on the other hand, a discipline developed by John Bennett and others, asserts that numbers do, in fact, have "qualitative significance". Instead of "associating numbers with letters", Dave could have presented a shell script to, for example, enumerate the various "inner connections" within each of Systematics' primary "systems" (monad, dyad, triad, tetrad, pentad and so forth).

Let's not encourage useless, unreal "disciplines" by publishing articles involving them. Rather, *Linux Journal* should focus on what is true and of value.

--

Kenneth Hood Jacker

Dave Taylor replies: *Interesting...there are 17 letters in your name, and the letters sum up to 77. When I started programming, one of the languages I learned was Fortran 77. Coincidence? Maybe not. In any case, thanks for your note, Kenneth.*

X Server Suckage

I have an update on this [see Letters, *LJ* April 2008]. I finally got tired of the old notebook running out of memory and migrated to the new Lenovo. I'm getting by using mostly one workspace, with all the windows overlapping, which I hate apparently about as much as my wife hated the pannable virtual desktop. Having recently re-installed Linux on my home desktop (going from Red Hat 9 to Ubuntu 7.10), I got a taste of Compiz and all its fancy features. That made me wonder why on the

Lenovo, Compiz wouldn't let me enable any visual effects.

It turns out this is yet another case of the Intel X server sucking. It seems under this X server, you can either have Xv accelerated video playback or Compiz. Ubuntu "solved" this problem by blacklisting the Intel X server. I found I could get around this blacklisting by adding `SKIP_CHECKS=yes` to /etc/xdg/compiz/compiz-manager, but the next time I tried to play a video file, I found I could not. There are workarounds, configuring the various video player apps to use something other than the default (Xv) for video output, but those result in slower or buggier (video always on top) behavior.

Some have suggested running the i810 X server rather than the newer Intel one, but when I tried that, X wouldn't run at all.

Had I known how bad the X server support is for this video chipset, I would have blacklisted machines using it while shopping for a new notebook.

I'm still waiting for Xi to get the necessary programming info from Intel so they can produce an Intel X server that hopefully doesn't suck.

As a side note, the ASUS Eee PC also uses a similar Intel video chipset and suffers all these same problems. I recently got an Eee at work, and that tiny screen just begs for a virtual/pannable desktop. Too bad it uses the Intel X server. Frequently, windows pop up that have to be moved (Alt-click-drag) partially off the screen to get to the buttons on them. These things aren't as big of a deal for me on the Eee, as I wanted it primarily as a router config terminal and "go anywhere" portable Internet terminal, and I knew before we ordered it that I wouldn't be happy with the screen. The Eee would be great if it was just a bit bigger (making the keyboard less cramped), had a bit more screen resolution and size and, of course, a non-Intel video chipset with an X server that doesn't suck.

--
Jon Lewis

More Business?

In regard to the letter from Nick Couchman in the March 2008 *LJ*, "More Business Content, Please", I agree with Nick to a point but must express that he may have missed the business side of some articles. Like he says, articles about LTSP for schools and such are great, but has he ever considered using it as a FREE (beer) connection broker for VDI? With XP licenses as the only pay-for product, I use LTSP to boot old machines with Etherboot or PXE into an rdesktop screen pointed at that person's XP virtual machine on VMware server. Linux all the way to the VM. I'd also like to call attention to Dave Richards' blog (**davelargo.blogspot.com**). He has more than 500 thin clients deployed in the city of Largo, Florida. The whole city operation runs Linux, Evolution, OpenOffice.org—beautiful.

I would like to see more business-related articles, such as using Coraid's AoE product in a VMware server or ESX environment. But, part of the fun is being able to read an *LJ* article and think "Hey! I can adapt that to my business."

--
Chris Turner

Help Him

I am writing regarding the article in the March 2008 issue of *LJ* titled "Desktop Must-Haves" by Dan Sawyer.

First off, I want to say that the article was great and well written and quite lucid. I have no problems with anything that Mr Sawyer said in the article, and agree with many of his choices for good Linux desktop applications.

What I, personally, have had issues with in moving from my Mac OS X platform to Linux as a desktop is the Pro Audio realm. I have yet to see any program that replaces three or four of my "must have" applications. I am learning that there may be replacements out there, and if I

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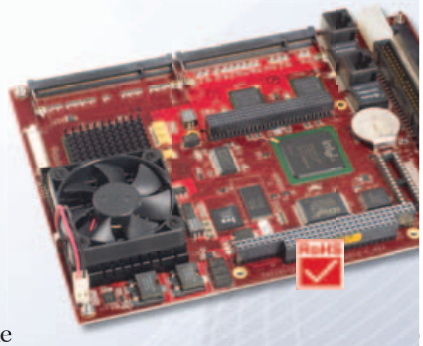

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www.versalogic.com/cob

can find one that suits my needs, I would replace my Mac with a nice Core Duo Intel box, most likely running Debian. The applications that I need to replace are Logic Express or another audio package like Adobe Audition 2 (Cool Edit) for multitrack recording and MegaSeg (which is a DJ software, **www.megaseg.com**). These are my biggest hold outs. I haven't been too keen on the iTunes replacement offerings, but admittedly have not looked at any of the projects since 2006.

My profession is Web development, and I do use *AMP. On Linux, I have found that the Bluefish Editor is my editor of choice and does most of what I need for the Web. I am also very open to using The GIMP or Krita, as Mr Sawyer pointed out, but the main reason I haven't switched is the lack of third-party plugin support for GIMP from the plugins I use all the time, namely Alien Skin Software. If they would write Xenofex for GIMP, I would be using it in a heartbeat. Yes, going from Photoshop to GIMP is a bit of a curve only because you have to learn what the authors of GIMP call your favorite tools. Once you are past that, you should be able to do everything in GIMP that you do in Photoshop (in my opinion) except for the aforementioned plugins, which to date I have not figured out how you could produce these effects without them. Also, the Layer Styles in Photoshop seem to be missing from open-source counterparts.

It would be nice to sell my Mac and go totally Linux (Debian for me), but I remain unconvinced that everything I do is covered, as of 2006 anyhow.

--

J. Mike Needham

Don't Slam Ada

Dave Taylor, in his March 2008 article "Understanding Shell Script Shorthand", says that Ada makes it easy for programmers to abbreviate their code ("abbreviate their code to make it shorter"! Well, yes, Dave, so it would!) to the point of obfuscation.

I've never (in 25 years) met an Ada programmer who thought it was clever, funny or macho to write code that's hard to understand. Indeed, the designers of the language rejected "neat" constructs that might make code easier to write if it was felt that they would make code harder to read.

--

Simon Wright

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 it in the magazine, we'll send you a free T-shirt.

Cory Wright of Natuba.com

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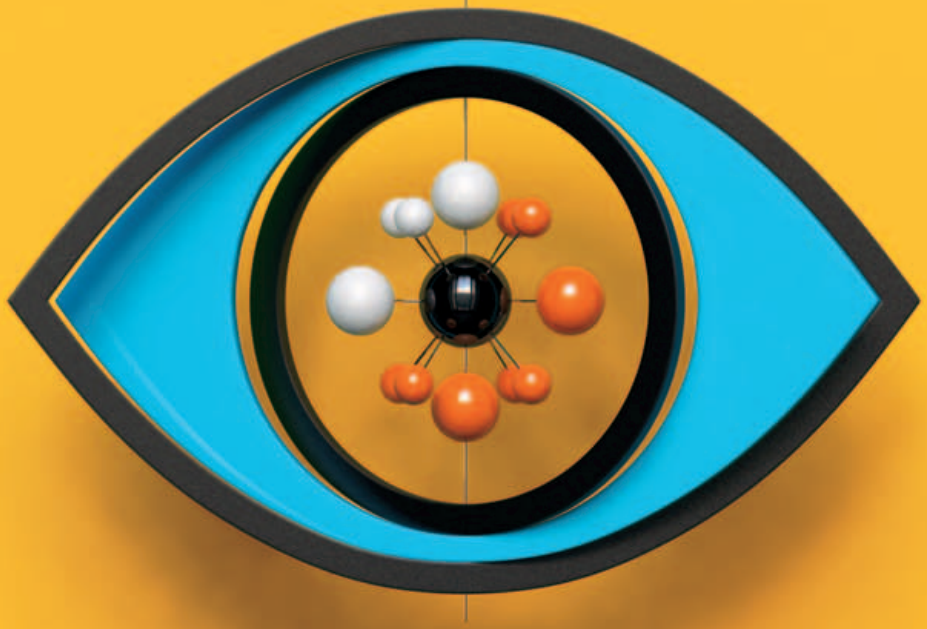

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WHAT'S NEW IN KERNEL DEVELOPMENT

Linux 0.01 is alive and well. **Abdel Benamrouche** recently ported the original Linux code from 1991 to **GCC version 4**. This is the sort of project people do because it's fun and unusual—not because they expect there to be any practical application for it at all. Yet, as often as not, there is. When **Cong Wang** heard about Abdel's work, his first thought was how useful it might be to university Computer Science departments teaching operating systems. With that thought, he immediately sent Abdel's work to Cong's own CS department. Where they go with it is anyone's guess.

The original Linux 0.01 required GCC 1.40 or thereabouts, according to a linux-kernel post by **Linus Torvalds** in August 2001, when **Tristan Sloughter** tried to get 0.01 running on his 386. A little later, in September 2001, **Mikulas Patocka** actually fixed a bug in the disk request sorting code of Linux 0.01. At the time, Linus offered Mikulas maintainership of the 0.01.xx kernel series, but Mikulas turned it down. Maybe Abdel will decide to take up the banner and maintain 0.01 himself.

The kernel sources include a variety of shell scripts that each try to rely only on the default **/bin/sh UNIX shell**. **Andreas Mohr** recently discovered that one of these scripts actually relied on the **bash shell**, though it claimed to work on whatever the user used by default—that is, on /bin/sh. He ran into this problem when he tried to use the script on a system that used the bash shell by default. So, after doing some cleanup, he submitted a shell to remove all the bashisms from the script. It was not easy—there were a number of obscure bash features represented in the code. But, after some testing, comments from other kernel folks and revised patches, it did seem as though he'd managed to eliminate all the bashisms from the script. **Adrian Bunk**'s suggestion that it might be quicker simply to make the script rely on bash explicitly was ignored in favor of the much more fun project of delving into shell arcana.

Apparently, too many people have started using the new **ext4 filesystem**. This code is not yet ready for widespread consumption, but it's been in the main kernel source tree for a while already to encourage experimentation. And, folks have been experimenting! Unfortunately, not everyone who's been using it has been aware that it was not fully ready. Adrian Bunk recently reported seeing users trying it out without considering the consequences, just because it was there in the kernel already. To deal with this, he proposed a patch, making ext4 dependent on the BROKEN configuration option. To compile the filesystem, users would have to edit the config files by hand to remove that dependency.

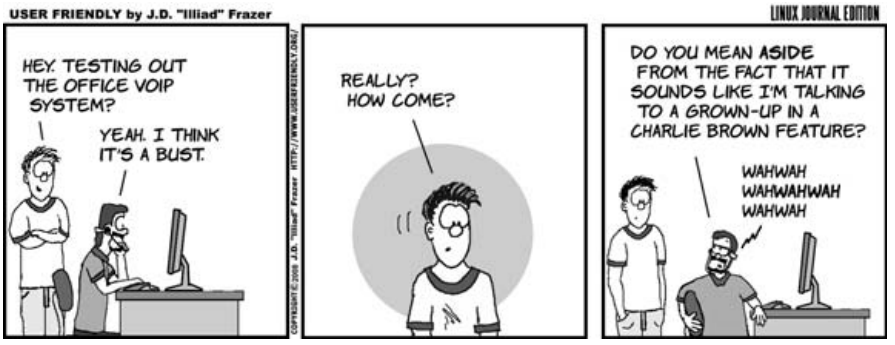
There have been various objections to this, including from folks like **Alan Cox**, who accused Adrian of meddling too deeply in kernel configuration culture. There is a lot of resistance to making ext4 harder to use, precisely because the ext4 developers very strongly want lots of people to test it. And, as they tend to be kernel "insiders" like Alan, they can get an experimental filesystem into the main kernel tree while other filesystems, who also want lots of testers, have to wait outside the tree and undergo a lot of additional scrutiny before being included.

This is not to begrudge ext4 its place of privilege. The ext4 developers are insiders because they've earned it, and they have a deep understanding of how kernel development should be done. Linus tends to trust their judgment, not because they are insiders, but because they have earned that trust. But, the fact remains that ext4 is in the main kernel tree, and it is not yet ready for regular use. Folks interested in it certainly should test it out if they want to, but with caution (and backups).

Michal Simek may become the official maintainer of the **Microblaze kernel port**, included in the main kernel source along with the other architectures. He coded up the Microblaze support himself, but he was not very familiar with what would be involved in being a maintainer and what sort of support he could expect from the kernel.org people (such as git repository hosting and so forth). A lot of folks had a lot of advice, and the whole discussion served to summarize current best practices regarding patch submissions and review, and the best way to host a full kernel tree (it turns out that hosting on kernel.org itself has the advantage of sharing git objects with Linus' tree, and this would make for a much smaller repository on disk). It seems likely that Michal will become the official maintainer. There certainly has been enough enthusiasm for him to do so.

A bunch of people have been translating **kernel documentation** into **Chinese**, under guidance from **Greg Kroah-Hartman**, who seems to be leading the effort. Recently, several translations were integrated into the kernel, including some by **Li Yang**, **Zhang Le** and **Bryan Wu**, among others. This push toward greater accessibility has been ongoing for years, but it appears to be picking up speed at the moment. These translations are dramatically increasing the available kernel developers who can participate in Linux development, and they pave the way for a deeper integration with the means of development.

—ZACK BROWN



LJ Index, May 2008

1. Billions of transistors exceeded by Intel's new Tukwila chip: 2
2. Years ago that Intel released a chip with more than 1 million transistors: 2
3. Years ago that Intel released a chip around a half-million transistors: 4
4. Years since Gordon Moore thought up his eponymous law: 33
5. Width in nanometers (nm) of Tukwila's circuitry: 65
6. Maximum read/transfer speed in MB/sec of Intel and Micron's new NAND memory technology: 200
7. Maximum write/transfer speed in MB/sec of Intel and Micron's new NAND memory technology: 100
8. Transfer ceiling of the USB 3.0 spec, in GB/sec: 4.8
9. Position of Russia among all countries searching for "linux" on Google: 1
10. Position of India among all countries searching for "linux" on Google: 2
11. Number of Asian countries in the top ten searching for "linux" on Google: 3
12. Number of European countries in the top ten searching for "linux" on Google: 7
13. Number of North American countries in the top ten searching for "linux" on Google: 0
14. Position of Russian among all languages searching for "linux" on Google: 1
15. Position of English among all languages searching for "linux" on Google: 9
16. Position of Ubuntu among all searches for Linux distros at trends.google.com: 1
17. Position of "Make Ubuntu laptops cheaper than Windows laptops (in all countries)" among popular ideas at Dell's IdeaStorm site: 1
18. Number of entries in Dell IdeaStorm's most popular ideas: 20
19. Number of popular IdeaStorm requests having to do with Linux, a distro or open source: 12
20. Number of device models counted running Linux in Intel's Mobility booth at CES 2008: 5

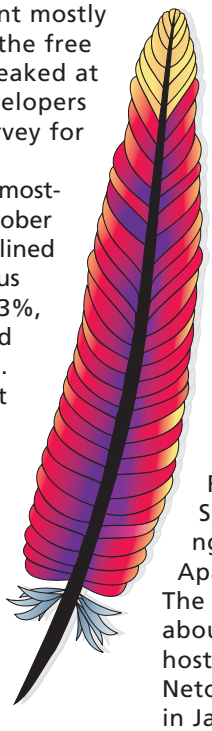
Sources:
1–5: ZDNet
6–8: Intel
9–15: www.google.com/trends
16–19: ideastorm.com
20: /photos/linuxjournal at Flickr (models were Clarion, Aigo, Lenovo, Samsung and Digifriends)

Apache's Share Goes Back above 50%

For more than a decade—from October 1995 to November 2005—Apache's growth in Web server market share went mostly up. In November 2005, the free and open Web server peaked at 70.98% among Top Developers on the Netcraft.com survey for that month.

Since then, the share mostly has gone down. In October 2007, Apache's share declined by 2.8% from the previous month, dropping to 47.73%, while Microsoft IIS gained 2.08% to hold at 37.13%. That was Apache's lowest share advantage since IIS appeared in 1996.

But since then, the trend has reversed again. The latest (February 2008) survey from Netcraft, with January 2008 numbers, had Apache at 50.61% on a 1.04% share increase.



Apache isn't only competing with IIS, of course. Google appeared on Netcraft's survey in 2007 and had a 5.33% share in January 2008.

And, the market isn't a pie. Its size overall constantly grows. The total number of servers, Apaches included, has been sloping upward nearly every month since 1995. One exception is the current (January 2008) report, where Netcraft notes "much slower growth".

One new open-source server to watch is nginx, or engine x. It's an open-source server developed in Russia. In the Google Online Security Blog in June 2007, nginx had a 4% share (to Apache's 66% and IIS's 23%). The nginx site currently says about 20% of Russian virtual hosts run on its server. On Netcraft, it cruised past 0.5% in January 2008.

—DOC SEARLS

LinuxJournal.com

We've had a pretty good couple of months over at LinuxJournal.com. James Gray has interviewed interesting folks from organizations such as Lesswatts.org, OSGeo and Mandriva. We appreciate these representatives taking the time to talk with us and share their insights.

Our videos have been quite fun lately, thanks to Shawn Powers. In addition to his usual "gadget" reviews, he has broadened his focus to include reviews such as the open-source game, *Battle for Wesnoth*. He gave us a quick look at the game and tossed in some bonus footage of himself getting clobbered on screen, so it's definitely worth checking out. If you missed his review of the X-Arcade, that is also worth a look. It will take you back to all those hours spent in arcades in the 1980s. You were there, weren't you? I was! All of our videos can be found at **www.linuxjournal.com/video**.

As United States politics heat up, we invite you to take a break from the mainstream and join us in supporting an alternative approach this year over at **tuxparty.com**. There, our favorite mascot will throw out some issues that may not be addressed in conventional politics. We support Tux for president, and hope you will too.

—KATHERINE DRUCKMAN

He Said It

Instead of the usual They Said It, this month we decided to compile quotations from Linus Torvalds alone, because they show a kind of historic turn as we head into an increasingly mobile Linux-based world.

» To the Linux-Kernel Mailing List (LKML), May 25, 2007:

> It's Friday evening, and the US is preparing for a long three-day weekend, often considered the official start of summer here.
>
> So what's a pasty white nerd to do? You can't go out on the beach, because the good-looking people will laugh at you and kick sand in your face.
>
> I'm not bitter.
>
> But now you *can* do something: you can download the latest -rc kernel, and smile smugly to yourself, knowing that you are running the latest and greatest on your machine. And suddenly it doesn't even matter that summer is coming, because you can just sit in the basement, and close the blinds, and bask in the warm light from your LCD, rather than the harsh glare of the daystar.
>
> The geeks with embedded hardware can consider themselves doubly special (and not just because your mothers told you you are), because we've got updates to ARM, SH and Blackfin.
>
> What more could you possibly want?

Source: **lkml.org/lkml/2007/5/25/439**.

» To various IDG publications in Australia in January 2008:

> Technology doesn't worry me. Stupid external issues, especially patents and stuff like that—those are the ones that worry technical people. Probably because they feel they can't (including me) do a lot about them. When you don't feel you're in control, you start worrying.

Source: **www.zdnet.com.au/news/software/soa/Torvalds-worries-about-patents-and-slow-storage/0,130061733,339285687,00.htm**.

> The embedded people actually solved a lot of the power problems, but they tended to solve it for their particular platform....You had ten solutions for ten different uses, then none were interchangeable because they were very specialized....Now...we have a good over-arching model that works hopefully for everybody....We're just now at the stage where we can solve them for everybody.

Source: **www.zdnet.com.au/news/software/soa/Linux-is-ready-to-go-green-Linus-Torvalds/0,130061733,339285555,00.htm**.

> I don't even have a mobile phone! I hate phones in general, because I'm the kind of person that when I work I want to concentrate on my work, and if somebody calls me that completely destroys my concentration. I hate phones because they just disturb you, and mobile phones are even worse because you have them with you all the time, so I don't do mobile phones at all. I have one of the early Linux mobile phones in my workroom because I got it for free, but it's not turned on.

Source: **www.computerworld.com.au/index.php/id;444282619**.

» To the *Sydney Morning Herald* at the same event:

> An OS should never have been something that people (in general) really care about: it should be completely invisible and nobody should give a flying f*** about it except the technical people.
>
> It's stupid—when you make a big deal about something like Vista or Leopard, a lot of it is about things I don't consider to be the operating system. It's about the visual shell around it. The fact that Microsoft tied the two together so much actually caused them problems, not just the legal problems. If you manage a thousand clients, or a hundred thousand clients, which is not at all unheard of, you sure as hell don't want to point and click at them. In many ways, Microsoft has had to fix the design mistakes they made when they thought the graphical approach should be a very intimate part of (Windows).
>
> To Microsoft and Apple, the OS is important as a way to control the whole environment, from a marketing and money-making standpoint, to force people to upgrade their applications and hardware.
>
> I don't think they're equally flawed. I think Leopard is a much better system. On the other hand, (I've found) OS X in some ways is actually worse than Windows to program for. That filesystem is complete and utter crap, which is scary. I think OS X is nicer than Windows in many ways, but neither can hold a candle to my own (Linux). It's a race to second place!

Source: **www.smh.com.au/news/technology/q-and-a-with-linus-torvalds/2008/02/05/1202090403120.html?page=2**.

—DOC SEARLS

OpenID's Open-Source SSO Gains Momentum

The decision by the Identity Gang (now formalized as Identity Commons) to get behind OpenID was an easy one: it was simple single sign-on, or SSO, and already in use at LiveJournal, the popular blogging system created by Brad Fitzpatrick, famous as well for memcached and other fine hacks. Brad also made OpenID open source, making it easy for developers to work with and contribute to it.

One remarkable fact about that Gang meeting (the first Internet Identity Workshop, in 2005) was that leading figures working on other identity systems—people from Microsoft, Sxip, Cordance (i-names) and Higgins—all jumped in to find ways of working with OpenID.

Since then, there have been many workshops, many meetings, much hacking and an acceleration of acceptance toward critical mass. You know that's been achieved when Google, IBM, Microsoft, VeriSign and Yahoo join an organization's board all at once. That happened for the OpenID Foundation in February 2008.

When I asked David Recordon, Vice Chair of the foundation board and OpenID's highest-profile advocate for his take on things, he said, "In 2007 OpenID saw incredible momentum as it grew from a grass-roots technology to a common tool in a developer's arsenal. Already in 2008, it has grown to include support by Google in Blogger and Yahoo by enabling hundreds of millions of their accounts as OpenIDs."

To find out more, or to get your own OpenID, visit **openid.net**. See also Reuven M. Lerner's column in this issue on page 18.

—DOC SEARLS

Spreadsheeting for Kids and Geeks

The XO is a laptop for children. A product of the noncommercial OLPC (One Laptop Per Child) Project, and run by veterans of MIT's Media Lab, its brainparent is Nicholas Negroponte, who says, "It's an education project, not a laptop project", and its goal is "to provide children around the world with new opportunities to explore, experiment and express themselves".

But, I've yet to see an XO in the hands of a child. Nearly all the OLPCs I've seen have belonged to geeks, or have been in use by them. As an example of the latter, see the shot taken at the latest Apachecon.

3.5 Geeks per XO Laptop, at the Latest Apachecon

As it's turning out, XO isn't just a fun toy for geeks and kids, but a target for development as well—for example, the Sweet SocialCalc Project. Writes Dan Brickin:

> I purchased an OLPC XO computer during the Give One Get One campaign, which arrived around New Year's. I love my XO and see its great potential. When I tried my new code on it, the code actually ran quite well.
>
> ...when we are done I hope we will have native OLPC code driving this (written in Python), so the JavaScript integrates with the OLPC user interface environment (which is called Sugar, hence the word sweet)....
>
> Feedback is welcome, as are volunteers to help us make this project a reality.
>
> In the future, we will also be integrating this code into more traditional platforms for more traditional wiki-like collaboration. Before that, though, I need to complete the implementation of these libraries, adding more commands, functions, etc.

Dan, by the way, is the other half of the pair that created VisiCalc, the first electronic spreadsheet. The other half was Bob Frankston, subject of a feature article this month (see page 42).

For more, visit the Software Garden OLPC page: **www.peapodcast.com/sgi/olpc**.

—DOC SEARLS

What They're Using

Michael Anti and His Eee PC

Michael Anti is an engineer and journalist whose work has appeared in the *New York Times*, *Huaxia Times*, *21st Century World Herald*, *Washington Post*, *Southern Metropolis Daily* and *Far and Wide Journal*. He has been a researcher, a columnist, a reporter, a war correspondent in Baghdad (in 2003) and more—and achieved notoriety in 2005 when Microsoft deleted his blog. Today, he is best known for his landmark work on press freedom in China—efforts that have earned him a Wolfson press fellowship at Cambridge University and Nieman Fellowship at Harvard University.

It was at a Harvard meeting where I noticed that Michael was using an ASUS Eee PC, with exceptional ease and enthusiasm. Turns out, it's one he bought from Amazon. It came new with Knoppix, but then he "cracked" it to do more than ASUS expects of ordinary users (for example, expanding windows to a full screen). I was impressed by how rapidly he typed on the keyboard. Later I found that he was actually typing in Chinese. I hadn't realized, until he explained it, that it's actually possible to type Chinese at the speed of speech on a qwerty keyboard. "I type in Chinese about five times faster than I write", he says. The word Harvard, for example, is four keystrokes rather than seven. So, if you know Chinese, you can use it as a kind of shorthand—impressive. (As you see from the photo, he was using Smart Pinyin.)

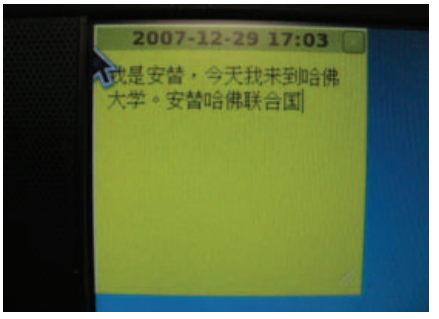
In sum, Michael said he has found the Eee PC ideal for three things: 1) hacking, 2) doing journalistic work and 3) watching TV. (In fact, he believes it is "the future of the TV".)

Ethan Zuckerman, who was at the same meeting, added, "I've seen these all over the place. I ran into (some) Asian businessmen in Amsterdam last week. And they were all carrying them. It's caught on really, really fast."

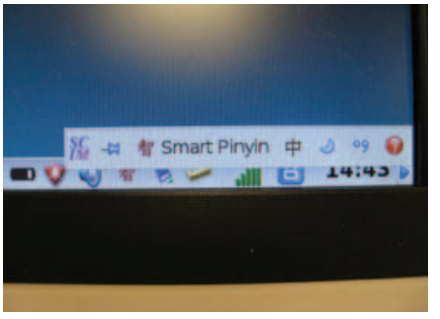
His one caution is adaptation. It took him a week to get used to the smaller-size keyboard. Plus, he adds, "You should have some five minutes to get used to it" when you're coming from a normal-size keyboard. Seems like time he's willing to invest.

—DOC SEARLS

Mike Anti and His Eee PC



Typing in Chinese



Using Smart Pinyin

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REUVEN M. LERNER

OpenID

An introduction to OpenID, an open-source, distributed, single sign-on solution for Internet applications.

Thank goodness for Firefox. Yes, it's a great browser. Yes, it has all sorts of wonderful plugins that let me do everything from debugging my Web applications to checking the weather forecast. And, the fact that it works across multiple platforms makes it even better.

But, as Web-based applications become an increasingly integral part of my life, I've grown dependent on Firefox's ability to remember my passwords. It might be silly, or even a bit pathetic, but there is no way I can remember all the different passwords I've created over the years. This is especially true for sites where I've changed my password on occasion, either because my current password expired or because I decided to change it.

This also means that when I use a different browser, or even a different computer, I'm often at a total loss. Sure, I remember some of my passwords, but there is no easy way for me to keep track of all of them without writing them down somewhere. So, I do the digital equivalent—storing them in my browser—and make sure I have my laptop with me wherever I go.

Juggling multiple passwords isn't new, of course. Even before the growth of Web applications, people were logging in to different computers, networks, e-mail accounts, database systems and so on. A number of companies made quite a bit of money from "single sign-on", offering back-end solutions that allowed people to log in to a single computer, providing them with access to many different ones.

But, although the problem might not be new, its scale is unprecedented. We no longer are worried about several hundreds or thousands of individuals keeping track of a dozen passwords, with access to an IT support department. Rather, we now have to worry about many millions of people, each of whom has dozens of passwords and little or no technical support for any of them.

Moreover, each Web site has its own particular needs, not to mention its own unique user interface. And, to top it off, the world is quite different from a corporation; you can't impose a standard solution from above. Rather, there must be a way to introduce competition into the equation, such that individuals can choose their own single sign-on provider.

Over the years, a number of companies have tried to enter this space for Internet applications. Perhaps the most famous (or infamous) was Microsoft's .NET Passport (now known as Windows Live ID), which was launched with great fanfare—and quickly attracted a great deal of negative attention related to privacy concerns. Even if Microsoft's product was technically excellent (and I'm not knowledgeable enough to judge it), people did not want to be told with whom they must entrust private and sensitive data.

An increasingly popular solution to this problem is OpenID. OpenID is not necessarily a new technology; it has existed in some form or another for several years already. However, it rapidly is picking up steam—so much that right before I wrote these words in February 2008, we saw Microsoft, Google, IBM, VeriSign and Yahoo embrace OpenID.

Now, it's true that the number of sites supporting OpenID is currently small—numbering about 8,000 at the time of this writing. However, the number is growing rapidly, and I expect the pace will pick up as the aforementioned Internet giants begin to get involved.

What if you're smaller than Google or Microsoft? Is OpenID worth adding to your site? Is it relatively easy? The answer to both questions, I'm happy to say, is yes.

This month, I discuss the user side of OpenID—how you register for an OpenID and how you manage it. I also explain how the OpenID specification takes into account the fact that you might eventually need to change providers.

The Basics of OpenID

The term OpenID refers both to a person's unique identifier and to the standard describing all the technology around that identifier. To create an OpenID, you must register with an OpenID provider. Once you have registered your OpenID, it is the provider that authenticates you for every OpenID-enabled application you use. In other words, the OpenID provider is responsible for checking your identity, which normally means confirming that the user name and password you enter are acceptable.

Thus, logging in to a site with OpenID means the following happens:

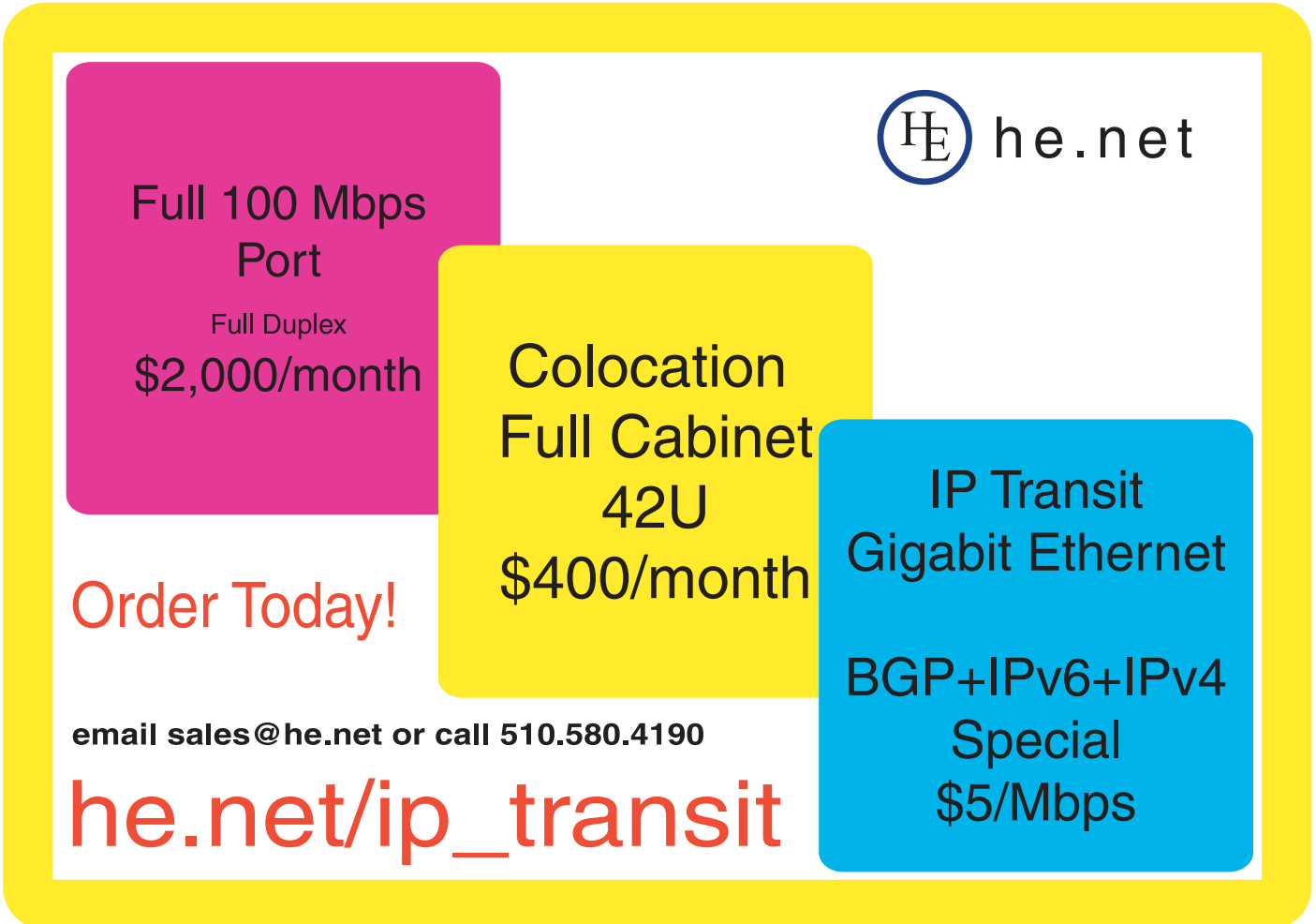
- You tell the Web application you want to log in with the OpenID protocol.

- You enter your OpenID (more detail on this shortly) into the application's login screen.
- The application sends you to the login screen for your OpenID provider.
- If the provider accepts your credentials (normally, your user name and password), it asks you to confirm that your identity may be exported to the Web application, and if it may do so in the future as well. Obviously, if you indicate you are willing to share your identity with this Web application in the future, you will skip this step in the future.
- Once allowed to export your identity to the Web application, you are returned to the original application you wanted to use, logged in and ready to use it.

Notice there are a few important differences here between OpenID and a "standard" login system. First, users authenticate against a different site from the one they are trying to use. This is similar to making a purchase via Google Checkout or PayPal, both of which require that users authenticate themselves and authorize the purchase amount on their own sites, rather than on the site belonging to the on-line store.

Some critics of OpenID say that users may be surprised or confused by the switch from one site to another, but I think Google Checkout and PayPal have demonstrated that a reasonable number of people are not put off by switching back and forth. Moreover, I have read that Firefox 3 will include some integrated OpenID support, which might remove some of the need to switch sites—or at least make it appear more integrated. However, I've been using the beta of Firefox 3 for several months and have yet to experience such integration.

And, although I use the term Web application, there is no requirement that OpenID be used only for Web-based applications. I expect that as OpenID takes hold, a large number of Internet-based applications, obviously including those that run on the Web, will use OpenID. However, there's no reason



why non-Web applications and services couldn't use OpenID as well. I even can imagine a day when you might use OpenID to enter your house or confirm your identity to your burglar-alarm company. In the world of OpenID, end-user applications are known as consumers, just as the OpenID authentication systems are known as providers.

Most OpenID providers authenticate users with a user name and password. Over time, we can expect them to go in other directions as well—for example, using biometric authentication systems. And, although OpenID providers currently offer their services for free, it's not hard to imagine a time in which some companies will charge for OpenID services, while others will support themselves via advertising. Because users can switch OpenID providers at any time, and because users have a choice as to which one they will use, we can expect both competition and ingenuity to be the rule.

One company, Vidoop, has a particularly interesting authentication mechanism, in which users select a pattern of images as their "password". Each time a user wants to authenticate, a set of images—including those that the user has selected—appears on a 3x3 grid, with each image in a randomly selected location and a random letter placed next to it. This effectively creates a one-time password, which users enter by typing the letters associated with the ordered set of images they originally chose.

I even can imagine a day when you might use OpenID to enter your house or confirm your identity to your burglar-alarm company.

Finally, I should note that you can create and use as many OpenIDs as you like, just as you would normally create as many user names as you like on a Web site. Some people do this to separate their work ID from their personal ID, or just because they prefer not to put all of their eggs in one authentication basket. Regardless, OpenID allows you to do this—although it is ironic that a single sign-on solution would spur people to create multiple identities.

Creating and Using an OpenID

With all the background information out of the way, let's create and use an OpenID. An OpenID is nothing more than a URL, typically written as http://USERNAME.PROVIDER.com. For example, my OpenID is http://reuvenmlerner.myopenid.com.

Notice that I can share this URL publicly; there is no reason for me to keep it secret. MyOpenID.com is just one of several OpenID providers. Indeed, many people already have an OpenID, even if they don't realize it. For example, if you have a blog at LiveJournal, that URL can be used as your OpenID.

To sign up for an OpenID, simply go to the home page of your provider. For example, go to the MyOpenID.com home page and click on "sign up for an OpenID". That takes you to **https://www.myopenid.com/signup**, which asks you to enter a user name (it must be unique) and a password. You also can provide an e-mail address, which is optional, but doing so allows you to recover your password if you ever forget it. Finally, MyOpenID.com uses a captcha to ensure that a person, rather than a program, is signing up for the account.

Once you have signed up for an OpenID, you can use it to log in to a Web site that supports it. Typically, logging in to a Web site requires that you enter both a user name and password. But, if you use OpenID, you enter in neither of these to the Web application's login screen. Instead, you enter only the URL of your OpenID, including the http prefix that we so often ignore nowadays.

For example, I can go to **www.wikihow.com**, a site that lets anyone create a how-to manual. I click on "create an account or log in" at the top of the page, which brings me to a login screen. The resulting screen tells me I can log in using OpenID, if I want, by going to **www.wikihow.com/Special:OpenIDLogin**. (In other words, wikiHow has two separate login pages: one for regular users with a user name/password combination and another for OpenID users, who enter only their OpenID URL.) Finally, I enter http://reuvenmlerner.myopenid.com into the text field.

Because I had logged in to OpenID earlier, I wasn't asked to provide my password. However, this is the first time I've tried to log in to wikiHow with OpenID. Thus, MyOpenID.com must verify that I am willing to share information with wikiHow. I click on the allow forever button, which means whenever I'm logged in to MyOpenID.com, it should share information with wikiHow. After clicking this button, I am redirected back to **www.wikihow.com**, where I am logged in and identified by my first name.

Switching Providers

This system works quite well in my experience, and you quickly become used to the back and forth authentication process. However, major problems remain. What happens if MyOpenID.com goes out of business? What if its database is compromised? What if it turns out to be highly unethical and is using people's IDs? What if I find a provider whose Web site is more attractive to me?

I always can switch to a different provider, of course. But, that effectively means having a new and different user name on a site. On a social-

networking site, this obviously would be disastrous, as I would need to reconnect from my new account to each of the people in my old account.

The solution to this is quite clever. Instead of giving people the OpenID I mentioned above, I instead give them an OpenID on a Web site that I control, whose URL is unlikely ever to change. For example, I can give an OpenID of http://reuven.lerner.co.il.

I know that the lerner.co.il domain will remain mine forever. Thus, I can be reasonably sure that this URL also will be in my possession for a long time. Moreover, I control the contents of the home page. That page may contain any HTML content I want. But, it also should contain the following two <link> tags in the <head> section:

```
<link rel="openid.server" href="http://www.myopenid.com/server" />
<link rel="openid.delegate" href="http://reuvenmlerner.myopenid.com/" />
```

We already saw how I can log in to wikiHow by giving my OpenID at MyOpenID.com. But, with the above lines in place, I also can log in to wikiHow by entering http://reuven.lerner.co.il.

This tells wikiHow to retrieve the home page from my personal Web site. It uses the first <link> tag to know which server to use and the second <link> tag to know which user name and ID to authenticate. Everything then continues as usual. I authenticate myself as necessary against MyOpenID.com, which then redirects me back to wikiHow.

The beauty of this redirection system is that if I decide against using MyOpenID for any reason in the future, I simply change the <link> tags in index.html. wikiHow and all other sites will follow whatever reuven.lerner.co.il points to, whether it's MyOpenID.com, Vidoop.com or something else. In this way, I ensure that my OpenID always is associated with the provider who offers me the best combination of security and usability for my purposes.

Unfortunately, things don't always go smoothly. For example, when I registered with wikiHow, it got my nickname (Reuven) from MyOpenID.com. When I try to log in with my new, redirected OpenID, wikiHow thinks it's dealing with a new user—one whose requested nickname clashes with that of an existing user. So, the key is to set up and use the redirecting URL early on, and not switch to it after you already have used OpenID for some time.

There are other problems as well. For example, I currently juggle two different sets of identities online, as some companies want to deal only with US citizens living in the United States. And, although I'm currently back home in Modi'in, Israel, I continue to have a US phone number (through Skype), a mailing address (at my parents' house), and a US bank account and credit card. So, I need two separate identities: one with my Israeli information and another with my US information.

Fortunately, OpenID 2.0 supports both the export of information to the consumer application and also the use of multiple personas. Each persona can have a separate name, nickname, image and location, and I can choose which persona is associated with each consumer, under the umbrella of the same OpenID.

Conclusion

OpenID is an increasingly important standard that seems poised to have a central role in future Web and Internet-connected applications. Using OpenID is not terribly complicated for end users, and it supposedly is going to be integrated into Firefox in the near future.

Next month, we will look at OpenID from the perspective of a Web site that requires users to register. How can you, as a Web developer, support OpenID on your site? We will see that with a bit of work, and some support from open-source libraries, we can support OpenID in our Web applications.■

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 main site for OpenID information is **openid.net**. That site has documentation, mailing lists, links to software and lists of OpenID providers and consumers.

A screencast that demonstrates many of the same ideas from this column is available at **simonwillison.net/2006/openid-screencast**.

A discussion of the pros and cons of OpenID is at **radar.oreilly.com/archives/2007/02/pros_and_cons_o.html**.

Finally, a list of sites using OpenID, as well as providers you can use, is at **openiddirectory.com**.

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MARCEL GAGNÉ

Jumbled Words

If the medium is the message, what happens if your understanding of the message rates only a medium?

What on earth are you doing, François? Our guests will be here any moment. What are all these yellow sticky notes doing everywhere? *Quoi?* You're preparing for the telephony-themed issue? Although I admire your desire to help, I confess that this time, I really have no idea what you are doing. The telephone game? Of course I know what the telephone game is. You tell one person a phrase, he or she whispers it to another, who tells yet another, until you run out of players. The last player repeats what he or she thinks the message is, and it invariably turns out to be something totally different from what was originally selected. I still don't see what all these notes are for.

Ah, I see. They are anagrams, mostly of your first and last name, it would appear. You've got it all mixed up, *mon ami*. Anagrams, or word scrambles, have nothing to do with the telephone game other than that the message gets scrambled in some way. How many of these notes have you got scattered around the restaurant anyway? Never mind. I don't want to know. Our guests are approaching as we speak. We'll discuss this later.

Welcome, everyone, to *Chez Marcel*! Please take your seats and make yourselves comfortable. You may want to forgive the yellow notes all over the walls. My faithful waiter has gone anagram-crazy, and what you see is the result. François, if you would be so kind, please head down to the wine cellar. Over in the west wing, there are a few cases of 2002 Bolgheri Rosso Piastraia from Tuscany. Please, fetch some for our guests.

While we await François' return with the wine, let me show you a great little program for generating anagrams. Written by Richard Jones (now maintained by Paul Martin), `an` is a command-line program designed to generate anagrams. The program is extremely easy to use, but let me offer a quick word of caution. You'll want to use one or more of an's command-line options as it is extremely liberal with the anagrams it returns, and you'll quickly drown in results. My own name, Marcel Gagne, generates 837,989 results if I type `an "Marcel Gagne"`. Notice that when using two words, I put them in quotation marks. If you use the -w option, an generates a list of unique words instead of myriad phrases. Using my name as the example, I get 318 words. Compare that to a return of `cam an ger g l e` followed by `cam an erg g l e` and so on.

Increasingly interesting results turn up if you specify words of a particular length. For instance, if you have ten letters to work with, and you'd like to see words of six letters or more, use the `-m 6` option, which stands for minimum word length of six. If you know that the word mossy can be generated by the words you are using and you want to see all the combinations of "lost mysteries" that include mossy and contain a minimum of four letters per word, you might try typing the following:

```
an -m 4 -c mossy "lost mysteries"
```

A similar program is Evans A Criswell's Wordplay. Wordplay is also a command-line program for generating anagrams. Unlike an, Wordplay generates less words by default, but it also is more likely to generate meaningful results. There are command-line options to limit the number of words or characters each word can have and so on. Simply type `wordplay` at the command line for a list of options.

You can waste an amazing amount of time using these simple command-line anagram-generators and discover some fascinating things. For instance, did you know that "red pestilence iota nil" is an anagram for "presidential election"? That's just silly, of course. After all, "lulu jar nixon" is an anagram for "Linux Journal". Then again, so is "lunar join lux". François! Thank goodness you have returned. Please, pour a rather large glass for each of our guests.

So, what's the point of all this? Well, anagrams can be a great mental exercise, one that is a lot of fun. To that end, there are a number of great games based on anagrams and word scrambles. One of these is Joshua Keel's *Kanagram* (Figure 1). *Kanagram* is not only a great game, it's also a great place to start our exploration of word scramble games. You shouldn't have any trouble getting your hands on this one, as it is very likely in your distribution's software repository. *Kanagram* presents you with a scrambled word and asks you to decipher the word. There's no ticking clock on this one, and you don't get dinged for getting the word wrong. To make the choice of words interesting, the game comes with a number of vocabularies. These are word categories, such as Computers, Inventions, Sports, Professions and so on. There also are generic vocabularies based on whether the words are easy,

Figure 1. *Kanagram* turns anagram generation into a stylish game.

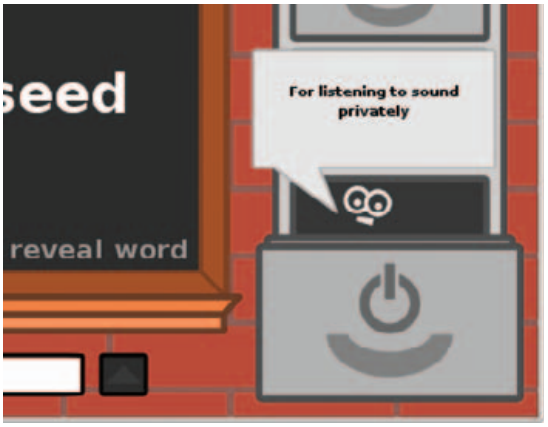

Figure 2. If you're not ready to give up, but you need a hint, *Kanagram* understands.

medium or hard.

On the left-hand side of *Kanagram*'s window, there's a large blackboard with the scrambled letters in the center. On the top right of the blackboard, the category is highlighted. You always can switch to another category with a click of the mouse. If you know the word, type it in the white input box below the blackboard. At any time, you can ask for a little help by clicking the word hint on the bottom left of the blackboard (Figure 2).

Expert included.

Rob is one of the Silicon Mechanics experts who make the interactive online tools at www.siliconmechanics.com a workable reality.

If you use our interactive configuration tools to create the specifications for cost-effective compute nodes—the 1Us pictured here—he's an important part of making sure your order is filled in a timely fashion. If you rely on the dynamic power calculator to optimize the energy efficiency of your new head node—the 2U pictured here— he's part of the team we rely on to deliver it to your specification. If you use the industry's first online cluster configuration tool for aggregating a rack of servers and individually configuring the components—like the one Rob is on top of—well, Rob really is on top of it. Rob is not an engineer, or a quality control professional, or a production manager. He's in charge of purchasing here at Silicon Mechanics, and he's the expert committed to stocking the high-quality, energy-efficient, state-of-the-art components your IT infrastructure requires.

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There's a ticking clock, fun sound effects and multiple levels that can be reached only by making it past a certain percentage of the words successfully.

That brings us to *Kanagram*'s right-hand side menu, cleverly designed to resemble a filing cabinet. If you do succumb to the pressure and need a hint, it appears in a pop-up near the bottom of the cabinet. Scroll your mouse pointer over the cabinet's drawers, and a tooltip describes what you'll find inside. You can jump to the next anagram, configure some of the program's functions, read the handbook or exit.

As I mentioned in the introduction to the game, *Kanagram* comes with a handful of vocabularies, but there are more available for download in a number of different languages. Simply click the second file drawer to open *Kanagram*'s configuration dialog. You can look at existing vocabularies and create your own by clicking Vocabularies in the sidebar. To download new vocabularies, click New Stuff instead (Figure 3).

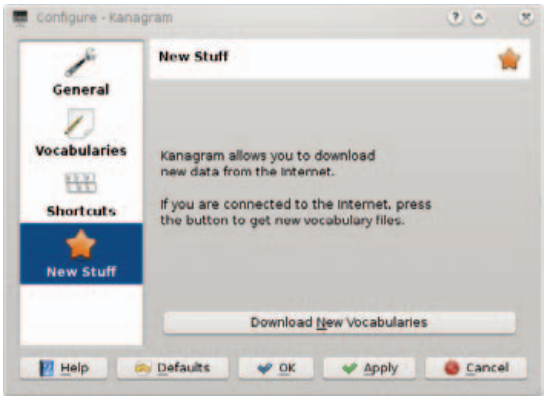

Figure 3. List, create or download new vocabularies.

When you click the Download New Vocabularies button, a new window appears showing what's available. You then can select and download vocabularies that appeal to you.

If you could turn anagrams into an arcade game, it might look something like Tom Bradley's *Scramble* (Figure 4). There's a ticking clock, fun sound effects and multiple levels that can be reached only by making it past a certain percentage of the words successfully. On the surface, it doesn't seem all that complicated. After all, each scramble consists of a measly six letters ("six letters" = "telex stirs"). When the letters appear on the placards at the bottom of the screen, click on the letters to form a word, then

Figure 4. *Scramble* jumbles a mere six letters. Think you can master it?

click Submit (or if you prefer, type the word and press Enter). If the word exists, it will load up one of the empty word boxes, after which you can move on to the next word.

Strangely enough, getting from one level to the next isn't always as easy as it looks. Sometimes, if you get really stuck, re-scrambling the letters can help—for that reason, you'll find clicking Shuffle every once in a while a handy thing. Did you, in a flash of brilliance, figure out the six-letter word? If you can guess the six-letter word right off the bat, you automatically move to the next level. Eventually, when you have exhausted all possibilities and the timer runs out, *Scramble* may deliver a classic arcade pat on the back. Yes, *Scramble* keeps track of high scores, and lets you enter your name in the high-scorers' list.

For the truly anagram-crazy, there's Colm Gallagher's *Anagramarama* (Figure 5). It doesn't quite maintain the arcade-like feel of *Scramble*, but it also doesn't limit itself to six letters. In that

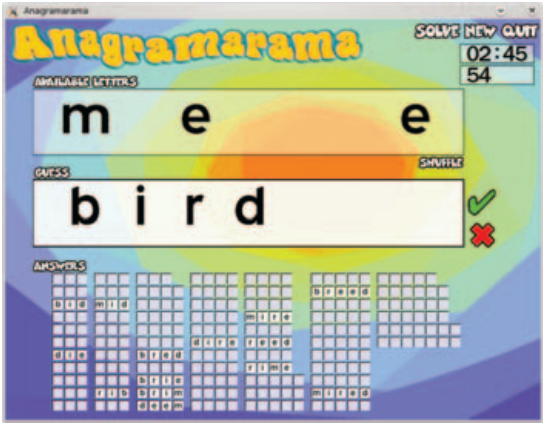

Figure 5. *Anagramarama*—more letters mean more words and more challenge.

respect, it can be much more of a challenge, particularly if you live for the thrill of building words from random collections of letters.

Resources

Source for an: **ftp.debian.org/pool/main/a/an**

Anagramarama: **www.coralquest.com/anagramarama**

Marcel's Web Site: **www.marcelgagne.com**

Scramble: **www.shiftygames.com/web2/index.php?module=game&name=Scramble**

Wordplay: **hsvmovies.com/static_subpages/personal/wordplay**

The WFTL-LUG, Marcel's Online Linux User Group: **www.marcelgagne.com/wftllugform.html**

When you click a letter from the top list of available letters, it drops into the Guess box below. After you've assembled your word, or something you think might qualify as a word, simply click the green check mark. Keyboard racers may prefer to type the letters, entering an anagrammatic stream of consciousness.

"I'm upset" is an anagram for "Time's up", and sadly, closing time approaches. Don't be too upset though. I'm sure we can convince François to refill our glasses a final time. And, while we sip our wine ("mute sip" also is an anagram for "time's up"), we may uncover some interesting anagrams by putting in the names of friends, family members and, of course, coworkers.

Raise your glasses, *mes amis*, 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. He also makes regular television appearances as Call for Help's Linux guy and every month on radio's Computer America show. 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 mggagne@salmar.com. You can discover lots of other things (including great Wine links) from his Web site at www.marcelgagne.com.

1 2 3 4 5 6

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DAVE TAYLOR

Handling Errors and Making Scripts Bulletproof

Shell scripts may be quick, easy and lightweight, but proper scripting includes the ability to anticipate and respond to error situations gracefully and without anything breaking. Dave explores some of the basic shell script error-handling options.

I realize I've been playing a bit fast and loose with my shell scripts over the last few months, because I haven't talked about how to ensure that error conditions don't break things. If you read the Letters section in *Linux Journal*, you know I haven't covered this topic because, well, you have covered it for me!

This topic ranges from the simple to the sophisticated, so let's start with a basic test: the return status after an application or utility is invoked.

The Magical $? Sequence

Different shells have different return status indicators (the C shell, for example, uses $status), but the most basic is Bash/the Bourne shell, which is what we've focused on since I started writing Work the Shell, and it uses `$?`.

Here's a quick example:

```
#!/bin/sh

mkdir /
echo "return status is $?"

mkdir /tmp/foobar
echo "return status is $?"

rmdir /tmp/foobar
echo "return status is $?"

rmdir /tmp
echo "return status is $?"

exit 0
```

Run this, and you can see the difference between commands that succeed and those that fail:

```
mkdir: /: Is a directory
return status is 1
return status is 0
return status is 0
rmdir: /tmp: Not a directory
return status is 1
```

You can see that when invoking `mkdir` or `rmdir` with an error condition, they output an error and—the important part—the $? return status is nonzero.

In fact, check out the man page for a typical command like mkdir, and you'll see: "DIAGNOSTICS: The mkdir utility exits 0 on success, and >0 if an error occurs."

In a perfect world, the `>0` return code would actually tell you what happened, but although that's true with the functions accessible via software, it's not true for the shell.

On the other hand, it's still helpful to explore how to make a shell function that does error handling too. Here's a basic example function:

```
makedirectory()
{
   mkdir $1
   status=$?

   echo "return status is $status"
}
```

This just makes a simple function that calls mkdir, and it should be no surprise that it works as follows if I invoke it three times—twice in error situations and once without an error:

```
mkdir: /: Is a directory
return status is 1
mkdir: /tmp/foobar: File exists
return status is 1
```

It's a drag to have `mkdir` generate an error message when you can produce your own simply by

testing the $? status variable.

Here's how you can do just that:

```
makedirectory()
{
   mkdir $1 2>&1 > /dev/null
   status=$?

   echo "makedirectory failed trying to make $1
➥(error $status)"
}
```

This is a bit tricky to understand, because you have to suppress the error message from `mkdir` so you can generate your own. That's done by redirecting standard error to standard out (the `2>&1` sequence) and then redirect standard output to /dev/null (the `> /dev/null` sequence).

Tip: there's a shorthand you could use here too, if you wanted to be a bit more cryptic: `&>/dev/null`.

Now when running this, however, the output is far more sophisticated:

```
makedirectory failed trying to make / (error 1)
makedirectory failed trying to make /tmp/foobar
➥(error 1)
```

That's a nice way to deal with errors, and of course, the function can also return the error code, with `return $status` as the last line.

Using test to Avoid Error Conditions

The best way to handle errors is to capture error conditions beforehand. This is best done with the wonderful and powerful test command. For example, the two typical error conditions that you'd encounter with the makedirectory() function are the directory already existing or the script not having permission to create the directory.

The first is pretty easy to test:

```
if [ -d "$1" ] ; then
  echo "Error: directory $1 already exists."
  exit 0
fi
```

The second is a bit trickier because you need to grab the parent directory portion of the requested directory then test it to see whether you have write and execute permission to create the subdirectory. This can be done with the dirname function (which returns . if there's no explicit directory given), followed by a test for -w for writeable and -x for executable.

It all combines like this:

```
parentdir="$(dirname $1)"
if [ ! -x $parentdir -o ! -w $parentdir ]
then
  echo "Uh oh, can't create requested directory $1"
  exit 0
fi
```

This is a sophisticated use of the test command, but read "!" as "not" and "-o" as "or", and you can see the test is "if not executable $parentdir or not writeable $parentdir then...", and that should make sense!

Avoiding Output Problems with noclobber

Finally, another thing to be aware of with the shell is that it's all too easy to zap important files with a redirect. For example, this shouldn't work:

```
$ who > who.output
$ ls > who.output
```

The second command should generate an error because the output file already exists, right? But it doesn't, and it simply trashes the who output without a warning or error—not good.

In a perfect world, the `>0` return code would actually tell you what happened, but although that's true with the functions accessible via software, it's not true for the shell.

To avoid that problem, you'll want to `set -o noclobber` in scripts or, better, for your login shell, and let it be inherited by subshells, including those that run your shell scripts. A good place to put it could be in your .profile or .bashrc.

With noclobber set, the two commands behave differently:

```
$ ls > who.output
-bash: who.output: cannot overwrite existing file
```

That's useful for everyone, and doubly so for us shell script hackers, right?■

Dave Taylor is a 26-year veteran of UNIX, creator of The Elm Mail System, and most recently author of both the best-selling *Wicked Cool Shell Scripts* and *Teach Yourself Unix in 24 Hours*, among his 16 technical books. His main Web site is at www.intuitive.com, and he also offers up tech support at AskDaveTaylor.com. Follow him on Twitter if you'd like: twitter.com/DaveTaylor.

Customizing Linux Live CDs, Part I

MICK BAUER

Make your desktop completely portable with a custom live CD.

In my recent column "Security Features in Ubuntu" (*LJ*, March 2008), I mentioned that the live CD method of running Linux from a CD-ROM or DVD rather than directly from a hard drive has important and useful security ramifications. I went on to promise that this would be the topic of a future column.

Never one to renege on a promise, this month I bring you the first of a multipart series about Linux live CDs. In this month's column, I describe some security usages for bootable Linux CDs and demonstrate a quick-and-easy way to customize the standard Ubuntu Desktop CD that allows you to change its included bundle of software.

Uses of Bootable Linux CDs

At this point, you may be wondering, "What's the big deal about bootable Linux CDs? Aren't all Linux installation CDs bootable?"

On the one hand, yes. Linux installation CDs always have been bootable. But, not all Linux installation CDs offer you the option of simply running Linux from the CD *without* installing it right away. This is the difference between a live Linux CD and an installer CD.

Live CDs are especially handy for trying out a distribution before committing it to your hard disk. Usually, they include an installer applet that makes it easy to make that commitment, if you so choose. But, these are very general live CD uses.

For the security-conscious user, or for the conscientious-security user (but not for the unconscious user), live CDs also are useful, among other things, for the following:

- Using untrusted hardware, such as public-use PCs at coffee shops.
- Analyzing computers that may have been compromised.
- Recovering data from systems that no longer boot for some reason.
- Running software you'd prefer not to install on your hard disk.

Depending on your needs, you might be perfectly happy using an existing Linux live CD distribution, such as Knoppix, BackTrack or Ubuntu Desktop. But, what if you want to apply the very latest security patches to the live CD's installed applications? What if your favorite live CD lacks an application you really need? Or, what if you don't want to have to configure things manually, such as network settings, after every single time you boot?

These are some of the many reasons you might want to customize your Linux live CD. For the remainder of this month's column, I walk through the process of patching and adding security software to Ubuntu Desktop 7.10. Much of what follows applies directly to other squashfs-based distributions, such as Linux Mint, SLAX and BackTrack, and indirectly to most other live CD distributions.

Prerequisites

Before you can customize your Ubuntu Desktop live CD, you need several things:

1. An ISO file for the current version of Ubuntu Desktop (or Linux Mint).
2. The squashfs-tools package installed on your system.
3. The mkisofs package installed on your system.

You can get the ISO file in one of two ways: download it from **www.ubuntu.com**, or create it from an actual Ubuntu CD via the dd command, like this:

```
bash-$ dd if=/dev/cdrom of=./ubuntu-7.10-desktop-i386.iso
```

For the remainder of this article, I assume your ISO image resides in your home directory. I also assume you're running Ubuntu, but if you aren't, for commands that begin with `sudo`, you instead should do whatever else you usually do to become root temporarily (for example, `su` or `su -c`).

The squashfs-tools package provides utilities for creating and mounting squashfs filesystems. Most of an Ubuntu live CD is taken up by one

enormous squashfs image that is uncompressed and mounted as / when you boot the CD. To remaster the CD, you need to mount a copy of its squashfs image, change various files and directories in it, and save the edited directory structure as a new squashfs image.

Finally, you'll use the mkisofs command to convert the various files and directories you've just edited into a single ISO image file.

In describing how these three prerequisites relate to each other, I also discuss the three stages of the live CD remastering process: mounting the squashfs image, changing it in various ways and incorporating it into a new ISO image.

The Procedure

The procedure I'm about to step through is based on the one at **www.debuntu.org** (see Resources). Much of what follows won't be very security-focused; in subsequent columns, I'll go into greater depth in applying this stuff to security applications. Right now, my immediate goal is to tell you what you need to know to begin experimenting with your own customized live CDs right away, and I'm sure you'll think of cool things to do between now and my next column.

What if your favorite live CD lacks an application you really need? Or, what if you don't want to have to configure things manually, such as network settings, after every single time you boot?

In demonstrating these commands, I'm going to try a new convention that bends reality a little bit and will number each bash-prompt: 01-$, 02-$, and so on. This way, I'll be able to refer to each command by line number. We'll see whether this helps, or whether I'm just getting nostalgic for my BASIC programming days—send me an e-mail if you have an opinion either way.

First, log on as a nonprivileged user, open a command window (none of what we do here will require the X Window System), and navigate to your home directory. Type this command to create mountpoints for the old ISO image and its squashfs image, a top-level directory for creating the new CD file hierarchy and a directory for rebuilding the root filesystem that will become the new squashfs image:

```
01-$ mkdir -p ./isomount ./isonew/squashfs ./isonew/cd ./isonew/custom
```

Next, mount the original ISO image, and copy everything in it, except the squashfs image itself, into the ./isonew/cd directory:

```
02-$ sudo mount -o loop ./ubuntu-7.10-desktop-i386.iso ./isomount/

03-$ rsync --exclude=/casper/filesystem.squashfs -a ./isomount/
➥./isonew/cd
```

Line 03 uses rsync rather than cp, so you don't need to repopulate the isonew/cd directory every time you make a new ISO image. Whenever rsync encounters identical files, it copies only the differences in the new file to the old one, rather than copying the entire file (if there are no differences, it leaves the "target" version alone).

Note: if you're working within some directory other than your home directory, and if that directory is on a Windows partition rather than a native Linux partition (such as ext2, ext3 or ReiserFS), you'll get *many* errors when copying files around—some of which may cause this procedure to fail. You don't need to do all of this within your home directory, but you should do it on a Linux partition.

You've copied the skeleton of the original CD into isonew/cd, so now you can get busy with the squashed root filesystem by enabling squashfs support in your running kernel and mounting the squashfs image:

```
04-$ sudo modprobe squashfs

05-$ sudo mount -t squashfs -o loop
➥./isomount/casper/filesystem.squashfs ./isonew/squashfs/
```

Next, copy the original root filesystem into the rebuild directory:

```
06-$ sudo rsync -a ./isonew/squashfs/ ./isonew/custom
```

Before you enter the Matrix by chrooting into this root filesystem and customizing it, you should make sure networking and the apt system will work once you do, by copying some configuration files from your running system:

```
07-$ sudo cp /etc/resolv.conf /etc/hosts ./isonew/custom/etc/

08-$ sudo cp /etc/apt/sources.list ./isonew/custom/etc/apt/
```

This assumes, of course, that your running system *is* communicating with the network properly and that its sources.list file includes entries for the universe, multiverse and partner repositories (or anywhere else from whence you intend to obtain packages). If you

have anything else you'd like to include in your custom live CD, such as other configuration files, documents, images and so on, now is a good time to copy those over too. Just remember that space is precious.

Now you're ready to enter your new root filesystem. I've written extensively about using chroot jails to contain server dæmons, so that if they're hijacked, the attacker gains access to only a small subset of your filesystem. Well, right now, you're about to chroot *yourself*, so that all changes you make—adding and removing packages, downloading updates, editing configuration files and so on—are applied to your custom ISO's root filesystem, not your underlying system's root filesystem.

Here's how to swallow the Blue Pill:

```
09-$ sudo chroot ./isonew/custom
```

From this point on, until you type the command `exit` (step 22, below), you'll be in an environment in which / is no longer your underlying filesystem's root, but actually /home/you/isonew/custom (where /home/you is your local home directory, or wherever else you created the isonew hierarchy).

Now that you're jacked in, you need to bring the proc and sysfs filesystems on-line, so that your "real" system's kernel can interact properly with the "fake" system represented by your soon-to-be-customized root filesystem. Now, set your home directory to /root (actually /home/you/isonew/custom/root):

```
10-# mount -t proc none /proc/

11-# mount -t sysfs none /sys/

12-# export HOME=/root
```

aptitude vs. apt-get

Note that I'm using apt-get here, rather than the more-sophisticated aptitude. This is because one of aptitude's key features, the ability to delete packages that are no longer necessary automatically, can be dangerous when used on any system on which packages have been installed by any tool other than aptitude.

Because aptitude maintains its *own* database of installation histories, it can miss key dependencies in this context and remove packages that you do, in fact, need. Therefore, you should use aptitude only to remove programs that you *installed* with aptitude. If you later need to undo an installation that included automatically installed dependencies, you can use `apt-get autoremove <packagename>` to achieve the same thing.

Note that the prompts in my examples have switched to # from $, indicating that you're now running in a root shell. This is necessary, because you'll need to be root in order to exit the chroot jail you've voluntarily entered.

Now you're ready to customize. This is the part when you don't necessarily need my help; you can be creative. For example purposes though, let's make some space for new packages and update the ones that are left.

What are you going to use your new live CD for? Secure Web browsing using untrusted hardware isn't a bad start. You shouldn't need OpenOffice.org for that, and it takes up something like 85MB of your compressed squashfs image (remember, a standard CD ISO can't be larger than 650MB).

You can remove OpenOffice.org, plus a couple of things upon which only OpenOffice.org depends, like this:

```
13-# apt-get remove --purge `dpkg-query -W --showformat='${Package}\n'
➥|grep openoffice`
```

Did you notice the embedded `dpkg-query...|grep...` command? It queries the root filesystem's deb-package database for a complete list of installed packages. The output of this is piped through a grep search for the string "openoffice". You can use the command in line 13 to find and purge other groups of packages by simply changing the grep query.

Suppose you also want to get rid of The GIMP, which takes up more than 6.5MB (after compression) on your live CD image. So, swap out the string "openoffice" in the previous command with "gimp", like this:

```
14-# apt-get remove --purge `dpkg-query -W --showformat='${Package}\n'
➥|grep gimp`
```

Other good candidates for removal include non-English language packs (which take up anywhere from 0.5–1.5MB compressed), and multimedia applications such as Rhythmbox, totem and sound-juicer, which take up a few megabytes each, even after compression, and are unlikely to be useful for security purposes.

Decide for yourself. Browse through the list of installed packages with a quick `aptitude search ~i |less`. If you mistakenly purge something you decide you actually need, you always can exit the chroot jail and re-execute the rsync command on line 06.

So, now you've made room for your custom toolkit. If you want to use your live CD for anonymous Web surfing, you may want to install Tor and Privoxy. First, you need to update your custom root

filesystem's package database to synchronize it with the sources.list file you copied over in line 08:

```
15-# apt-get update
```

Now, you can use `apt-get install` just as you would on any other live system to install your custom packages:

```
16-# apt-get install tor privoxy
```

As a professional paranoiac, I'd be remiss if I didn't point out that both of these packages are from Ubuntu's universe repository, and as such, they aren't provided with the same level of support as packages in the main and restricted repositories, although the Ubuntu MOTO Security Team does its best to keep up with security patches. This is a trade-off you'll probably find yourself making frequently, however. As I pointed out in my column in the March 2008 issue, many of Ubuntu's most useful security utilities are available only in the universe and metaverse repositories.

After you've installed your custom applications, make sure your entire system is fully patched. As with any other Ubuntu (or other Debian-based) system, you can use `apt-get dist-upgrade`. Because this will result in quite a bit of updates being downloaded and installed, and because space is at a premium on our ISO image, immediately follow the upgrade with a `clean`:

```
17-# apt-get dist-upgrade

18-# apt-get clean
```

Come to think of it, this one step—upgrading the live CD's packages—may be the only security-related reason you need to customize your live CD. Applying security patches is that important!

There's just one more thing to do before packing up your new ISO: custom configuration. You may want to edit the hosts or resolv.conf files you copied over before (or, after exiting the chroot jail, you simply may want to copy over them with the originals from ./isonew/squashfs/etc). You may want to preconfigure

Expert included.

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Appendix

Here's the complete procedure, in the form of a raw list of all commands described in this article. The $ prompt indicates commands executed as an unprivileged user, and the # prompt shows commands that are executed by root.

```
00-$ dd if=/dev/cdrom of=./ubuntu-7.10-desktop-i386.iso

01-$ mkdir -p ./isomount ./isonew/squashfs ./isonew/cd
➥./isonew/custom

02-$ sudo mount -o loop ./ubuntu-7.10-desktop-i386.iso ./isomount/

03-$ rsync --exclude=/casper/filesystem.squashfs -a ./isomount/
➥./isonew/cd

04-$ sudo modprobe squashfs

05-$ sudo mount -t squashfs -o loop
➥./isomount/casper/filesystem.squashfs ./isonew/squashfs/

06-$ sudo rsync -a ./isonew/squashfs/ ./isonew/custom

07-$ sudo cp /etc/resolv.conf /etc/hosts ./isonew/custom/etc/

08-$ sudo cp /etc/apt/sources.list ./isonew/custom/etc/apt/

09-$ sudo chroot ./isonew/custom

10-# mount -t proc none /proc/

11-# mount -t sysfs none /sys/

12-# export HOME=/root

13-# apt-get remove --purge `dpkg-query -W --showformat='${Package}\n'
➥|grep openoffice`

14-# apt-get remove --purge `dpkg-query -W --showformat='${Package}\n'
➥|grep gimp`

15-# apt-get update

16-# apt-get install tor privoxy

17-# apt-get dist-upgrade

18-# apt-get clean

19-# rm -rf /tmp/*

20-# umount /proc/

21-# umount /sys/

22-# exit

23-$ chmod +w ./isonew/cd/casper/filesystem.manifest

24-$ sudo chroot ./isonew/custom dpkg-query -W --showformat='${Package}
➥${Version}\n' > ./isonew/cd/casper/filesystem.manifest

25-$ sudo cp ./isonew/cd/casper/filesystem.manifest
➥./isonew/cd/casper/filesystem.manifest-desktop

26-$ sudo mksquashfs ./isonew/custom
➥./isonew/cd/casper/filesystem.squashfs

27-$ sudo rm ./isonew/cd/md5sum.txt

28-$ sudo -s

29-# cd ./isonew/cd

30-# find . -type f -print0 | xargs -0 md5sum > md5sum.txt

31-# exit

32-$ cd ./isonew/cd

33-$ sudo mkisofs -r -V "Ubuntu-Live-PrivateSurf" -b
➥isolinux/isolinux.bin -c isolinux/boot.cat -cache-inodes -J -l
➥-no-emul-boot -boot-load-size 4 -boot-info-table -o
➥~/Ubuntu-Live-7.10-PrivateSurf.iso .
```

Tor by editing /etc/tor/torrc and /etc/tor/tor-socks.conf, and Privoxy via the files in /etc/privoxy.

As with removing and installing packages, this process is the same as on any other system: fire up your (non-GUI) text editor of choice (nano, vi and ed are all present in the standard Ubuntu ISO), and edit anything that needs editing.

Are you done customizing? If so, you can take your Red Pill and exit the Matrix—I mean, the chroot jail. On your way out, empty the /tmp directory, and unmount the chrooted /proc and /sys filesystems:

```
19-# rm -rf /tmp/*

20-# umount /proc/

21-# umount /sys/

22-# exit
```

You're back in reality (at least, back in your previous working directory on the underlying system). Before you pack up your ISO, you'll have to build a new manifest file (a list of all packages in the new live CD root filesystem), recompress the customized root filesystem into a squashfs file and regenerate the md5sum of your live CD files.

Right now, my immediate goal is to tell you what you need to know to begin experimenting with your own customized live CDs right away, and I'm sure you'll think of cool things to do between now and my next column.

First, to rebuild your manifest file:

```
23-$ chmod +w ./isonew/cd/casper/filesystem.manifest

24-$ sudo chroot ./isonew/custom dpkg-query -W --showformat='${Package}
➥${Version}\n' > ./isonew/cd/casper/filesystem.manifest

25-$ sudo cp ./isonew/cd/casper/filesystem.manifest
➥./isonew/cd/casper/filesystem.manifest-desktop
```

In line 23, you made the old manifest file writeable, so you could copy over it. In line 24, you temporarily popped back into the root filesystem chroot jail to generate the package list with dpkg-query. And in line 25, you copied the new manifest into an identical file called filesystem.manifest-desktop.

Now you can resquash your root filesystem:

```
26-$ sudo mksquashfs ./isonew/custom
➥./isonew/cd/casper/filesystem.squashfs
```

If you like, you can edit the DISKNAME parameter in the file ./isonew/README.diskdefines. Regardless, next you should regenerate your live CD's md5sum, so you can detect tampering later on:

```
27-$ sudo rm ./isonew/cd/md5sum.txt

28-$ sudo -s

29-# cd ./isonew/cd

30-# find . -type f -print0 | xargs -0 md5sum > md5sum.txt

31-# exit
```

And, you've reached the final step. Now you can write your finished ISO image file:

```
32-$ cd ./isonew/cd

33-$ sudo mkisofs -r -V "Ubuntu-Live-PrivateSurf" -b
➥isolinux/isolinux.bin -c isolinux/boot.cat -cache-inodes -J -l
➥-no-emul-boot -boot-load-size 4 -boot-info-table -o
➥~/Ubuntu-Live-7.10-PrivateSurf.iso .
```

Your home directory now contains a new customized live CD ISO file, named Ubuntu-Live-7.10-PrivateSurf.iso. You can boot it directly from hard disk using VMware, QEMU or some other virtualization engine to test it. Or, of course, simply burn it to CD using your CD-writing utility of choice.

Conclusion

You've now got the basic technique for customizing an Ubuntu live CD. Although I didn't go into much depth showing actual customizations beyond removing and adding packages, I'll continue this series next time with detailed guidance on bundling and preconfiguring specific security tools into your live CD.

Until then, have fun experimenting with live CDs, and of course, 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

Debuntu.org's "Customize Your Ubuntu Live CD" Tutorial: **www.debuntu.org/how-to-customize-your-ubuntu-live-cd**

Jeffery Douglas Waddel's "Secure Boot CDs for VPN HOWTO": **www.linux.org/docs/ldp/howto/Secure-BootCD-VPN-HOWTO.html**

Daniel Barlow's "Building Your Own Live CD": **www.linuxjournal.com/article/7246**

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Last-Minute Secondary Mail Server

KYLE RANKIN

Is your primary mail server down with no spare set up? Find out how to set up a quick-and-dirty secondary mail server to tide you over until the primary is back.

It's easy to build redundant systems when time and money are limitless. When you have neither, or you are designing a personal system, often backups and redundancy are parts of the project you plan to get to on a rainy day. Of course inevitably, you put those tasks off until the main system fails, and then you scramble to pick up the pieces. Setting up RAID and doing backups, in fact, are probably the most common examples of these do-it-on-a-rainy-day tasks (and if you haven't heard yet, they are not the same thing). We all know we *should* back up important data, and we *should* set up a RAID on that important file server, and by now, enough of us have been bitten by that mistake that I'm not going to talk about either today. Instead, I'm going to talk about one of those services that gets less attention: your mail server.

It is important to have a backup mail server, but whether you work for a small company, or you administer your own personal mail server, you might not have gotten around to a secondary mail relay.

It is important to have a backup mail server, but whether you work for a small company, or you administer your own personal mail server, you might not have gotten around to a secondary mail relay. Then, disaster strikes. It could be that the primary mail server's hardware failed, or maybe it was hacked. In either case, it is going to be down for a few days. In the meantime, you still would like to be able to send and receive e-mail. In this column, I cover a few easy, and more important, quick steps to create a secondary mail relay to tide you over until the primary can come back on-line.

Now, my preferred method for an emergency mail server uses a Knoppix disc. I always have one around somewhere, and because I can install just about any software I need on the live CD, it is ideal when I need a basic Linux system fast. I can just locate a spare machine, boot Knoppix on it, and set up my server. When the emergency is over, I can shut it off with no commitment.

Then again, you might want to make this secondary mail server a bit more permanent. These same steps will work just fine on any ordinary Linux system that has postfix available.

Before you perform any steps, be sure to choose a server that has enough storage to store your mail. This number varies based on your e-mail traffic and the number of clients on the server, but the machine will need to store all incoming mail locally until the primary server comes back up. So, if you get 50MB of mail each day and plan for the primary to be down for three days, you should have at least 150MB of spare storage for the mail spool in /var/spool/postfix plus extra, just in case. If you don't have enough spare storage or you use Knoppix for this, mount an extra partition, create a postfix directory on it and symlink /var/spool/postfix to it.

Now that you have chosen a server, the first step is to install postfix. Postfix is a common package and should be available for any major Linux distribution you use. On Debian-based systems, the installation process automatically runs a configuration script to set up a reasonable default config. If you do run into this script, choose the "Internet Site" configuration type and accept the rest of the defaults in the script. Alternatively, you can copy a default configuration that ships with your postfix package or run it through a configuration script your distribution includes.

Once postfix is installed, you need to tweak the default configuration so that it can act as your mail relay. Postfix makes this pretty simple, and you need to worry about only a few configuration options. Edit the /etc/postfix/main.cf file, and locate a line called mynetworks. This option tells postfix for which networks to relay mail. Ideally, you should set this only for internal networks or specific external hosts you trust will not relay

spam through your system. If you allow all networks, you have just turned your system into an open relay and will likely find yourself on a spam black-hole list in no time. If your local network is 192.168.1.x, for instance, you would add an entry for that and for localhost:

```
mynetworks = 127.0.0.0/8, 192.168.1.0/24
```

Next, you need to tell postfix for which incoming domains it will accept mail for relay. This variable will be set to any domains for which you accept incoming mail. So, if you own example.com and example.org, for instance, you would add:

```
relay_domains = example.com, example.org
```

You even can act as a secondary mail server for friends. Simply add their domains here as well, and your mail server will accept incoming mail to those domains and then forward it to the appropriate primary mail server. How does it know which server to use? It relies on DNS, which I discuss shortly.

The final postfix options to change tell postfix how long to spool and attempt to deliver mail before it bounces it. By default, postfix queues mail for three days, and during that time, it continuously attempts delivery. After three days, postfix bounces the mail and sends an e-mail notification to the sender that the e-mail could not be delivered. If your primary server is going to be down for a few days, you probably will want to extend this default. Locate the following values (or add them if they aren't defined) in /etc/postfix/main.cf, and edit them so they look like the following:

```
bounce_queue_lifetime = 14d
maximal_queue_lifetime = 14d
```

Here I increased the maximum time to 14 days, but you can change it to a value that makes sense for you. Generally, you don't want to hold on to e-mail for too long, as senders likely will want to know eventually if their e-mail could not be delivered. Once these options are changed, type `/etc/init.d/postfix start` to start the service, or type `/etc/init.d/postfix reload`, if postfix already is running.

Next, test the server. Either configure your mail client to use this server as its SMTP gateway and then send an e-mail to your domain, or if you feel fancy, connect to port 25 on the server using Telnet, and type the raw SMTP commands. Check /var/log/mail.log or /var/log/maillog to confirm that postfix accepted and spooled your mail.

The last step is to configure your DNS server so that it lists your new machine as a secondary mail server for your domain. Your DNS server should have at least one MX record defined that looks something like this:

```
example.com.    IN MX    100    mail1.example.com.
```

If I created a new mail server and added its IP to DNS so that mail2.example.com pointed to it, I then would add the following line to my DNS zone:

```
example.com.    IN MX    200    mail2.example.com.
```

Because I assigned mail2 a higher value (200) than mail1 (100), other mail servers know that mail1 is my primary and that mail ultimately will land there. However, if mail1 is unavailable, they know that they can attempt delivery on mail2 (and some mail servers attempt mail delivery on secondary servers first anyway). Once my DNS zone is reloaded, mail that has been queued up on remote servers ever since mail1 went down should start being delivered to mail2. Be sure to add this DNS entry for any domains you added in the relay_domains option. It also may go without saying, but be sure that mail2.example.com points to an external IP address that lands on your mail server.

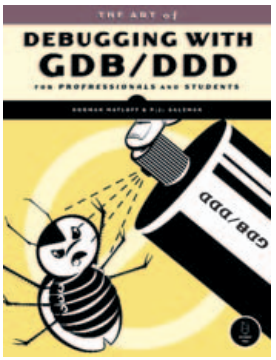
As this server runs, monitor its storage to make sure you have plenty for new incoming mail. You also can run the mailq command to see all the queued messages. Once your primary server comes back up, postfix will start delivering its queued messages automatically (it actually will have been attempting it the entire time). By default, postfix will throttle this delivery so it doesn't flood the primary mail server, but if you want all of the queued e-mail delivered immediately, type `postqueue -f`.

Once your primary server comes back up, postfix will start delivering its queued messages automatically (it actually will have been attempting it the entire time).

With the primary machine back up, you might want to take down this temporary machine or at least work on a more permanent solution. If you do take it down, be sure to remove its MX record from all your DNS servers. You *do* have redundant DNS servers, right?■

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.

Norman Matloff and P.J. Salzman's *Debugging with GDB/DDD* (No Starch Press)



The new book *Debugging with GDB/DDD* by Norman Matloff and P.J. Salzman, published by No Starch Press, highlights the importance of debugging to successful software development. Focusing on GDB, a popular open-source debugger, the book shows developers how to reduce the time they spend finding and fixing programming errors. *Debugging*'s approach is to apply a range of real-world coding errors, from simple typos to major logical blunders, to illustrate how to manage memory, understand core dumps and trace programming errors to their root causes. The book also covers topics missing from other debugging books, such as threaded, server/client, GUI and parallel programming.

www.nostarch.com

Cohesive Flexible Technologies' Elastic Server On-Demand Community Edition

Fresh out of beta is Cohesive Flexible Technologies' Elastic Server On-Demand (ESOD) Community Edition virtualization platform. The product is a free Internet platform for independent developers and individual enterprise developers to take advantage of virtualization and cloud computing utilities like Amazon's Elastic Compute Cloud. Users can "take their application stack 'recipes', capture them, and reproduce them as virtual servers rapidly and automatically", says CohesiveFT's CTO. The firm claims to be the "first service to offer developers and operations complete control of their server assembly, independent of which virtualization or cloud technology they require." The ESOD Community Edition is free to use and is intended for individual developers and noncommercial, nonproduction use.

www.cohesiveft.com

TotalView Technologies' Workbench Manager

Adding to its rich portfolio of debugging tools, TotalView Technologies has released Workbench Manager, an application that allows developers to create an integrated, cohesive view of the development and debugging work-flow process. One can manage any version of TotalView Debugger, MemoryScape memory debugger and any third-party application used for development and debugging, all from a single dashboard-like GUI. As a result, you easily can integrate both commercial and open-source tools in your toolchain. TotalView Technologies' products can be used to debug Linux, Mac OS X and UNIX applications running on development machines with single, dual-core, multicore or multiple processors.

www.totalviewtech.com

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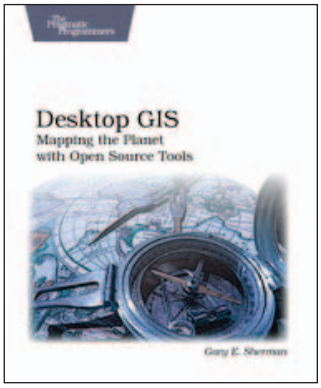


Gary E. Sherman's *Desktop GIS* (Pragmatic Bookshelf)

A book on a specific Linux topic typically means it's on the cusp of breaking out. Such is the case with Geographic Information Systems (GIS), the focus of the new book *Desktop GIS: Mapping the Planet with Open Source Tools* by Gary E. Sherman and the Pragmatic Bookshelf. The book's purpose is to help you deal with the issues involved in assembling your GIS toolkit, such as choosing the right platform and tools, dealing with integration issues and getting support. Sherman introduces the main open-source applications, such as GRASS, Quantum GIS, uDig and others, and also delves into scripting with various languages. The author is the founder of the Quantum GIS Project.

www.pragprog.com

SoftIntegration's Ch and Embedded Ch

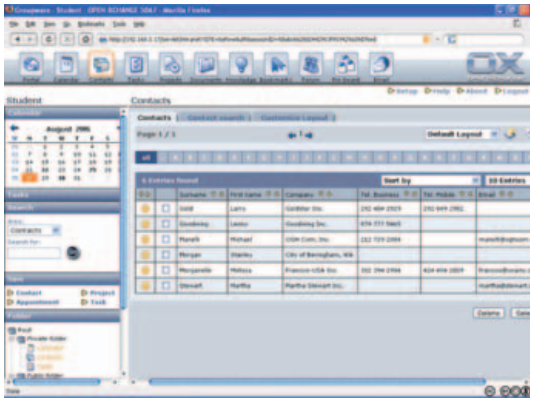
New on the development scene are SoftIntegration's Ch 6.0 and Embedded Ch 6.0, interpreters for cross-platform scripting, 2-D/3-D plotting, numerical computing, shell programming and embedded scripting. New features in v6.0 include debugging capability, a user-friendly IDE for teaching/learning programming (in the Professional Edition) and new plotting features, including multiple coordinates and new plotting types. Ch and Embedded Ch are available for Linux x86, Linux PPC, Windows, Mac OS X, Solaris, HP-UX, FreeBSD and QNX Neutrino RTOS.

www.softintegration.com

ADLINK Technology's ALS-3206 Rackmount Network Security Platform

ADLINK Technology has just beefed up your options for network security, adding the ALS-3206 Rackmount Network Security Platform to its solutions palette. The ALS-3206 series is billed as a flexible, mid-range, cost-effective solution for IDS, IPS, UTM, firewall, VPN gateway, load balancing and traffic-mining applications. The line further supports several Intel processors and chipsets and provides six gigabit Ethernet ports, one PCI extension slot and two configurable PCI-X slots. One of the PCI-X extension slots can be configured to extend a four-port gigabit Ethernet card and the other to extend a network security accelerator. This combination of features is suited, says ADLINK, for antivirus software security, content security and PKI software applications.

www.adlinktech.com



Open-Xchange Community Edition

You can feel the trembling emanating from Redmond after Open-Xchange's announcement of its newly GPL'd Open-Xchange Community Edition (OXCE). Open-Xchange calls OXCE "the only remaining independent open-source alternative to Microsoft Exchange" and offers the necessary tools to facilitate communication and teamwork: e=mail, calendaring, contacts, tasks and document sharing. The company further cites its intuitive tools and intelligent features, such as smart links between calendar appointments, task lists, contacts, documents, bookmarks, knowledge articles and Ajax-based mashup capabilities by Netvibes' Universal Widget API (UWA). Initially, OXCE is available for Debian and Ubuntu, with additional Linux distribution support coming later.

www.open-xchange.com

Sybase's Adaptive Server Enterprise Cluster Edition

If downtime ain't an option for your database, Sybase hopes you'll deploy its new Adaptive Server Enterprise (ASE) Cluster Edition. The technology enables enterprises to deploy database environments across shared servers in a cluster, which offers the added benefit of optimal service through events such as system failures, peak loads and planned maintenance. In addition, Sybase's product allows for savings in hardware and power costs through optimal resource utilization. Another technology, Virtualized Resource Management, supplies application workloads with a virtual view of the physical cluster that can be changed dynamically on demand. ASE Cluster Edition is available for Red Hat and SUSE Linux, as well as 64-bit Solaris.

www.sybase.com/clusters

Please send information about releases of Linux-related products to James Gray at newproducts@linuxjournal.com or New Products c/o *Linux Journal*, 1752 NW Market Street, #200, Seattle, WA 98107. Submissions are edited for length and content.

HARDWARE

An Ideal Appliance?

Inside the Teak 3018

DAN SAWYER AND D.N. LYNX CROWE

AR Infotek's new entry into the network security appliance market is the Teak 3018, which the AR Infotek Web site bills as having "...reliable high performance that meets trusted wireless network security appliance requirements in ROBO (Remote Office, Branch Office), SOHO (Small Office, Home Office), SMB (Small/Medium Business) environments."

That was part of the announcement that ran in all the Linux hardware rags in December '07 and January '08. A small, low-profile, hackable fanless box, the Teak 3018 looked to be a great entry into the realm of appliance hardware. It promoted itself as a solid platform with excellent capabilities, good security and an all-around solution for SOHO network security woes. We laid our grubby little paws on a pair of them and dug deep inside to answer some important questions about them:

1. Are they, as the press releases imply, consumer appliances, or are they something else?
2. Do they perform as advertised?
3. What other nefarious ends might they be put to by the intrepid hardware hacker?

After a lot of delving, digging, hacking and cataloging, I bring you the good, the bad, and the ugly of this unassuming-looking little brown box.

The Good

The Teak 3018 is compact, unobtrusive and looks pretty spiffy sitting on fashionable bookshelves—mostly because, unlike the rather gaudy Linksys firewalls, it stays out of the way, visually speaking. The whole thing, both in its design and implementation, is (as designed) fairly hospitable to Linux hackers. The CPU chipset and peripheral components are all well supported by the kernel, but just in case you're installing a distro that doesn't have the right drivers, it includes the source for the kernel modules and device drivers on the included SDK CD-ROM.

Under the hood, the Teak is a low-power x86 system. Specifically, it's a 500MHz AMD Geode LX-800 processor with the CS5536 companion device, equipped with 128–512MB of DDR RAM (128MB standard) soldered onto the motherboard. It sports a CompactFlash socket and a 2.5" hard drive bay with an Ultra DMA 66/100 IDE controller for your internal storage needs, as well as two OHCI-compliant USB 2.0 ports. A serial COM port gives auxiliary access for those wishing to hook up extra peripherals, such as a Linux console or a home automation device, while four 10/100Mbps auto-switching Ethernet ports—two of which have a hardware bridge that keeps your network signals traveling through the box in case of power failure—and a pair of Wi-Fi aerials hooked up to an Atheros 5004X SuperAG 802.11a/b/g chipset-based Wi-Fi module round out the feature set. Further icing on the cake is a watchdog timer, which can cause the system to reboot automatically if the software crashes.

The box the Teak sits in is sturdily built. Everything is securely bolted down. The top slides off easily after you remove just four screws, and the quality of the external design is a cut above—not only is it unobtrusive as previously mentioned, it also has a reset switch on the front, rather than

Table 1. Uses for the Teak

Purpose	Suitable?	Comments
Router	Possibly as a subnet router	Too few ports to be really useful as a general-purpose router.
Gateway	Yes	
Access pointers	Uncertain	It's hard to tell from the documentation what is meant by "access pointers".
VPN endpoint	Yes	Hardware AES encryption is a plus.
Firewall	Yes	
Antivirus filter	Yes	
Antispam filter	Yes	
Intrusion detection system	Yes	
Content filtering	Yes	
Bandwidth management device	Yes	

hidden around back as is common on most SOHO network appliances. A front panel mounted set of four system status lights, and a pair of status lights located by each Ethernet port, let you verify the operation of your system as well. The power supply—external, to help maintain the fanlessness and keep the case quiet—has all the proper international safety certifications and provides very clean power from a wide range of power sources.

Of course, with a setup like that in an easily accessible box, you can build pretty much anything you like. AR Infotek's marketing and press releases for the 3018 pitch it as a network security appliance, but with that kind of open hardware sitting under the hood, you can make it sit up and do tricks with a little bit of work. Still, what review would be complete without a good look at whether the machine can do what it says it's supposed to be able to do?

The manual suggests a number of uses for the box, most of which are actually doable.

The hardware itself meets all the trusted wireless network security appliance requirements for ROBO, SOHO and SMB environments, with the AES encryption standard supported in hardware.

There are a few other interesting little tricks up the Teak's sleeve. The system is built on a commodity motherboard, which means it not only runs a standard Phoenix BIOS, but it also has a sound chip and, because it's an AMD chipset with an ATI graphics package, a video capture chip. Although the pinouts for the video capture hardware and the sound hardware aren't documented in the manual, they may be among the undocumented functions of J12. This isn't the kind of board that can easily be hacked up by a hardware hacker with a soldering iron—multilayer boards with flat packs aren't really designed for that sort of thing. If the interface pins were brought out onto pads or connectors, that'd be another thing entirely, but as it stands, some of the more interesting functions of the Geode chipset are inaccessible.

So, is the Teak a "network security appliance" suitable for small-/medium-sized business, small office/home office and remote office/branch office applications?

Unfortunately, that brings us to the bad part of the review.

The Bad

To put it bluntly, the Teak 3018 isn't as advertised. The BIOS is its only firmware. No operating system, firewall, routing software or anything else that would qualify it as a "Network Security Appliance" comes with the box. The real story is that the 3018 is simply a general-purpose platform that can be made into pretty much anything your geeky heart desires. Be that as it may, it isn't anything out of the package but a bare-bones system. It's not a network security "appliance" as delivered. It's a system designed for OEMs to build into network security appliances.

As an OEM system, the Teak provides a good solid hardware platform, but it's not without a few serious flaws. There are two basic classes of beefs I have with the thing: hardware problems and documentation issues.

Hardware Problems

Although the selection of the hardware that goes into the Teak is deliberately Linux-friendly, the way the hardware is put together isn't particularly impressive. To begin with, in both of the systems we received, the wireless antenna wires were routed through the cooling fins on the CPU heat sink—not an auspicious way to string a thin-gauge coax, to say the least. Sharp bends over sharp edges not only abrade the insulation, they also mess with the impedance of the cable, which can cause RF signal loss and other nasty problems.

The internal layout problems don't stop there. The wireless chipset isn't on the motherboard, but is instead plugged in via a MiniPCI wireless card, which sits on a riser card floating above the motherboard. This would be a fine arrangement if the card didn't sit directly above the CompactFlash card slot and cover it so completely that it's not possible to load or unload a CF card without pulling out the wireless apparatus. If you're wanting to use a hard drive instead of a CF card, you're still going to run into some trouble. The system includes a handy drive-mounting cage that will hold your 2.5" IDE drive almost exactly the right distance from the controller port for the included hard drive cable to reach. "Almost" is the keyword here. The supplied flat cable had been crimped into a rough cylinder by a pair of tie-wraps, leaving no slack in the cable and putting excess stress on both connectors. This isn't a good idea, as it introduces unnecessary failure points in the cable and connectors.

The unit also includes an XVGA port that isn't routed to the outside of the box, which is itself a fairly defensible decision in something intended to be a network appliance. However, there is no pre-scored punch-out for those who wish to add a video connection permanently to their product, perhaps as a real-time network status display. Note that only one XVGA cable and one SDK CD-ROM were supplied for the two units. This is most likely because this is an OEM product, and an OEM will usually need only one of each as samples and then duplicate them as needed for production.

Documentation Problems

Particularly vital to a piece of OEM hardware is good documentation. Here again, the Teak falls down. There is no hard-copy documentation, only a CD-ROM full of text files and PDFs (with no PDF reader included).

The CD-ROM contains a slew of documentation for a wide range of models and is not particularly well organized. What's worse, it doesn't actually include some of the most important pieces of documentation on, for example, the motherboard, which you're left to find yourself on-line. Worse yet is that the documentation supplied for the Geode chipset is the preliminary set. The current documentation on the AMD Web site is at revision 2, and there are some significant changes from the preliminary docs. The CD-ROM itself doesn't have a README file, and

the package the Teak comes in doesn't have a packing list, so there's no way to be sure that you've gotten everything you're supposed to unless, for example, you bought two or more of them. As an OEM company, that's not a problem, because it's something that's generally covered in the purchase order when the contract is negotiated, but if you're ordering a single box to hack for your own personal project, you're going to have a hard time figuring out whether you got everything you were supposed to. See the sidebar for a packing list I built based on the two boxes I got for this review.

Unfortunately, the documentation's troubles don't end there.

The block diagram—essential for proper software and embedded system design—is scanned at a very low resolution. Hard to read on the included PDF, it becomes marginally legible when printed out. The block diagram itself is incomplete—the Wi-Fi module isn't included on the generic block diagram, not to mention there's no indication that it's plugged in to the MiniPCI slot. Neither the block diagram, nor the other documentation, indicates the type of Wi-Fi card—we identified it by looking at the labels on the chipset and finding the manufacturer details on the FCC Web site.

There's also the curious matter of J12, a set of pin connectors on the motherboard that do something—what, you may ask? We haven't the foggiest idea. It may be for the video capture hardware, or it may be for the sound chip, or something else. There's no way to tell—it's not in the documentation, and it's not silk screened on the motherboard.

Information on the BIOS—including any place to download updates—is also curiously absent from the documentation. Meanwhile, on the CD-ROM, they do supply an audio driver compatible with the onboard audio chipset, while the location of the pins for accessing and wiring up the speaker/microphone/line-in ports to the audio hardware is curiously absent from all documentation. This is understandable, as this is a network security appliance, not a general-purpose box.

The specs for the box mention a BIOS ROM upgrade utility, but there's no sign of it on the SDK CD-ROM.

Teak Packing List

- SDK CD-ROM full of documentation and drivers.
- IDE cable.
- Six feet of Ethernet cable.
- Power cable and power supply (with proper international safety certs).
- Two Wi-Fi antennae.
- 9-pin-to-9-pin RS-232 male-to-male serial interface cable.
- XVGA monitor cable to plug straight in to the motherboard.
- Four screws, Phillips, presumably for mounting a hard drive.

And then, there's the GeodeROM documentation. AMD doesn't make the GeodeROM available, so why's it there? Checking the AMD Web site, we found out that the GeodeROM documentation is supplied because it contains useful hints on how to make the best use of the chipset.

The two boxes we got had an external label problem as well. The first box was labeled NSM-3018-1, while the second box had a label showing NSM-3018-7. We suspect this is a printer's error on the second label, but there's no way to be sure with what we were provided.

The Ugly Verdict

The ugly truth of the matter is that the AR Infotek Teak 3018 doesn't know very well what it's trying to be. The marketing literature makes it look like it's designed to compete with the sort of firewall/switch appliances that you get at your local computer shop, when in fact it's an OEM device that is incomplete without a lot of tinkering. Presumably, it was designed to sell in large quantities to OEMs and VARs who will then install the appropriate add-ons to make it sing right out of the retail packaging, but if this is the case, the folks over at AR Infotek need to do a lot more work on improving their documentation and organizing it in a way that's intelligible. It also could use some basic niceties like a packing list, a price guide, environmental specs and a readable block diagram.

On the other hand, it's a hardware platform that's well suited to hackers—particularly hackers willing to do their own legwork and not rely on their hardware vendor to tell them what it is they're actually buying. The possibility of teasing audio and video capture functionality out of a network appliance is interesting as well, raising the prospect of constructing low-end PVR for capturing content destined for one's iPod rather than one's TV. The careful selection of Linux-friendly hardware throughout and the inclusion of driver sources on the CD is another point in its favor for the hobbyist. We'd give it a B+ as an OEM product for network security, mostly for its inadequate documentation.■

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, when he founded the Blenderwars filmmaking community (www.blenderwars.com). He currently is the host of "The Polyschizmatic Reprobates Hour", a cultural commentary podcast, and "Sculpting God", a science-fiction anthology podcast. Author contact information is available at www.jdsawyer.net.

D.N. Lynx Crowe has been writing software and designing computer hardware for more than 42 years, mostly in the area of hard real-time embedded systems. He is cofounder and CTO of Missing Lynx Systems, Inc., a technology solutions company specializing in business consulting, system and product evaluations, and bleeding-edge research and development. He currently resides in the San Francisco Bay Area with two friends and six formerly feral cats.

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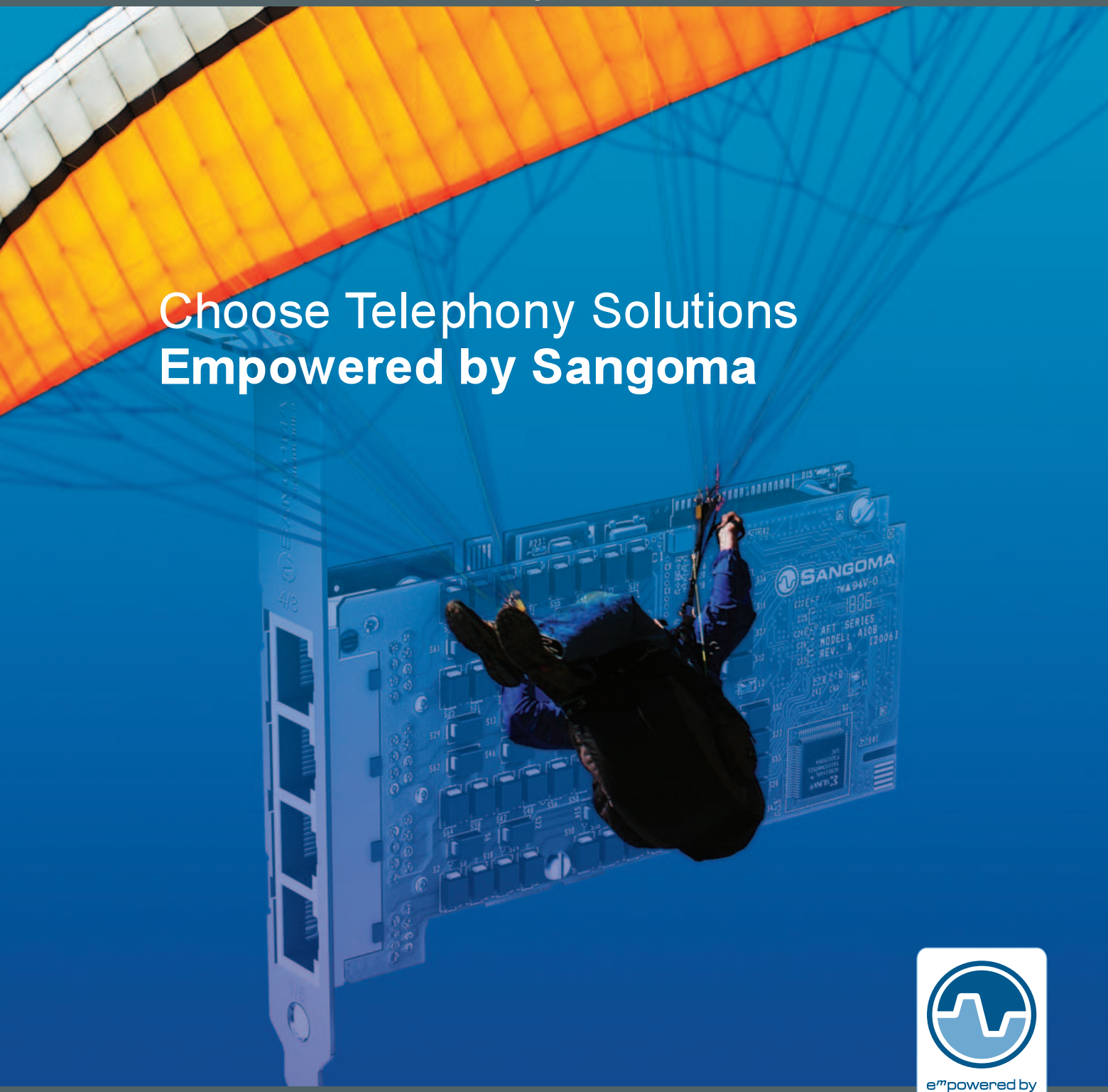

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BEYOND TELECOM

Bob Frankston on the Future We Make for Ourselves

Tech pioneer Bob Frankston makes the case for liberating networking from telephone and cable companies.

DOC SEARLS

TELECOM AND THE INTERNET have always been strange bedfellows. On the one hand, we have an industry that's been around for 171 years or more (dating from the first commercial telegraph), and on the other, we have something new with an "end-to-end" model that doesn't require telecom at all to do what it does.

Yet to most of us, Internet access is gravy on top of telephone and television service—part of a bundle that telcos and cablecos call a triple play. Never mind that telephony and video are all made up of the same bits. The carriers want us to think only in terms of familiar and expensive services such as television.

In fact, these models are so highly familiar to our minds that we can hardly think of a world without them. Bob Frankston, however, insists that we should.

Best known as the co-inventor (with Dan Bricklin) of the first electronic spreadsheet (VisiCalc) and as a prime mover behind home networking during his employ at Microsoft in the 1990s, Bob is presently putting his energies into urging us to see past telecom completely—and to start communicating for ourselves, in our own ways, free of telecom's proprietary confines.

In a way, Bob is playing the same role for connectivity that Richard M. Stallman started playing for software when he insisted that it be free. Like RMS, Bob comes from free-as-in-freedom rather than free-as-in-beer. He wants us to be free from forced dependency on big companies and big governments that put us in silos and tell us how to connect and communicate with one another. And, he wants us to be free from the thinking that has us accepting telecom as a way to frame the Internet and everything we do with it.

Unlike RMS, however, Bob has no dogma, no manifesto, no canon. His thinking is too protean and broad for that. Instead, he writes and talks with energy as boundless as the possibilities he wishes to liberate by leaving telecom behind.

Which is why we're here. I think what Bob says about telecom is of founding importance to the future of the Net.

The interview that follows was conducted in January and February 2008, and is a tiny fraction of the total words exchanged. Here's hoping our severe editing will not fail to keep Bob from opening your minds to the possibilities of Life Beyond Telecom.

DS: You like to talk about connectivity rather than communications. Why is that?
BF: Connectivity is about relationships, while communications is what we do with those relationships. The power of today's Internet comes from letting us focus on the relations and our ability to communicate rather than the twisting passages through telecom's maze of copper, fiber and radios.

The networks in our homes are a good example. You "just" print without worry about negotiating for the printing provider.

DS: So the Internet should be a big home network?
BF: Yes, but we need to be careful since the network emerges out of our networking. Copper and radios are just a means we use. It's like the difference between driving and buying a ride from a railroad. We should have infrastructure rather than a choice of whose services we must purchase. DIY must be an option!

DS: Why the railroad analogy?
BF: Because we're still thinking in railroad terms. The FCC (Federal Communications Commission) was partly an outgrowth of the ICC (Interstate Commerce Commission), which regulated railroads. Given the opportunity—which they were—railroad owners became infamous robber barons. How different is that from today when phone companies charge you for the contents of your freight cars, rather than just for using the track? Take SMS, for example. It's just data—a small number of bits using idle capacity. Yet an SMS bit costs millions of times more than a video bit.

They can charge that because, like the railroad barons, they use their control of the infrastructure to force us to buy vintage services at arbitrary prices. These are phone and cable companies with railroad legacies. Not Internet companies.

The importance of the Internet lies in the dynamic process by which a very simple design decision made in the 1970s has become the defining infrastructure for the world. It's what happens when you give billions of people the opportunity to create their own solutions and share them. The infrastructure of telecom is not the infrastructure of networking. We must not confuse the two. The infrastructure of telecom is about billing for scarcity. The infrastructure of networking is DIY and connecting anything to anything.

DS: JP Rangaswami of British Telecom (disclosure: I consult BT on open-source strategy) says the core competence of telcos is billing.
BF: That's true. And it's their core cost as well. When the infrastructure was expensive, it made sense to account for each use of wires and switches. Today, those costs have vanished. Remember that the reason we pay for redundant broadband paths is to keep the bits in billable channels. Even on "TV" we still divide the "dial" into "channels" or dedicated frequency bands—a legacy of analog signaling.

DS: And, why even bother with pushing dozens to hundreds of streams down a "pipe"—because that's what we call it now—when the user is watching only one at a time, and in most cases, it's not even a live program?
BF: Yes! In fact, none of this analog baggage is necessary with digital signaling. Even the distinction between wired and wireless bits no longer makes sense. Why do we need megawatts to shout a signal over a distance from the tops of towers and mountains, when a few milliwatts in your living room or a street lamp can connect you to the whole Internet?

Signaling on single frequencies is a legacy from the early days of radio. You had to be careful to avoid stepping on others' signals. 802.11 puts the responsibility on the receiver and thus encourages innovation rather than caution. Why do we still use a system that requires a license to transmit? It's as if we weren't allowed to own anything blue because that color was taken.

DS: So, what do we really need, if we don't need telecom?
BF: We need surprisingly little—just the means to do our own networking using our community's copper, fiber and radios. We first connect with our neighborhood and interconnect neighborhoods. We don't "access" a far-off Internet. We internetwork.

DS: I think the shift you're looking for has a good model with construction. That industry was born in 1833, when Augustine Taylor built St. Mary's Church in Chicago. Taylor was the first to use what we now call 2x4s, 2x6s, studs and joists. He did it cheap and with amateur volunteer carpenters. It caught on. Suddenly just about anybody could frame and build anything. Old-time builders called it balloon construction, because they thought it would blow away. But it didn't. Instead it revolutionized construction by letting anybody build anything cheap. If you want to build Tudor, or Prairie, or an office or a cabin, you frame it up. As a result, construction is perhaps the largest industry in the world today. And, nobody "owns" it. So, what are the equivalents of 2x4s here?
BF: In telecom, we already have it—bits (or packets). We can run bits over any physical (or virtual) transport and interpret them as we wish. So we can take copper, fiber and radios (CFR) and just treat them as interchangeable bit paths.

Accountants have a term for this—fungible. You don't have to maintain the identity of each kernel of corn—you just count them. Bits are bits. Telecom is about monetizing the path, but if bits are fungible, the paths are no longer special—it's like rangeland versus small plots of land.

DS: It's hard to give up the idea of a network.
BF: We've already done that. Back in the 1980s, UUCP (Unix-to-Unix Copy) was a good example of networking without a network—just cooperating computers calling each other. As with the Internet, it was a learning experience. Today we can do a far better job of networking if we aren't confined to broadband pipes. But the telcos are hooked on that confinement—and providing it as a set of "services". But, it's a losing proposition. By holding on to that model, they'll fail. They're like a monkey with its hand in a jar, unable to let go, even though that's the only way they'll become free.

DS: Haven't they made some progress?
BF: Not enough to save them. Or us. Today they know that abundance created by fungible bits is their enemy, and it's only a matter of time before they lose control. Too bad we focus on fixing the symptoms—for example, by trying to bolt neutrality onto the artificial FCC Regulatorium. Instead, we should recognize the problem is one created by regulations themselves—a product of the 1930s depression era. The technology and fears of those times make no sense

Bob at Just One of His Desk Workstations

these days. Yet we still accept that static solution instead of what I call the opportunity dynamic.

DS: What is the opportunity dynamic?
BF: We get Moore's Law-type hypergrowth by taking advantage of opportunities rather than allowing only narrow solutions. The dynamic has worked so well that today, even the carriers can't afford their own network. They too are using IP but insist on billing us as if they had special gear for everything. It's as if we had to put a 41-cent stamp on e-mail.

If we are dependent upon the phone company meeting performance requirements, we pay a high price for our dependency. With the Internet, we discover what we can do with what is available. Even better, thanks to software, we can easily share the results with others. At first, you couldn't make phone calls over the Internet, but you could send e-mail. Finding value in what we had drove a dynamic till today we have an ocean of bits, and voice "just works" thanks to statistics. It's not magic but a simple dynamic with demand actually creating supply, because we are taking advantage of available opportunities.

DS: Is this, then, "Frankston's Law"?
BF: Yes, "Marketplaces that provide opportunity rather than just solutions allow demand to create supply." It's a generalization of Moore's Law. The bottom-line question is, "Why must everyone have to justify new ideas to a telephone company or, for that matter, to any intermediary?" The power of the end-to-end argument is that we can create solutions without depending on intermediaries.

DS: What other ideas must we purge from our minds?
BF: One is that infrastructure has to be expensive and owned by service providers. That's why we can never finish paying for it. The actual cost of copper, fiber and radios is far less than something as mundane as sidewalks. Imagine if sidewalks were a service.

There are so many ways to redefine problems and come up with solutions that are far more valuable—even if we never solve the original problem. Who needs to make sure video signals arrive within a few milliseconds when we can buffer them and provide far higher quality than would be permitted by streaming?

"Phone wire" carries just one phone call, but if you look at the physics of sending signals over copper, you'll realize that we've barely tapped the potential capacity. For example, we don't need to think of them as isolated "pairs".

DS: We've seen this proven by the Internet, which was not created by telecom, even though we took advantage of telecom's copper and circuits.
BF: Yes, but we're still being timid, because we're still using the prototype Internet, which still has legacy limitations. I think of it as a class project done by friends and colleagues. For me, it was exactly that. It's a nice demo, but still only a demo.

DS: If it's a demo, what's it demonstrating?
BF: The power of the end-to-end constraint, of not depending on favors from a service provider. Of course, this breaks the fundamental presumption of the Regulatorium: that everything must be a billable service.

Where we are now is like the container shipping business, back when it was starting to happen. The old shipping companies opposed it, but they didn't own the ocean. Now look at how much less shipping costs today.

In *The Box: How the Shipping Container Made the World Smaller and the World Economy Bigger*, Marc Levinson notes that the incumbent shipping companies were unable to control the ocean and prevent container shipping from happening.

Yet, the telcos have managed the amazing feat of controlling the ocean of bits. The problems with single frequency signals that I spoke about earlier provide a reason to take the limitless potential of wireless communication and lock it into fictional channels! Amazing!

This is perhaps the central issue: each of these bad decisions creates stakeholders who want to hold on to their own no matter what the harm done to society.

DS: Seems to me that Google gets the abundance side of the Net, today, no?
BF: Not entirely true. It does benefit from being the largest ship on a rising sea (perhaps an uncomfortable metaphor these days). Its advertising revenue model decouples it from the particulars of technology and the network. But, it seems to want to tether users to its service platforms. After all, an advertiser depends on delivering customers to buyers.

Decoupling is important. This is why at Microsoft I made sure that home networking was available as a technology rather than being treated as a profit center. It's valuable because of what it enables.

DS: What should Google do then?
BF: Why not give away 100,000,000 open access points instead of spending billions on the 700MHz spectrum auction? It would cost less and benefit us all. Or, simply announce it is going to spend a few million to fund connectivity in Silicon Valley. That would drive the dynamic.

The idea of owning the transport reminds me of the days when roads were privately owned and you had men with pikes collecting tolls. We've long since recognized that value in the roads, as with networks, is in what we do with them and not in the roads (or networks) themselves. But the legacy lives on in the word turnpike.

DS: What about municipal Wi-Fi?
BF: The idea is laudable, but all too often muni Wi-Fi is in the mold of another telco system. If we opened up access points, it would be a non-issue, and then we could discover what to do with what we already have!

DS: Let's talk about history. You've been around since the early days of both Multics and UNIX.
BF: Yes. In fact, UNIX came out of the Multics Project. Although Multics defined much of what we think of as computing today, it was captive to Honeywell's business model, which kept it far more expensive than it should have been. UNIX was inexpensive and, thus, gave users a chance to experiment with owning their own systems.

PCs took this a step further. I even dispensed with operating systems when they got in the way. For a while, even UNIX was too much like an old-style mainframe. Things are different today—there is far more computing power, so we can afford to have operating systems.

The demos have driven the dynamic. That's what happened with early UNIX and the Internet. Imagine if we didn't hobble ourselves with the presumption of scarcity. And, if we focused less on patching up today's demo and more on taking advantage of connectivity.

DS: Explain.
BF: In order to build something that worked using 1970s and 1980s technology, we put in some scaffolding—today's Internet backbone. Today, we've confused this scaffolding with essential infrastructure. The 32-bit IP address was a clever hack—it was adequate for a prototype even though it created a dependency. Housekeeping was a problem, so the DNS was created to provide stable identifiers, only to fail because you don't even own your name—your lname. You lease it.

Too bad we continue to try to shore up the scaffolding. IPv6, for example, focuses on the network, not on our ability to do networking ourselves.

The 32-bit IP address was shim in the days when computers seemed immobile. The DNS was created to provide stable identifiers but failed. You can only lease your "identity"!

We deliver physical mail to addresses. Even the Post Office is smarter than that. They know the address is a hint, but the destination is a person.

The Internet ain't bad for a demo but far from what is possible if we take full control from the end.

DS: You've been accused of trying to destroy all of telecom—or at least of disrupting it severely. Isn't that where you're headed here?
BF: Disruption is a consequence and not a goal. For the most part, you want to get the benefit of community.

Modems are an interesting example, because they were accused at the time of destroying the phone network by tying up all that gear. But the bad behavior drove a dynamic. It turns out the problem was not in trying to send the data, but in a network that tied up resources even if you were sending only a few bits. If it weren't for the common carriage laws (inherited from railroads), they could've banned modems—we'd have never known about the Internet.

The carriers actually had a digital alternative, ISDN, but it was too tied to their business model—meaning they charged too much for it. They used it to bring back per-minute charging—you paid even when idle! Analog telephony was "worse", but due to an accident of history, analog phone service didn't have the meter running, which meant we could stay on-line using dial-up! This shows how it is not about technology but how we think about opportunities.

"IF WE FOCUS ON CONNECTIVITY FIRST, SPEED WILL COME."

Today, we are enamored with broadband—the new ISDN. And, like ISDN, it is technically better. But, like ISDN, it's fatally tied to a business model that is in inherent conflict with providing abundance. It allowed us to innovate past the telcos, and for that reason, it was far better. Today, broadband plays the same role that ISDN did.

The irony is that here too the copper wires provide a very cost-effective alternative. If we focus on connectivity first, speed will come. DSL (the technology, not the service) is just a faster modem and can drive the dynamic. And, if we don't care about controlling the path, we can use 802.11 to provide essentially 100% coverage with existing access points!

Why not repeat history and first light up existing copper at modest speeds and modest cost and complement it with open access points? That will drive the dynamic while broadband is a dead fish trying to swim.

DS: So here's the pushback. For most people, the entire frame of reference is the devil we know. The Internet is bundled by the carriers with phone and television, as just another service. And this is seen as a Good Thing. Why are you looking to solve a problem most people don't think they have?
BF: I'm reminded of when Ben Franklin was visiting the Court of King George and realized there was no middle ground between American independence and British rule.

We're not bargaining. We're reframing the problem. Bear in mind what Henry Ford said. If he'd asked customers what they wanted, they'd say, "faster horses". VisiCalc happened because we took advantage of an opportunity. It wasn't that we set out to change the world. That was an accident. Who could have guessed? And no one even asked for it.

DS: Speaking of opportunity, most of our readers are exactly the kind of people who aren't happy being slaves, and who might not want just faster horses. These are the folks who should want to take advantage of your opportunity dynamic.
BF: That's good. Now you need to remember that it takes many people trying many ideas to get something that changes everything. What can you do with the bits you have? I'm sure a lot of readers are already reprogramming their access points, which are typically open-source Linux boxes.

DS: Count on it.
BF: Then it's clear how the value is in how we use the network and not the network in itself. The network itself is a cost center. Why would carriers want that burden if they can't use it to force us to buy services? They are in a trap. If they give us capacity, we won't need to pay for services. If the bits are fungible, they can't bill us for them. They need to escape the Regulatorium rather than hope they can retire before it all comes to a head.

So, rather than thinking of networks, we must think of common infrastructure paid for as such—it will cost less than nothing because we already have so much and haven't even taken advantage of what is already there. Why do cities even have phone bills or separate systems for each service?

Think of the savings if cities used this common infrastructure instead of separate ones for each purpose.

Ultimately, I see replay of divestiture. But if the issue is forced, they can change. It would be fair for them to cut a deal with the FCC to get some money for their shareholders. After all, the FCC put them in an untenable situation.

DS: Who, then, should own the physical infrastructure?
BF: The physical infrastructure needs to be owned and operated locally, like roads and sidewalks. The longer we wait, the more jarring the correction.■

Doc Searls is Senior Editor of *Linux Journal*. He is also a Visiting Scholar at the University of California at Santa Barbara and a Fellow with the Berkman Center for Internet and Society at Harvard University.

Resources

VON Railroads: **www.frankston.com/?name=VONRailroads**

Sidewalks: Paying by the stroll: **www.frankston.com/public/?name=sidewalks**

Writings Archive: **frankston.com/public/?**

SATN.org Blog (with David Reed): **www.satn.org**

PODCAST RECORDING SHOOTOUT

So many VoIP programs, so little time. What's a podcaster to do?

DAN SAWYER

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Do you have a podcast? Okay, dumb question. Of course you do—podcasting is the blogging of tomorrow. It's quick, it's easy, it's not tied to a computer screen, and your audience members can take you with them anywhere on their iPod-ish devices. Best of all, you don't have to worry about actually learning to spell in order to inflict your opinions on others. So long as you can speak clearly and have fun doing it, you too can have a podcast. So who wouldn't want to do it?

I mean, you have an opinion you want to express, right? Or you have a story you want to tell. Or you simply have a desire to see what will happen if you gradually fade the volume out on your podcast until it's near zero, encouraging your listeners to turn their headphones up, before you blast them with a channel-saturating guitar riff to wake them up. The point is, you have a podcast, or you want one.

One thing you begin to notice when you get into podcasting is that listening to your own voice is boring—really boring. It's cathartic to rant into a microphone for half an hour and then put it on iTunes for the world to hear, but after a while, it's really nice to have listeners call in, or have guests, or pick up a cohost in another state.

How can you do it? Telephony, naturally.

Now, I must emphasize that not just any telephony client will work. Ekiga and Skype are not created equal. Neither are Gizmo and Twinkie. That doesn't mean they aren't all good for something, but good for something isn't the issue here. We need good for podcasting, which is a whole other spool of fiber-optic cable.

In my podcasting and production career, I've run into a lot of remote conferencing, and I've found that pretty much any remote conferencing is done for one reason: you can't get the talent into your recording studio (humble as it may be).

Why this can happen is a bit of another matter. For one of my podcasts, The Polyschizmatic Reprobates Hour (don't ask), my sometime-cohost lives halfway across the country, and to have any kind of intelligible real-time conversation, we needed a good telephony setup. This went double for when we needed to bring in guests for interviews. The basic requirements list is as follows:

1. Good sound quality: this show is already going to be compressed to MP3; we don't want to start off with crappy sound in the first place.

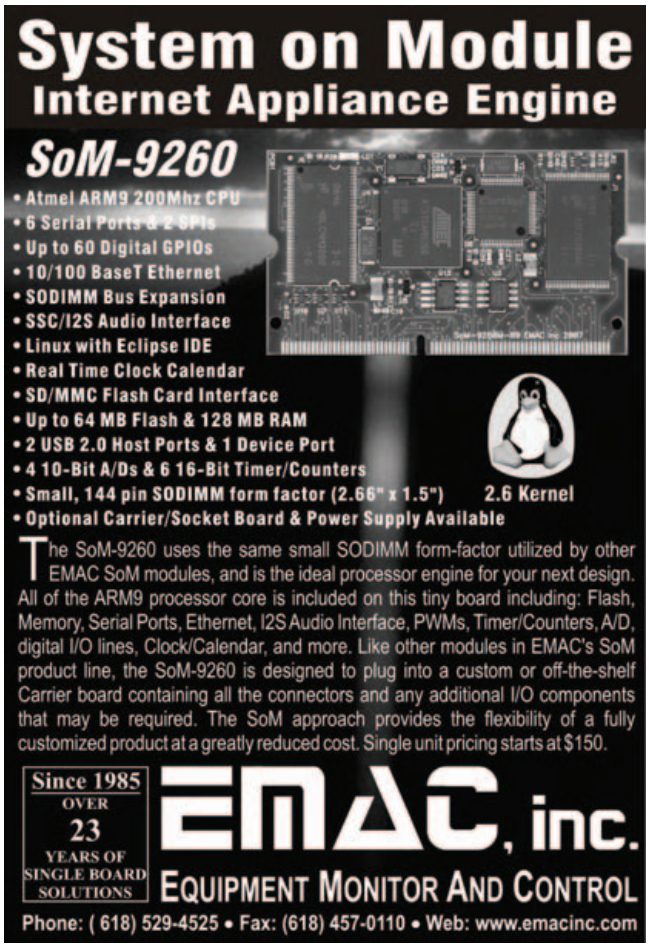
2. Ease of installation: most people still are fairly technophobic or tech-ignorant, and most people still run Windows. That means whatever telephony software you're using for your podcast conferencing, it has to be one that you can get guests up on in a few minutes. Longer or more troublesome than that, and you're going to hear the words of death: "Maybe we should do this another time."

3. Ease of dial-out/dial-in: sometimes, your guests just aren't going to be able to get on your VoIP network, and when that happens, you have to call them on a phone. In that case, you want the experience to go quickly and smoothly—there's nothing worse for your street cred than making a guest, who has carved out an hour for you, wait by the phone. Chances are you'll need to do this at some point. When you do, will it be quick and painless? Will the price be right?

4. Ease of recording: of course, the best-sounding protocols

A NOTE ON PRODUCTION

Your podcast will sound only as good as the production technique. Good equipment is important, and good doesn't always mean most expensive. More important is good engineering—proper EQ and compressor settings, a low noise floor and proper mic technique will make or break your production sound. The software you use is a small component in the podcasting battle. Production and publicity are the other two parts of the holy trinity. If you want to survive in the new media world, get to know them all.



on the slickest software in the world aren't going to get you anywhere if you can't record your conversations, and on this score, VoIP software is justly infamous. Because of the way most conference calls grab your sound ins and outs, it often kills the hardware duplexing your otherwise bright-and-shiny ALSA drivers usually support. But, a lot of people podcast over telephony, so there has to be a way.

5. Carts: this is something from the old days when those of us who took broadcasting training at college radio stations actually had to juggle tapes. A cart was a tape cartridge on a continuous loop that contained station ID, sound effects, music beds or anything else we wanted to punch in to the broadcast. Nowadays with podcasting, most people just lay this stuff down in the final mix, but sometimes it's nice to be able to play things while the show is being recorded—sound effects, quotes from sources upon which you're commenting and so on. This is one of those nice-to-have-but-not-essential features, which does make life a lot easier.

Now, looking back over that list, the vast field of SIP clients narrows substantially. Instead of a couple dozen to pick from, there are only two that will fit the bill, and neither of them are open source.

WHITHER 64?

Neither Skype nor Gizmo offers anything in the way of 64-bit versions for Linux, even though there are user complaints and pleadings about this dating back to May 2005 on both companies' support forums on exactly this topic. Skype recently has introduced a 64-bit Vista client, but Mac and Linux 64-bit clients are, as yet, nothing more than a pleasant adolescent fantasy for the lonely off-platform user. Gizmo, meanwhile, is 32-bits all through.

Both install and run on 64-bit distros, with a little bit of a headache making sure they've got the right 32-bit libs to call in and with setting up the chroot environment. It's a stopgap that works okay, but it ain't pretty, and in a time when 32-bit desktop and laptop processors are being end-of-lifed by hardware manufacturers, this situation really is irritating.

Skype vs. Gizmo

The two main contenders that are suitable for workhorse podcast use are Skype and Gizmo. Both are very easy to download and install. Both offer comparable rates on calls coming in from the phone network and going out again, both nationally and internationally (though Gizmo has a slight edge in this respect). Both are user-friendly and easy to get potential guests set up on so they can be on your show.

They both are usable. They both are workable. They both run quite well on Linux, Windows and Mac OS. Their feature sets are comparable in many respects. But, they are not the same.

The Technical Lowdown

Skype, now the prized stepchild of the eBay corporation, runs on a proprietary peer-to-peer networking back end that co-opts the user's system resources to route calls, up to the maximum of what it can grab that's not being used by other systems. This is comparable to how BitTorrent works, though unlike with BitTorrent, users have no control over how much in the way of bandwidth or system resources they want to allocate to the task. The practical upshot for this where performance is concerned is curiously double-edged. At the beginning of a Skype call, the connection typically is loud and clear, the mix is well proportioned, and the compression artifacts are very difficult to hear (and, if you're good with EQs, you can pretty much notch out the most obvious ones). However, as a call progresses, more of your personal bandwidth gets allocated to other network calls, and the quality of the audio gradually degrades. At low traffic times, this effect is barely noticeable, but at high traffic times, you may find yourself having to restart the call every 10–15 minutes as the quality falls below what you find acceptable (or intelligible).

Its networking setup isn't the only thing that's proprietary—it's also a closed system. Skype's network can't be dialed in to directly from any other voice-conferencing network.

The standards are closed, and they're black-boxed. Although this isn't a problem that's directly relevant to podcasting, if you're looking for a general first-line VoIP package, it's something you'll want to keep in mind. Skype is like Vegas: what happens there, stays there—well, assuming its encryption algorithms are robust.

Gizmo, a service and application owned by SIPphone, Inc., has a somewhat different approach. Although the software itself is proprietary, it uses the open SIP protocol for its transport across the Net, and calls are routed directly over the SIPphone network between the individual call participants, rather than being routed through a peer-to-peer network. Because it uses SIP and Jabber, it can hook up with any software using either of these protocols fairly transparently.

Gizmo uses TLS and SSL encryption to discourage eavesdropping—open technologies whose strengths and limitations are well known. The corporate culture is deliberately geared toward transparency rather than toward opacity, which is an operating philosophy that warms the cockles of this Linux geek's heart. However, when it comes to encryption, Gizmo also loses a point, as it does not encrypt between Gizmo and non-Gizmo SIP clients.

The sound quality on Gizmo follows a different curve from Skype. Because Gizmo routes over the SIP network instead of through a peer-to-peer setup, it is more subject to the fickle winds of fate. When Net traffic is up, Gizmo calls tend to decay. When it's down, they do better. However, Gizmo does not progressively degrade performance over the course of a call or take your bandwidth for allocating to other calls on the network.

In terms of actual performance, the sound quality is usually a wash, but Gizmo consistently sounded better the times I've used it for multiparty conferences than has Skype, particularly on extra long calls.

Recording the Podcast

So, you've got your guest on the line, your cohost on the other line, and all three of you are happily chatting it up in the conference. The podcast is off to a great start—if you can manage to record it correctly. Sometimes, this isn't as easy as it looks.

Skype is notoriously difficult in this area. Although the latest version works on ALSA instead of OSS, on many distros it still doesn't always play nice. It doesn't work well with the Windows or Mac sound systems, either. With full duplex sound hardware, this should be a no-brainer, right? Simply dump the DSP to a file in parallel with running the conference. Alas, some programs want to be front and center, end of story. Skype is one of them. In order to record a Skype call, you have to do one of two things:

1. Hijack the DSP with a middleware layer. There are a number of

packages that'll do this—for a fee—on Windows and Mac. On Linux, I've only ever found one solution that works, and it's a kludge. Twisted Little GNOME has cleverly cobbled together LAME, OggEnc, SoX, Vsound and Skype in an elaborate (though very dependable) script, available at **sourceforge.net/project/showfiles.php?group_id=146056&package_id=160795&release_id=358917**. Unfortunately, this script is not well maintained and tends to break when Skype upgrades. Worse still, this is the only hijacking option that I've been able to find for Linux. The other method of recording Skype calls is suitable only for audio engineers and people that like playing around with too many cables.

2. The two-computer mixdown: there are a few permutations of this, but basically, you'll need two computers—one to conduct the call (Box A) and the other to record it (Box B). To do the recording, you either split your mic into two channels before it hits Box A, and split the speaker out after it leaves Box A, and run them both to Box B as left and right channels. The other option works only if you're running a mixing board: route your mic input to both Mains and Subs, and plug the Box A output in to the board as a Subs-only source, then send the Subs to Box B for recording (if you're not following this, don't worry—just be glad you're not an audio engineer).

Either way, if you intend to record a Skype call, be prepared to put up with a bit of misery.

Gizmo, by contrast, has a recording tap built in to the program, and when you press Record, it announces to all parties on the call that the call is being recorded. Thus, not only is recording the call painless, it also covers your backside legally (see the Legal Issues sidebar).

Carts and Extras

When it comes to live carts, on Skype, you're out of luck. Without third-party plugins, there isn't a thing you can do with Skype to make it play nice with other sound apps on the computer, and not a lot of those plugins are available for Linux.

With Gizmo, on the other hand, you have options. Gizmo comes with a cart interface where you can preload ten sound FX for playing at the touch of a button. You also can route XMMS through Gizmo and play your carts from there, if you need a longer playlist.

Skype and Gizmo also offer varying sets of extras to entice customers. Both have integrated text chat—a very useful feature for prepping your guests for their next question or conspiring with your cohost behind your guests' backs. Both have integrated file transfer—handy for sending outlines or PowerPoint slides to discuss.

Skype's two big standout extras are one-click video conferencing (even under Linux), which can double as a whiteboarding system and extremely easy-to-set-up conference calls.

Gizmo's conference call system, by contrast, can be a bit twitchy, particularly when trying to bring in someone from an external phone network. On the other hand, with Gizmo, you get free voice mail, which is lovely for handling show feedback. On Skype, voice mail comes only with a subscription to Skype Pro.

LEGAL ISSUES

It is a felony in many states to record a phone conversation without the other party's knowledge or permission. If you're dialing out to a phone network, or your guests are dialing in from the phone network, always be sure you get your guests on record acknowledging that they know they're being recorded, and keep those records. It's a good idea to get these records for straight VoIP calls too, as the law will doubtlessly be extended to VoIP networks at some point in the future.

Conclusion

Of the two, on technical merits, Gizmo is the clear victor over most of the field. Happily, it's also the winner on cultural merits. However, Skype is used more widely, and potential guests are more likely to be familiar with it. The different network architectures of the two services gives an odd kind of redundancy—often, when one's sound quality stinks, the other's works gloriously. My advice: keep them both around. But, when it comes time to buy call-out credits or to get a call-in number, stick with Gizmo.■

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, when he founded the Blenderwars filmmaking community (www.blenderwars.com). He currently is the host of "The Polyschizmatic Reprobates Hour", a cultural commentary podcast, and "Sculpting God", a science-fiction anthology podcast. Author contact information is available at www.jdsawyer.net.

TECH TIP Check to See If Your ssh Key Is Loaded

If you use ssh-agent and have scripts that use commands, such as ssh or scp, that need your ssh key, you may have had the experience of running your script only to discover that you never ran ssh-add to add your key to ssh-agent. So, you type the passphrase once to run the script, and then you have to run ssh-add afterward and type it again to add it to ssh-agent.

To avoid this, add a check to the top of your script to see whether your key is loaded. If not, load it, and avoid having to run ssh-add afterward:

```
if ! ssh-add -L | grep --silent '/\.ssh/id_.sa'; then
 ssh-add
fi
```

The -L option of ssh-add shows what keys are added, its output is piped to grep to check to see whether your key is loaded. If it's not, ssh-add is invoked to add your key. —MITCH FRAZIER

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Turn Your Computer into a Phone with Skype

[GETTING STARTED WITH SKYPE. FEDERICO KEREKI]

Want to use your computer as a full-fledged telephone, and be able to make free phone calls over the Internet or paid calls to any normal number? How about adding more features, such as instant messaging, file transfers and video conferences? How about being able to use it on Linux, Windows or Mac OS X? If these things interest you, you should install Skype.

Skype is a free, VoIP (Voice over Internet Protocol) program, created in 2003 by Niklas Zennstrom and Janus Friis. Two years later, eBay acquired it for more than 2.5 billion dollars (plus an unspecified extra amount depending on performance).

As of the beginning of 2008, it has more than 250 million users, both for its free and paid services, in practically every country on earth. When you connect to Skype, in the bottom-right corner, you will see how many other users are on-line at the same time. In my experience, it's usually around ten million, which is a hefty number indeed. Skype derives its income from paid services (including calling or receiving calls from landline or mobile phones, voice mail, call forwarding and so on), but you can use it without paying a cent if you call only other on-line users over the Web.

From Music to TV

Skype wasn't the first collaboration by Zennstrom and Friis, and it isn't their last. In 2000, they created Kazaa, a well-known peer-to-peer file-sharing program. Obviously, they were able to apply the P2P expertise gained there to Skype's own development. Kazaa had plenty of legal problems (similar to those of Napster) because of sharing copyrighted material, mainly music. In 2001, Kazaa was sold to Sharman Networks, which had to face several copyright-related suits. In July 2006, there was an out-of-court settlement, when its Web site seemingly was updated for the last time.

After selling Skype to eBay, Zennstrom and Friis turned to TV and created Joost: a system for distributing video (mainly TV shows) over the Web, once again using the same peer-to-peer technology used on Skype. Joost's development started in 2006, and currently (February 2008), it's at beta. If you want to test-drive this software, however, you are out of luck. For the time being, there are only Windows and OS X versions available. According to some reports, Wine isn't a solution either, though that might change.

Joost will be a free system, supported by advertising, just like traditional TV, aiming for full-screen, high-quality viewing. Though its technology isn't yet mature or fully reliable, it's an interesting concept and free of the legal problems that troubled the original Kazaa. There are some licensing aspects that still need work (most of the available content can be seen only in the US right now), but there's much promise ahead.

Getting Skype

The program itself is free, but it's not open source. And, if you like running the best and latest versions of programs, prepare yourself for a disappointment. The current Windows version is 3.6, the current OS X version is 2.6, but Linux is trailing far behind with only a beta, called 2.0. Thus, plenty of features are missing from the Linux version (see the What's Missing in the Linux Version of Skype? sidebar), but Skype still is quite usable as is.

Skype's hardware requirements are pretty modest. You need a 400MHz processor or faster, 256MB of RAM and about 20MB of free disk space. If you want to talk (don't sneer; you can use Skype just for instant messaging), you need a microphone and either earphones or speakers. And, if you want to make video calls, you need a Webcam. Finally, you need to open an account, but you have to install the program first.

Installation should be quite easy. As far as I've seen, it's available for pretty much all distributions, so you should have no problem finding it in your repositories. Because I use Smart, getting Skype simply meant typing `smart install skype`. In any case, you should check that the version you get is not earlier than 2.0. (To do so, start Skype, click the S on the lower left, select About, and you'll see a window with the version information.) Because Linux lags behind Windows as far as versions, you just might have version 1.4, which would require an upgrade.

If your version is an older one (or if you just want to make sure to have the latest one), visit Skype's download site,

Figure 1. You need an account to use Skype. On Linux, checking Sign me in when Skype starts is safe to use.

and get whatever is correct for your machine. There are distribution-specific versions for Debian, Fedora, Mandriva, MEPIS, OpenSUSE, Ubuntu and Xandros. There also are some generic versions—the "static" one might be best for you.

After the download is ready, open a

Figure 2. Creating an account is simple, but you must do it with Skype.

console, `cd` to the directory where you downloaded the software, and do `sudo rpm -Uvh skype-2-`*XXX*`.rpm`, and you should be ready.

When you open Skype, if you already have an account and a password, simply enter them to connect (Figure 1). However, if this is your first time ever, or if you just want to create a second or different account, click Don't have a Skype name yet?, and a window will open where you can create an account. Follow the instructions on the screen, and you'll be set (Figure 2). Skype won't allow passwords that are too short, but play it safe, and use a long one, preferably with numbers and special characters.

Configuring Skype

The first time you run Skype, check its configuration. Click the S on the bottom left, and you'll see the Options window. Here are some of the possibilities:

- General allows you to specify what happens when you double-click on a contact (either start a call or a chat),

the timeouts (after how much time you will be shown as Away or Not Available) and the program language. Although Skype's Web site advertises almost 30 languages, it came with only 13. Spanish was noticeably missing.

- Privacy lets you decide whether you will accept calls or chat invitations from anybody or only from people you specifically allow, whether you will answer incoming calls automatically (I wouldn't check that), and how long you want to keep the chat history.

- Notifications allows you to assign sound bits to different events, such as an incoming call or an answered call, and whether you will be shown a pop-up notification. If you click Advanced View, you can specify scripts that should be executed on specific events, or a message that should be sent to the other party.

- Chat permits you to define what will happen if somebody starts a chat with you, such as whether to use emoticons and whether other parties should be informed when you are typing.

- Call Forwarding is a paid feature. When someone calls you, and you are not at your computer, you can have Skype call your mobile or landline phone, paying per minute at the regular call rates. (If you call people who forward their calls, you pay nothing.) You even can forward calls to more than one phone, answer whichever you want, and you will be billed accordingly.

- Voice mail is another paid feature, available only with a Skype Pro subscription. Basically, it works as an answering machine, and you can listen to the calls you received whenever you are signed in.

- Sound Devices lets you choose which devices should be used for sound. I'd suggest keeping the default devices, unless you know what you're doing. Click on Make a test sound to verify whether Skype can produce sound, and then click Make a test call to check whether your microphone is working. Then, follow the spoken instructions to see if everything's working.

- Web Devices can be used to specify whether Skype Video will be used, whether video should start automatically, and whether you want to receive other people's video and let them know you have video capabilities. After you have set up your Webcam, use the Test button to verify that you can see yourself.

What's Missing in the Linux Version of Skype?

Skype for Linux is several versions behind the current Windows program and is still in beta. In later versions (keep your fingers crossed, but be prepared for a long wait), it could add:

- Enhanced file transfer speed.
- More stable video calls among users with Internet connections of different speeds.
- Improved video and audio quality on low-speed Internet connections.
- Call quality feedback and bandwidth indicators.
- Safety and privacy improvements.
- Support for MySpace.
- High-quality video calls.
- Video snapshots.
- Auto redial.
- Call transfer.
- Private telephone numbers.
- Import contacts from MSN, Yahoo and Gmail.
- Skype Prime (calling lines that charge per minute).
- Skype Find (a community-generated directory).
- Sending SMS.
- Ten-way conference calls.
- Public chat rooms.
- Predictive dialer.
- Contact grouping.
- Shared groups.

This is a (shortened) version of all new features in the release notes since January 2006, when version 2.0 for Windows came out, so there should be plenty forthcoming for Linux users.

- Advanced lets you select whether you want to check for updates when starting Skype (I'd suggest doing so), which port to use (leave it as suggested), and if you are using a proxy, its details.

- Blocked People lets you manage your blacklist. If you don't want to receive calls from particular users, you can block them from Skype's main window. Right-click on users' names, and you will have the option to block them. If you want to restore (unblock) someone, you can do so here.

Play around with all options, but be sure to check, at the very least, the Sound Devices screen and do a test call. Otherwise, you might find that people call you, but you can't hear them, or that you speak, but nobody hears you.

Using Skype

After installing Skype, your first goal should be setting up your contacts list. The green plus sign icon in the lower-left corner lets you look for other Skype users (Figure 3). In the text box at the top, enter either the Skype name, part of the full name, or the e-mail address to search for someone. You can restrict the search further (probably necessary if the person you are seeking has a common name) to a specific country, state, city, language and sex. Click Search, and Skype runs through all users, looking for those who match and shows a window with the list. If the person you are seeking is on the list, click on the name to select it, and then click Add Contact. The contact will appear on your personal list.

If you have purchased some credit, you also can call landlines. (In order to buy credit, visit Skype's Web site, and you'll find the link in the top-right corner.) You can pay with PayPal, Visa, MasterCard and a few other options. (Remember to use some of the credit; if you don't spend any of it in 180 days, your credit expires and you will lose whatever you had still remaining in your account.)

If you want to add a standard phone, in the Add a Skype contact box, click the bottom link, Add an ordinary phone, and you will be able to enter the name and phone number. These numbers will show

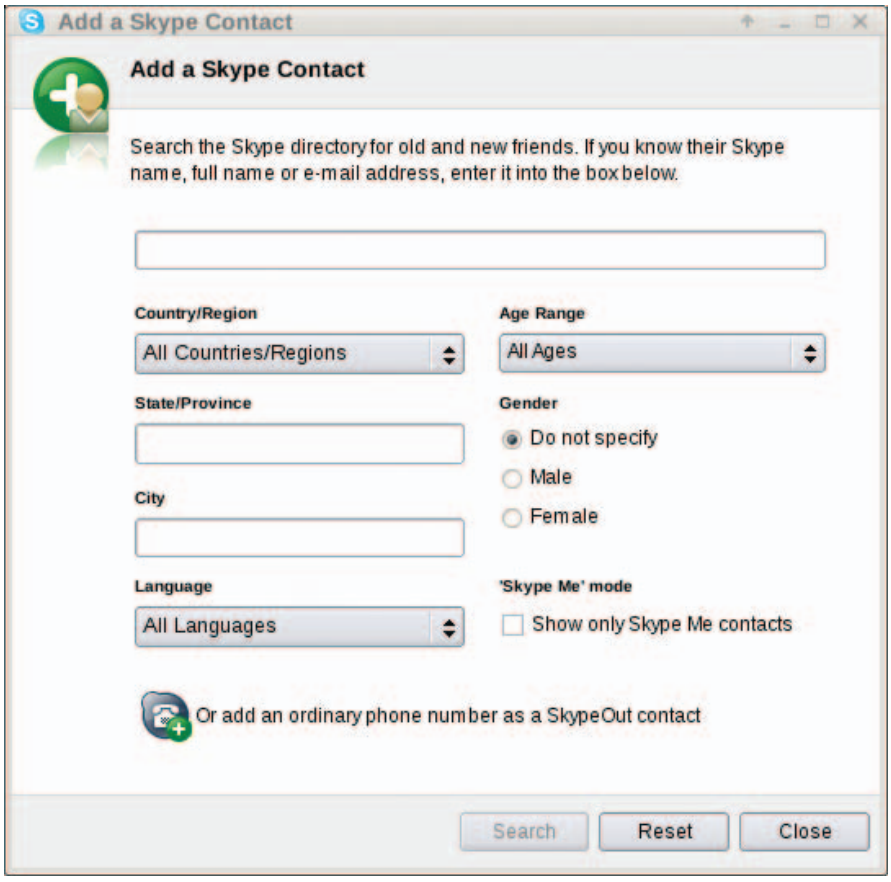

Figure 3. Use the search form to look for people and add them to your contact list.

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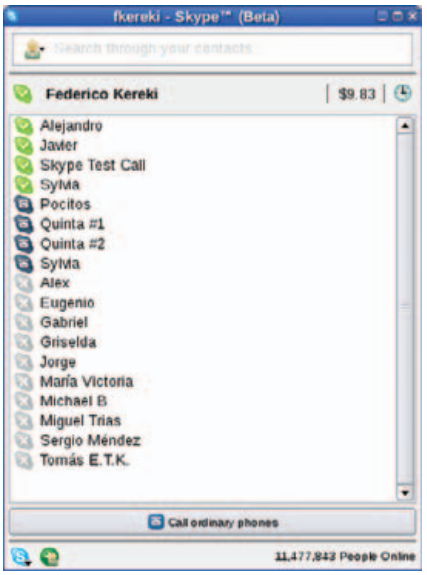

Figure 4. In your contacts list, green icons correspond to Skype users who are on-line, grayed-out icons indicate off-line users, and blue icons represent standard phones.

up in your contact list with a blue (instead of green) icon, so you can recognize them at a glance (Figure 4).

If you click on a user, you can see his or her picture (if you want to upload yours, click on your own name, and then click Edit Profile), and you will see three icons: a sky-blue Start Chat icon, a green Start Phone Call icon, and a down-pointing arrow that adds several more options, such as Send File, View Profile, Rename Contact (if you want to change the way the user appears on your list), and for unwanted users, Delete Account and Block Account. Another option is to click on Call Ordinary Phones, which shows a touchtone-type display, allowing you to key in any number from any country; remember this has a cost, and you must have enough credit for this.

During a phone call, you can right-click on the call window at any time and get similar options as described in the above paragraph. You even can start a chat, simultaneously with the call (you might want to do this should your connection prove a bit flaky). Another option is adding video, so you can send your image to the other party. You can do this automatically (depending on how you configured the video options, as described previously) or on demand (simply click the button). Click the red button at the lower right to hang up and finish the call.

The chat window is quite similar to all other IRC channels. You can add more people to the chat if you like; simply click the Add People button. To end a chat, click on Leave Chat or close the window.

Resources

Skype: **www.skype.com**

Download Skype: **www.skype.com/intl/en/download/skype/linux/choose**

Joost: **www.joost.com**

Kazaa: **www.kazaa.com**

TIME article on "The Skype Guys": **www.time.com/time/magazine/article/0,9171,1187489,00.html**

Libland Webcam Drivers: **mxhaard.free.fr**

List of Supported Webcams: **mxhaard.free.fr/spca5xx.html**

Getting Your Webcam to Work

The biggest enhancement in Skype 2.0 is the video capabilities, so I certainly needed a Webcam in order to write this article. I went to a nearby computer shop, and knowing there could be driver problems (most Webcams, if not all, come only with Windows drivers, and not even a peep regarding Linux), I applied my common sense, studied the options thoroughly and opted for the cheapest model—if it wouldn't work, at least it wouldn't cost much!

Even with the lack of support, there's a good source of drivers at the Libland Web site. Its owner, Michel Xhaard, is doing a great job in providing a free driver that works with more than 200 different Webcam models. Thus, as the model I bought wasn't exactly cutting-edge, I thought there would be a good chance it would work out of the box with this driver.

I installed the Webcam, and did `lsusb`, which produced a line reading `Bus 001 Device 002: ID 0ac8:307b Z-Star Microelectronics Corp.`. The first four characters (actually, hexadecimal numbers) after ID identify the manufacturer, and the last four characters specify the model. I then checked the list of supported Webcams, looking for these values, and didn't find them; however, I did find several other models from the same manufacturer, so I decided to give the driver a whirl. Because I'm running kernel 2.6.23, I needed the gspcav1 driver; for kernels below 2.6.11, scpa5xx is needed. I downloaded the package, and then as root, did the following:

```
tar zxf gspcav1-20071224.tar.gz
cd gspcav1-20071224
./gspca_build
```

The process ran seamlessly, so I tried the Webcam with Skype, and it worked. You might not be so lucky, but I recommend starting your search for a driver at Xhaard's site.

Conclusion

Skype lets you turn your computer into a phone, capable of calling both Skype users and common phone numbers all over the world. Let's hope that the Skype developers speed up a bit, and let Linux users have more of the functionality available in other operating systems.■

Federico Kereki is an Uruguayan Systems Engineer, with more than 20 years' experience teaching at universities, doing development and consulting work, and writing articles and course material. He has been using Linux for many years, having installed it at several different companies. He is particularly interested in the better security and performance of Linux boxes.

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Adventures with Chumby

Turn the Chumby device into a useful kitchen assistant.

DANIEL BARTHOLOMEW

I am now the happy owner of one of the coolest gadgets I have ever experienced, the Chumby. At first glance, this diminutive computer appears to be nothing more than a Web-connected alarm clock. This, in and of itself, is a neat idea, and worth the price of admission for me. However, the Chumby is much more than a simple alarm clock, Web-connected or not. To that end, I made a conscious decision when the Chumby was on its way to me from the factory in China *not* to have the Chumby in the bedroom. Such a useful device should be in a room where people can take advantage of it while they're awake.

Figure 1. What Comes with the Chumby

The Chumby, at its heart, is a small embedded computer wrapped in a soft, squeezable shell made of plastic and leather. If you want to get technical, the Chumby is powered by a 350MHz ARM processor and contains 64MB of SDRAM and 64MB of NAND Flash ROM. For output, it has a 3.5" LCD color touchscreen, 2W stereo speakers, two USB 2.0 full-speed ports and a headphone jack. For input, it has the aforementioned touchscreen, a squeeze button on the top, and an accelerometer for motion and tilt sensing. It connects to the Internet via 802.11b/g, which means you need to have a wireless network of some sort. Power is supplied by an external AC adapter, and there also is a connector for a nine-volt battery for emergency power.

The Chumby displays small Flash movie "widgets". These Flash movies can do anything that Flash movies can do within the limits of the Flash-Lite-3 embedded Flash player that the Chumby runs. In practical terms, this means it can play most Flash movies that run in version 8 or lower of the Flash browser plugin. Some features were added in version 9 of the browser plugin that are not supported in Flash-Lite-3.

Figure 2. Back of the Chumby

A lot of thought and care has gone into the design of the Chumby, and every effort appears to have been made to make the Chumby as easy to use as possible. Even the packaging contains some nice touches, such as the linen bags the Chumby arrives in instead of yet another box. The bags are useful and mean less waste—always a good thing in my book.

The user interface also is well designed. My very nontechnical wife was able to find her way around the Chumby easily. There even is a nice movie that plays when you turn the Chumby on for the first time that gives you a quick tour of the interface and main features.

Once I had the Chumby unpacked and connected to my

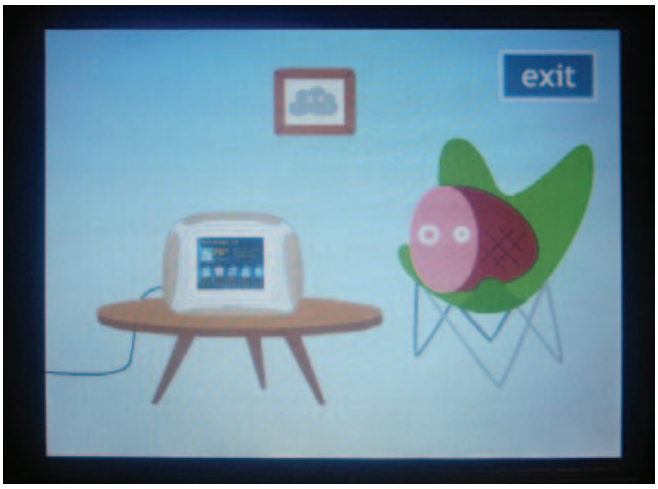

Figure 3. The Chumby Guided Tour

network (and had given the little charms that I found in one of the bags to my kids), it was down to business. My original thoughts on what I wanted to do with the Chumby were to turn it into a kitchen assistant with a favorite recipes database that it served up from either a built-in or in-house Web server, a recipe search widget (to search the recipes in the database, or find new ones on-line), a music player, a shopping list creator, a meal planner, a calendar, a photo album, an egg timer, a calculator and a plain-old alarm clock. Ten things shouldn't be too hard, right? Well, my success was mixed. Some things worked out great, and others, not so much. I haven't given up on getting all of the above working eventually, but not all of them work at this time.

Figure 4. The Chumby in the Kitchen

My first order of business was to try to create some Flash widgets, and I quickly found there are some major downsides to having Flash be the preferred method of application development on the Chumby. The good part is that the Flash software from Adobe is easy to use and can create all sorts of things. The bad part is that said software—apart from it being proprietary, closed-source and available only for Windows and Macintosh—costs twice as much as the Chumby, and there are no easy-to-use open-source alternatives to the Flash programming environment that run on Linux.

There has been some progress in this area, mostly along the lines of simple environments for writing and compiling Adobe's Action Script language into Flash movies, but the best of these, FlashDevelop, is Windows-only. I'm also not too keen on learning yet another programming language. There are some Linux GUI tools that are in the proof-of-concept stage (meaning they look nice but don't work).

Another option for me would have been to hack the underlying embedded Linux operating system on the Chumby and add something like embedded GTK or KDE, but I quickly put that out of my mind, as I don't think I have the chops to avoid turning the Chumby into a paperweight in the process.

So, I went with what I had, and what I could find. The upside to this approach is that new widgets are being released

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The Secret Chumby Menu—It's as Easy as Pi

There's a secret menu on the Chumby, and it is fairly easy to reach. Here's what you need to do:

1. Bring up the control panel.
2. Tap on Settings.
3. Tap on Chumby Info.
4. On the info screen, in the upper-right corner is a tiny Pi symbol, tap it.
5. Done!

If you followed the above steps, you now are looking at a screen titled "Do you believe in the Users?". *Tron* references aside, now you can do things like browse the filesystem and start up the SSH dæmon.

all the time—more than a dozen in the few weeks that I've had the Chumby—and people are constantly thinking up new things for their Chumbys to do.

The Chumby as an Alarm Clock

There is an alarm clock built in to the Chumby, so this one was checked off of my list before the Chumby arrived. The Chumby can have multiple alarms, and the alarms can trigger different sounds and activate different sets of widgets. For example, in the morning I have an alarm that does not make a sound (the Chumby is not in my bedroom, so any alarm sound would not be heard), but what it does do is switch the active set of widgets over to my "morning" set, which contains a mixture of news and weather widgets that I like to look at while I'm getting breakfast ready. When the time comes to take the kids to school, there's another alarm, and this one does make a sound. I also have other morning, afternoon and evening alarms that—although they don't make any noise—switch the active widget set to the sorts of things I am generally interested in at those times.

The Chumby as a Digital Photo Frame

The photo album also was checked off before the Chumby arrived. There are many options for displaying photos through your Chumby. The easiest are the series of official photo widgets that can pull photos from your Flickr, Picasa, Photobucket or MySpace accounts. You just enter your login details and the album you want, and away you go.

There is also a neat service called Dailio where you can send photos to a special e-mail address, and they will show up on your Chumby without any further effort.

The Chumby as a Kitchen Timer

The egg timer was another easy item to cross off my list, as an enterprising member of the Chumby community (the same one who created the Dailio widget) already created one that works very well.

Figure 5. Toasty, the Chumby Kitchen Timer

The Chumby as a Calculator

There is a also a calculator widget that a different member of the Chumby community created. It works well, and that's about all I have to say on the subject, apart from that I wish the buttons were bigger.

The Chumby as a Calendar

The calendar widget I'm using is one that displays my Google Calendar. It is limited to an agenda view that lists each scheduled item in order. It would have been nice to have daily, week or month views, but it is certainly usable if not quite what I was looking for.

The Chumby as a Music Player

I was very pleased with the Chumby's support for listening to music. The music section of the Chumby control panel has several options that let you listen to music from a variety of locations. These include an iPod, SHOUTcast streams, Mediafly podcasts, any radio streams in MP3 or Ogg format from radio stations or your own local SlimServer, or music files (in Ogg, MP3 or FLAC format) from a USB thumbdrive plugged in to one of the available USB ports.

Incidentally, the speakers on the Chumby sound quite nice, especially considering their size. There is, of course, the option to plug in a set of external speakers or a pair of headphones to the headphone jack if you want better sound.

The Chumby as a Recipe Book

The first idea I had for my kitchen-assistant Chumby was to make it into a recipe book, so I focused a lot of my efforts here. The recipe book idea is also, coincidentally, my wife's

Figure 6. Music on the Chumby

favorite use for the Chumby. She's been storing her favorite recipes for years now on her computer in .odt format, and whenever she cooks something she needs a recipe for, she either makes a lot of trips back and forth to her computer, or she prints the recipe out. Neither of those options are ideal.

As with the other tasks I had outlined for the Chumby—I named him George, by the way—I first went looking to see if someone had a recipe widget already created. I could not find any, so I then decided to look to see whether there were any widgets I could easily adapt into becoming a recipe widget.

There are several photo-viewing widgets, so my first inclination was simply to create 320x240 pixel images of my recipes, upload them to my Flickr or Picasa accounts, and then view them on the Chumby. This worked—a PNG image is a PNG image after all—but it didn't work very well, because practically all of the photo widgets are for showing slideshows, with the photos switching every few seconds. This is fine if you are displaying photos—I use the Flickr one for pictures of my kids and love it—but recipes need to stay on the screen for several minutes (or longer,

Chocolate Oatmeal Cookies

Ingredients:

½ cup milk	½ cup margarine
2 cups sugar	6 tablespoons Cocoa
pinch of salt	Wax paper
1 teaspoon Vanilla	3 cups oatmeal

Directions:

Mix sugar, cocoa and salt. Add this to melted butter and milk. Stir and let boil for three minutes. Add vanilla and oatmeal. Drop spoonfuls onto waxed paper. Let cool. Makes 4 dozen cookies.

Figure 7. My Early Attempt at a Recipe Book—Individual "Card" Images

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Chumby Software Licenses

The software on the Chumby is open source, through and through. Just take a look at the Software Licenses screen (accessed from Settings→Chumby Info→Software Licenses). Hack away at the Chumby all you want.

depending on preparation time).

The photo widget that worked the best was the Dailio widget. Unlike other photo widgets, this one lets you set how long a photo stays displayed (from five seconds to five minutes). There also is a forever option, which I assume means that the photo stays displayed until you change it manually, but that option did not work for me. Instead, it caused the recipes to blink and stutter. So I was stuck with five minutes, which is okay, but not perfect.

I finally found the perfect recipe option sitting right under my nose: Impress, the OpenOffice.org presentation application. It has an option to export any slideshow as a Flash (.swf) file. It also turns out that these files play perfectly on the Chumby, even though they are not technically the correct size. So I chose one of the basic templates, and then, using each slide as a "recipe card", created a recipe book.

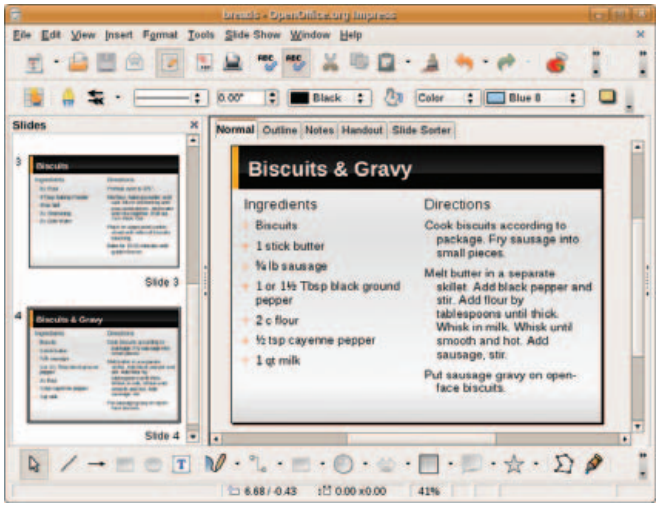


Figure 8. Creating a Recipe Book

For simplicity and ease of use, I did not put in any transitions or text animations. I also tried to keep the fonts as large as possible while still fitting an entire recipe on a single slide. The side effect of not putting any auto-advancing slides into my presentation is that each slide stays put until I'm done with it, which is perfect behavior.

Each presentation always starts at the first slide, and you have to tap through each preceding recipe to get to the one you want. So I created several presentations with general themes, like desserts, main dishes and so on, to keep the number of recipes per widget manageable.

Currently, the recipe books are pretty plain. Over the next few weeks, I plan to add photos to the recipes and make other general improvements, but as they stand now, they already have been put to good use.

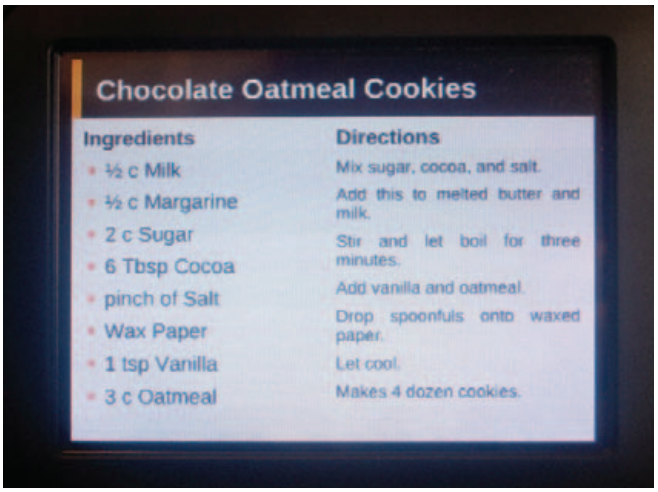


Figure 9. A Recipe on the Chumby

The process of getting a custom widget, like my recipe books, onto the Chumby is simple. There actually are a couple ways to do this, but the most straightforward option is to upload it to Chumby.com and add it to one of your channels there. All you need is your .swf file and an icon. The icon is a simple 80x60 pixel .jpg image. I kept mine simple by putting black text on a white background using The GIMP.

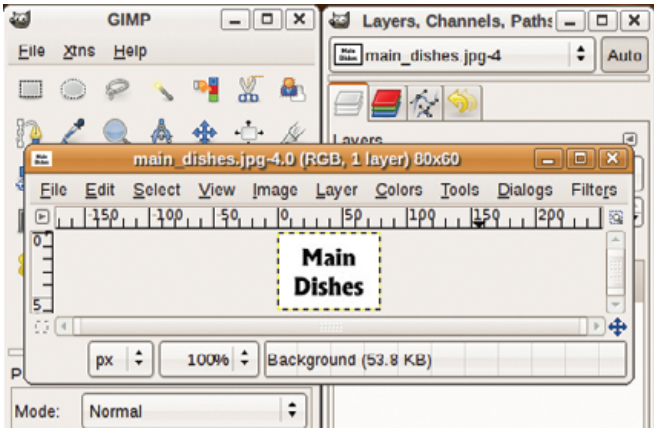


Figure 10. Creating an Icon in The GIMP

Go to **www.chumby.com/widgets/upload** to upload your widget. The form is self-explanatory. Once uploaded, your widget will be available in the category you chose,

Listing 1. Sample profile.xml File

```
<profile>
  <widget_instances>
       <widget_instance id="1">
       <widget>
         <name>Breads</name>
         <description>Various bread recipes.</description>
         <version>1.0</version>
         <mode time="180" mode="timeout"/>
         <access sendable="false" deleteable="false" access="private"
          virtualable="false"/>

         <user username="myusername"/>

         <thumbnail href="file:////mnt/usb/breads.jpg"
          contenttype="image/jpeg"/>
         <movie href="file:////mnt/usb/breads.swf"
          contenttype="application/x-shockwave-flash"/>
       </widget>
       </widget_instance>

       <widget_instance id="2">
       <widget>
         <name>Cookies</name>
         <description>Various cookie recipes.</description>
         <version>1.0</version>
         <mode time="180" mode="timeout"/>
         <access sendable="false" deleteable="false" access="private"
          virtualable="false"/>

         <user username="myusername"/>

         <thumbnail href="file:////mnt/usb/cookies.jpg"
          contenttype="image/jpeg"/>
         <movie href="file:////mnt/usb/cookies.swf"
          contenttype="application/x-shockwave-flash"/>
       </widget>
     </widget_instance>

  </widget_instances>
</profile>
```

and if you marked it as public, it will be viewable by all Chumby users (once the Chumby folks have determined that it isn't a malicious widget).

The only real downside to the browser method is that Chumby.com will let you upload only widgets that are less than 100K in size. If you create a widget larger than that—and I expect that once I've added all my recipes and photos, each recipe book has the possibility to be larger than that—the other way to get a widget onto your Chumby is with a USB thumbdrive.

For the thumbdrive method, apart from the icon and Flash files, you need a text file named profile.xml. The Chumby looks for this file when it boots and will add any widgets described in it to all of your widget channels. This file is self-explanatory, and the Chumby Wiki provides full instructions.

There is also a neat service called Dailio where you can send photos to a special e-mail address, and they will show up on your Chumby without any further effort.

The Chumby as a Recipe Search Engine, Shopping List Creator and Meal Planner

I haven't been able to get all the things I wanted to get onto the Chumby onto it. However, after actually using the Chumby for a couple weeks, I'm not so sure they were good ideas to begin with.

The main reason for this is that my intended recipe search, shopping list creator and meal planning widgets all would require extensive text input, and that is where the Chumby is not ideal. The Chumby is mainly an output device, suited to displaying various bits of information. Input is best limited to simple interactions, such as tapping on buttons and sliding your finger around the screen.

The Chumby can handle text input, and some widgets require it. The control panel, for example, has a simple on-screen keyboard where you enter in your wireless settings during the Chumby's initial setup. Also, in the music interface, there is another on-screen keyboard where you enter in the location of the music stream to which you want to connect. But, supporting text input where required and doing a lot of text input are two very different things.

After entering text in just those two above-mentioned places, I could see it was not something I would want to do on a regular basis with the Chumby, because although it works, it's slow. The problem is that when using the Chumby, the natural thing to do is to use your fingers, and most widgets—if they have buttons at all—keep them

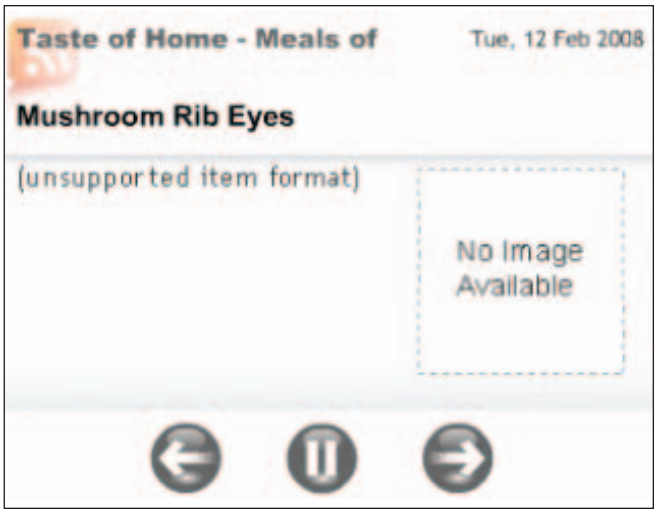


Figure 11. Some RSS feeds don't work.

large and few in number. For effective text input, you need a lot of small buttons, and on the Chumby's screen, lots of small buttons practically requires you to use a stylus—not something I want to have to use with the Chumby.

I toyed around with using an RSS widget to display recipe data from sites that offer it, such as Taste-of-Home's Recipe of the Day, but as you can see from the screenshot, my testing did not go so well.

Final Thoughts

The Chumby is an amazing device. It can be adapted to fit in with almost any room in the house and can display any sort of data that can be displayed within the confines of the Flash file format.

New widgets come out all the time, and the basic software is under constant improvement. Check out **chumby.com** and browse the available widgets; there's something for everyone.

The Chumby is also very hackable. The underlying operating system is embedded Linux, and all the source code (apart from a few licensed bits that they aren't allowed to disclose) and complete hardware schematics are available on the Chumby Web site. The developers really seem to get the idea of making a device hackable, with their only warning being a gentle reminder that if you take your Chumby apart, it will void the warranty. Beyond that, they actively encourage you to turn the Chumby into anything you please and are eager to help you in any way they can through their Web site, forums and wiki.

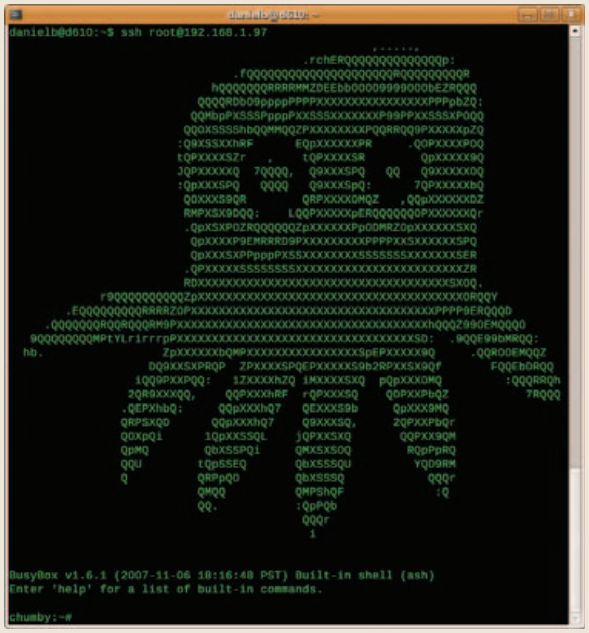
In these days of locked-down, don't-you-dare-look-behind-the-curtain-or-we'll-sue gadgets, having one that you can mod to your heart's content, with full schematics and source code—and the original developers—to guide you, is a nice feeling.■

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

SSH and HTTP on the Chumby

Being based on Linux, the Chumby has a lot of functionality that isn't exposed right off the bat. An example of this is the built-in Web server and the ability to SSH into the Chumby.

The Web server, by default, has only a link to some statistics on how good the wireless connection is, but it can be extended easily.



Yes, you can SSH into the Chumby.

When you SSH into the Chumby, you'll find a nice, embedded command-line environment waiting for you, courtesy of BusyBox. You even can set up cron jobs and run shell scripts.

Resources

The Source for All Things Chumby: **chumby.com**

The Friendly and Helpful Chumby Forums: **forum.chumby.com**

The Chumby Wiki: **wiki.chumby.com**

Nitty-Gritty Chumby Details: **www.chumby.com/developers**

FlashDevelop: **www.flashdevelop.org**

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AVSynthesis: Blending Light and Sound with OpenGL and Csound5

Introducing a unique and powerful program for mixing *son et lumière* into fascinating experimental videos.

DAVE PHILLIPS

The artistic combination of sound and image is a common enough phenomenon. Movies, television and various Internet channels demonstrate the happy results from the blend of recorded sight and sound. However, these examples typically utilize sound in the role of an accompanist, perhaps greatly significant but still primarily an accompanist.

There is another way to consider the role of music and sound in video production—a way in which the sound itself informs the flow of images and their transformations. Although not a novel concept (see the Wikipedia entry on John Whitney), the practice has taken on a new richness of possibilities with the use of computers in the recording and editing of digital *son et lumière*.

Jean-Pierre Lemoine has been exploring these new riches at least since the late 1990s. I profiled his HPKComposer (coauthored with Didiel Debril) in my *Book of Linux Music & Sound*, which was written in 1999, and even then the HPKComposer Web page stated that the program was "... a 3D art composition tool for Csound". At that time, the authors chose to use the Virtual Reality Modeling Language (VRML) for its graphics engine. I could meet the program's Java requirements and work with its Csound side, but I was unable to work with VRML under Linux then. Nevertheless, the Web site's screenshots made quite an impression, and I hoped that someday such a program would become useful under Linux.

Cut to the work of Csound developer Gabriel Maldonado: his CsoundAV for Windows is a true fork from the canonical Csound source tree, but Gabe is a genial fellow who freely offers all his code extensions to the community. Recent developments in canonical Csound have facilitated the adoption of some CsoundAV opcodes, though we await the inclusion of the CsoundAV opcodes for OpenGL, and this situation brings us to the latest work of Jean-Pierre Lemoine, titled simply AVSynthesis (Figure 1).

AVSynthesis embraces and extends many of the design concepts behind HPKComposer. The program blends sound and images to produce abstract non-representational works of art. It's written in Java, and Csound is still the audio engine of choice, but the VRML interface has been replaced by a set of image controls based on the OpenGL shading language (GLSL). The program creates radical associations and correspondences between image and sound, leveraging the powers of Csound and OpenGL for the arbitrary manipulation of digital audio and digital images.

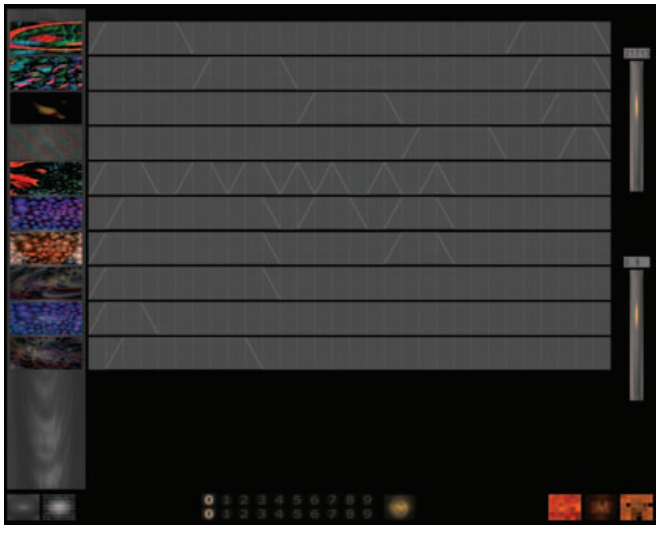

Figure 1. AVSynthesis in Play

Requirements and Installations

Like many experimental applications, AVSynthesis is not a perfectly packaged program, and it is not ready for use right out of the box. It is a unique program, and as such, it has some unique requirements that may not be met by your distribution's package repositories. Building the required dependencies is not especially difficult, as long as you have a typical Linux development environment installed and properly configured for your system. I include here the particular instructions for compiling Csound and configuring AVSynthesis, with some notes on the requirements for building the application on a 64-bit system.

AVSynthesis demands a specific set of dependencies:

- Java (1.5 or higher)
- LWJGL (the Light Weight Java Game Library)
- Csound (5.07 or higher)

- OpenGL

Where they are noted, the versions are critical, and each component is subject to its own build prerequisites. As mentioned, Csound needs some special attention in order to use it with AVSynthesis.

Csound has its own set of necessary dependencies, but space restrictions here forbid a complete description of the program and its requirements. Fortunately, thorough and excellent documentation is available from **www.csounds.com**, so I focus here only on the configuration needed to compile the program for use with AVSynthesis.

The following options configure and compile the csound binary for double-precision floating-point numerics and create lib_jcsound.so, a Java "wrapper" library for Csound's audio synthesis and processing services:

```
scons useDouble=1 install=1 buildPythonOpcodes=1 buildInterfaces=1
➥buildJavaWrapper=1 dynamicCsoundLibrary=1
```

The Python opcodes are not required by AVSynthesis, but I include the option for use with Steven Yi's blue, a superb environment for working with Csound. All other options in this build configuration must be included for work with AVSynthesis. If the build is successful, the lib_jcsound.so library will be at the top level of the Csound source tree. Install Csound (`scons install`), then copy lib_jcsound.so to the AVSynthesis native directory. That's it; you're finished with setting up the audio side of AVSynthesis.

The OpenGL and LWJGL libraries provide the interface's visual components and style. The various parameter control screens resemble the control panels seen in many OpenGL-based games, with visual effects, such as animated icons and mobile transparencies—niceties that liven the appearance of the program and improve its work flow.

The LWJGL libraries present a minor difficulty. The AVSynthesis package includes the LWJGL libraries as Windows-format DLLs but not the required native Linux libraries (that is, in .so format). The package includes these DLLs:

- DevIL.dll
- ILU.dll
- ILUT.dll
- _jcsound.dll
- lwjgl-devil.dll
- lwjgl.dll

Those files must be replaced by the following native Linux equivalents:

- libIL.so
- libILU.so
- libILUT.so
- lib_jcsound.so
- liblwjgl-devil.so
- liblwjgl.so

The lib_jcsound.so library comes from the Csound build described above; the others come from the LWJGL binary package (downloaded from **lwjgl.org**). Alas, 64-bit users will need to build and install the LWJGL and the IL libraries themselves. As far as I could tell, packages for these libraries are not readily available in 64-bit format, but building them is trivial and requires no special instructions beyond adding --with-pic to the configuration step (`./config --with-pic`). After building or downloading the libraries, they must be copied to the AVSynthesis native directory. You then can move or delete the DLL versions.

Neither Java nor OpenGL requires any rebuilding or special runtime options. These are common packages now, so if you don't have them installed already, summon your package manager and install the latest versions (Java must be 1.5 or higher). AVSynthesis itself is launched from a .jar file that works equally well in a 32-bit or 64-bit environment.

In addition to these software requirements, your computer should have a fast CPU and a video system capable of accelerated 3-D graphics. I tested AVSynthesis on two machines: a 32-bit box with an AMD64 3800+ CPU (a 2.4GHz chip) and a 64-bit machine powered by an AMD64 3200+ CPU (2GHz). Both systems include NVIDIA graphics boards (GeForce 7300GS and GeForce 7600GS, respectively), with xorg.conf configured for NVIDIA's proprietary nvidia driver (that is, not the open-source nv module). The 32-bit iron runs the JAD distribution, based on OpenSUSE 10.2, and my 64-bit box runs 64 Studio, a Debian-based distro. Both systems are optimized for multimedia and include kernels optimized for real-time performance. However, programs such as AVSynthesis want resources, lots of them, and I consider my machines as rather low-end for AVSynthesis. Your mileage may vary, of course, but for the best results from this program, I recommend a 3GHz CPU, at least 2GB of RAM, a fast 3-D graphics card and a large, fast hard disk.

I also recommend a high-quality audio system. Cheaper desktop speaker arrays may be suitable for watching DVDs, but Csound is capable of audiophile-quality output, so you'll want a sound system as powerful as your graphics system. Here at Studio Dave, I have my JAD box connected to a relatively low-end 5.1 sound system (a combination of Creative Labs and Peavey hardware), while the 64 Studio machine is hooked up to a conventional small studio audio system with a Yamaha digital mixer, a standalone 100-watt power amplifier and a pair of high-quality monitor speakers.

Getting Started with AVSynthesis

Now we can get started with AVSynthesis. First, edit the data/config.xml file for the runtime options for Csound and OpenGL. I added these options to set up Csound for running with the JACK audio server and to configure OpenGL for my screen dimensions and video frame rate:

```
<config csound="-+rtaudio=jack -+rtmidi=portmidi
 ➥--expression-opt -odac:alsa_pcm:playback_ -d -m0 -g -f
 ➥-M0 -b1024 temp.orc temp.sco" ksmps="16" width="1280"
 ➥height="1024" fullscreen="false" FPS="30"/>
```

Other options must be used if Csound is not compiled with JACK or PortMIDI support. See the Csound documentation for information about other startup and runtime options.

Next, I prepared the Csound and Java environments with these commands:

```
export OPCODEDIR64=/usr/local/lib/csound/plugins64/
export PATH=$PATH:/home/dlphilp/jdk16/:/home/dlphilp/jdk16/bin/
```

These commands can be added to your home directory's .bashrc file to automate this step.

Next, I used QJackCtl to configure and start the JACK audio server. This step is unnecessary if you're not using JACK, but I advise doing so for best latency.

Finally, I could start the program:

```
cd $HOME/AVSynthesis
java -Xmx768m -Djava.library.path=./native -cp
 ➥AVSynthesis.jar:./lib/*  org.hpk.av.AVSynthesis
```

This command calls Java, sets a memory amount for it, points the Java library path to the AVSynthesis/native directory, declares the classpath (-cp), loads the needed .jar files from the top directory and the lib directory, and launches the application. By the way, the cryptic string at the end is in the AVSynthesis jar file. It's a weird way to start an app, I know, but Java can be like that.

How It Works

AVSynthesis takes two or more PNG or JPG images, blends them together in an animated sequence and treats that sequence with various transformations made possible by the OpenGL shading language. At the same time, the program creates a soundtrack that follows the same timeline as the video sequence. The soundtrack itself may be heavily treated by the synthesis, processing and composition algorithms provided by Csound. In AVSynthesis-speak, this combination of sound and image is called a layer. By the way, you can add your own PNG and JPG images to the AVSynthesis data/textures directory, and your own soundfiles can be added to the data/loops directory (for processing by the Csound loop instrument generator).

Given the space limitations for this article, it's impossible to describe the variety of controls over the image and sound processors fully. Consider this possible scenario for the audio section alone: up to three sound sources are available per layer, each sound source is one of five generator types, and each generator's sound can be modified further by up to three audio signal processors. Each processor is one of 13 types. Almost every parameter in the synthesizers and the processors can be modulated by one of eight envelope curves, and each curve is also subject to a modification of its time span. As you can see, it's complexity within complexity, and I haven't even considered the possibilities added by the sequencer and the mixer.

Let me describe an uncomplicated project—an exercise to demonstrate AVSynthesis basics. Note that my description only scratches the surface of this program, and that its full power can be seen and heard only *in vivo*. I've provided links in the Resources section to some demonstration files, but they merely hint at the possibilities. Worse, the necessary video compression codecs are unkind to the vivid clarity of an AVSynthesis real-time performance. With these facts in mind, let's proceed to the project.

The Composition Editor, Part 1

AVSynthesis opens to the composition editor, the program's highest level. This screen is similar to a track display in a digital audio multitrack recorder, but a track here performs only one task. Each track is a timeline divided into 30 ten-second sections, and each section contains one stage of a simple three-stage line-segment envelope that controls the visibility and the corresponding audio volume of the track's layer. As we shall see, this envelope itself may be modified by factors working elsewhere within the program.

No text labels or tooltips describe the Composition screen's various functions, so the user must memorize their significance and purposes. Fortunately, there are relatively few functions on this screen. Figure 2 defines the other screen elements, most of which deal with performance controls and save/load functions. Later, we'll consider some of them more closely, but first, let's make a movie, with sound.

Figure 2. The Composition Screen Layout

The Layer Editor

Figure 3 shows a default empty layer. When the mouse pointer stays on the layer image, a transparent overlay appears with various controls for managing the layer. Click on the icon in the lower-left corner of the overlay to invoke the Layer Editor shown in Figure 4. The icons across the top of the screenshot represent, from left to right, the transformed image, the base image selector, the modulating image selector, the GL shader effect editor, the envelope curve editor and the audio system editor. Let's start our movie-making by selecting our base and modulator images to create an image for treatment by the GL shaders. Next, click on that image (it's the largest of the top three) to invoke the GLSL shader selector, then set the light source, contrast and effect processor for your blended image. Each shader has its own set of performance controls, some of which are shared by all the shaders, while others are unique to the particular effects you've chosen. Figure 4 displays the results of such a process after adding the Wobble shader.

Figure 3. A Blank Layer

Figure 4. The Layer Editor

At this point, you can call the GL shader editor for further finessing of the transformation. Note that the transparency that appears over the blended image includes a play control for testing your later transforms at any point in the process, so feel free to bend, fold, staple and mutilate to whatever degree necessary. Set constraint ranges, apply envelope curves and specify single values. Experiment, experiment, experiment. Be aware, however, that AVSynthesis is short on safeguards, so save your work frequently. There's also no undo/redo, and you receive no warnings about anything except when you decide to quit the program.

Figure 5 shows the control panel for the Wobble effect. The shader's unique controls are at the bottom of the panel and

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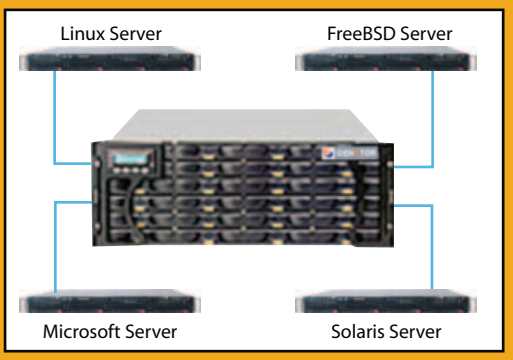

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consist of a start slider and two sliders apiece for controlling the frequency and amplitude parameters of the effect. The remaining controls are, as mentioned, common to all the shaders. They include texture managers, a transparency slider, color controls, and eye and light positioners. These common controls can be augmented by extensions required by a particular shader.

Figure 5. GL Shader Controls

A parameter value can be set explicitly with its slider, or you can define a range of values with the constraint mask (the black and gray bars shown in Figure 5) to limit the possible values only to the range covered by the mask. This range can be modified further by one of the envelopes defined in the Curves screen.

The Audio System

The icon at the top-right corner of Figure 4 invokes the AVSynthesis audio system editors. When the icon is selected, a column of new icons appears at the screen's left (Figure 6). From top to bottom, these icons represent the audio sequencer, three synthesizers, three processing modules and the audio mixer. They are all external representations of the Csound engine within AVSynthesis. We'll consider each of these components in turn, but only briefly.

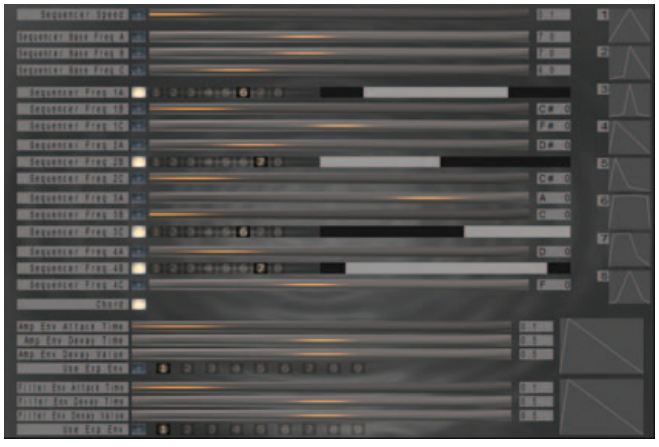

Figure 6. The AVSynthesis Sequencer

The sequencer manages the flow of time for the evolution of both the sound and the video transformations. Lower values represent slower speeds, and higher values make things happen faster. However, time distortion possibilities are rampant in AVSynthesis, and it is not always a simple matter to predict exactly how long a composition will last.

The controls in the synthesis, processing and mixing screens behave exactly like their video counterparts (Figure 7). Values are defined with sliders and masks, envelopes can be placed over ranges and so forth.

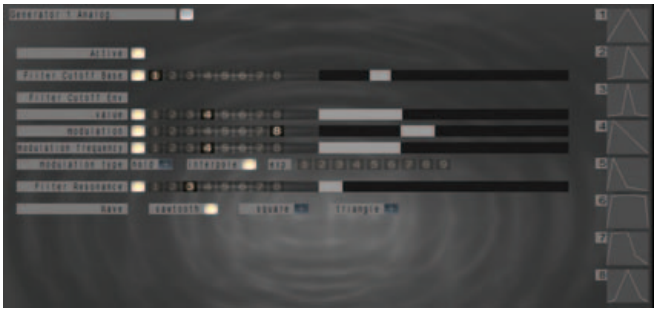

Figure 7. A Csound Synthesizer

Incidentally, Csound's deployment is completely concealed to the normal user, and no prior knowledge of Csound or any other programming language is necessary in order to use AVSynthesis.

The test play function is available here too. When you are satisfied with the sound, save the layer, then click the mini-image of the composition editor (at the top-left corner of the Layer Editor) to return to that screen.

The Composition Editor, Part 2

Before doing anything else, save your performance and all its parts with the Save Part/Performance button (Figure 2). Up to ten performances can be saved, each with ten parts, with up to 13 layers per part. For now, just save your work to its starting location (for example, Performance 0, Part 3).

Your track is represented now by its layer's blended image. Next, we need to add a performance curve in the track timeline. Left-click near the top of track section to set a peak for the curve, near the bottom for a zero value. The envelope curve offers only fixed-length attack and decay segments, but you can click and drag to set arbitrary lengths for peak and zero-value segments (Figure 1). Okay, we've defined our visual and audio elements and their transformations, we've set a performance curve in the composition timeline, so we're ready to put AVSynthesis into one of its performance modes.

The square buttons at the bottom right of the Composition screen represent the program's three performance modes. The right-most button turns on the rendering mode, the center square puts AVSynthesis into a MIDI-controlled mode, and the left button toggles the real-time performance mode.

The real-time mode plays the arrangement of layers and their associated curves on the composition screen timeline. Click the button, and your composition plays in real time. Click anywhere in the composition screen to stop playback. If an

error occurs, AVSynthesis may print some relevant information to your terminal window, or it may run with no display or sound until you click to stop playback. Or, it may freak out entirely and freeze your system. As I said, it's experimental software, so these things happen.

When the MIDI performance mode is selected, the MIDI continuous controller #85 can be used as a layer fader during real-time performance from the composition screen. The input port is designated by the Csound options specified in the AVSynthesis config.xml file. In my example above, the -M0 option sets the input port to the ALSA MIDI Thru port.

I tested MIDI control by hooking a sequencer to the MIDI Thru port in QJackCtl's MIDI Connections panel. I used loops of sequential and random values for controller #85, and everything worked perfectly. The implementation is limited, but it points the way toward more interesting real-time performance controls, such as layer blackouts and sudden appearances. This MIDI control extends only to the video part of a layer; it does not affect the audio portion.

The rendering mode runs the arrangement in the Composition screen in slower than real time to produce one TGA image file per video frame. The frame rate is set in the data/config.xml file (see above), and the author advises leaving it at its default of 30 frames per second. Thus, at the default frame rate, 30 image files will be created for each second of your composition. These files can be compiled into an animation (see below). At the same time, Csound's output is captured to a soundfile (render.wav in the data directory) that can be added to the animation.

For some reason, the render mode works only once per session. If you want to record another take, save your work and re-open the program. Hopefully, this limitation will be removed in a future version.

Incidentally, the Fullscreen, Save Perf/Part, Realtime Performance and MIDI Mode buttons are available from all screens within AVSynthesis.

Making a Movie

AVSynthesis does not create a movie directly. When you click on the Render button, the program creates a series of uniformly sized image files (approximately 4MB each), and the number of files can be massive. You will need a video encoding program to turn these static images into a flowing animation. The following instructions use MEncoder from the MPlayer Project, but any other video encoder should work, as long as it's capable of converting static TGA images into a movie.

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The first step sorts the TGA files into a numbered list. This step is necessary if your encoder reads the TGA files in this order: 1.tga, 10.tga, 100.tga, 1000.tga, 1001.tga...101.tga, 1010.tga, 1011.tga and so on.

Encoding the files in that order results in images rendered out of their original sequence. We need to encode them in this order: 1.tga, 2.tga, 3.tga, 4.tga and so on.

I asked the mavens on the Linux Audio Users mailing list how they would resolve this irritating dilemma. Various solutions were proposed, and the most appealing of which was this elegant fix from Wolfgang Woehl:

```
cd data/render
find *tga | sort -n > list
```

The list file can then be processed by MEncoder.

As I mentioned, the Csound audio output is saved in a separate audio file named render.wav in the AVSynthesis data directory. By default, this file is a 16-bit stereo WAV file with a sampling rate of 44.1kHz—that is, a CD-quality soundfile. It needs no special attention unless you want to rename it.

Now, we're ready to encode our images and soundfiles. Given the potentially large number of TGA images, the encoder is likely to produce a very large video file, and even a relatively short animation can devour dozens of gigabytes of storage. We need to consider a compression scheme to reduce the file size.

I discovered two ways of using MEncoder to create a compressed AVI from my audio and video data. The first way uses a multipass method:

```
mencoder -ovc lavc -lavcopts vcodec=huffyuv:pred=2:format
➥=422P:vstrict=-1 -noskip -mf fps=30 -o master.avi mf://@list
mencoder -ovc lavc -lavcopts vcodec=mpeg4:vme=1:keyint
➥=25:vbitrate=1000:vpass=1 -noskip -o foo.avi master.avi
mencoder -oac copy -audiofile ../render.wav -ovc lavc -lavcopts
 ➥vcodec=mpeg4:vme=1:keyint=25:vbitrate=1000:vpass=2
 ➥-noskip -o foo.avi master.avi
```

The first step creates a huge master file, which is then treated to a two-pass reduction scheme that adds the audio data in the second pass.

This single-pass method also creates a large file, but it has the advantage of faster production:

```
mencoder -oac copy -audiofile ../render.wav -ovc lavc
 ➥-lavcopts vcodec=mpeg4:vme=1:keyint=30:vbitrate=1000
 ➥-vf scale=800:600 -noskip -mf type=tga:fps=30 -o
 ➥avs-001.avi mf://@list
```

As presented, this method sets the movie display size to 800x600. The scale parameter also can be included in either the second or third steps in the multipass example, and may in fact be necessary if your system complains about creating a large-sized movie.

I've placed three example AVIs on-line at **linux-sound.org/avs-examples**. Each animation demonstrates some of the effects possible with a single GL shader (for example, wobble.avi), the simplest Csound audio setup (one synth, one signal processor), and the (mostly) default values for the sequencer. Alas, the compressed videos can only hint at the visual beauty of AVSynthesis performing in real time, and they are offered merely as glimpses of the program's artistic potential.

Known Problems

The AVSynthesis config.xml file includes entries for changing the program window size. AVSynthesis defaults to the current screen settings, and it will fail to launch if it can't validate the dimensions given in the config file. Alas, I was unable to launch the program in any screen mode other than my default dimensions (1280x1024).

The Csound phase vocoder opcodes are very CPU-intensive. AVSynthesis has crashed randomly when I use the effects based on those opcodes, though it works fine with them at other times.

The render.wav file and the data/render directory must be cleared by the user; AVSynthesis will overwrite the current contents.

Sound may become distorted when using the Analog Synth 2 and the Wild Grain processor. Use the mixer to balance audio output from the synths.

The Wrap

AVSynthesis is well worth the effort required to make it happen. The further I get into AVSynthesis, the more possibilities I discover that warrant yet deeper exploration, and I can see (and hear) myself staying involved with the program for quite a while. The program's author has stated that he intends to squash remaining bugs and add some new features, but he wants to keep AVSynthesis as uncomplicated as possible. You can check out the latest version yourself, and with this guide's assistance, you should be running AVSynthesis quickly and smoothly under Linux. Have fun, be creative, and be sure to let Jean-Pierre know how you're using his software.■

Dave Phillips is a professional musician and writer living in Findlay, Ohio. He's been using Linux since the mid-1990s and was one of the original founders of the Linux Audio Developers group. He is the author of *The Book of Linux Music & Sound* (No Starch Press, 2000) and has written many articles on Linux music and sound issues for various journals and on-line news sites. When he isn't playing with light and sound, he enjoys reading Latin literature, practicing t'ai chi, chasing shar-pei puppies and spending time with his beloved Ivy.

Resources

AVSynthesis: **avsynthesis.blogspot.com**

My AVSynthesis Examples: **linux-sound.org/avs-examples**

Csound: **www.csounds.com**

OpenGL: **www.opengl.org**

CsoundAV: **www.csounds.com/csoundav**

MPlayer: **www.mplayerhq.hu**

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Fresh from the Lab

A look at promising software in development.

JOHN KNIGHT

Zero Install System (0install.net)

You may have heard of this project before—another attempted solution to a software installation problem with Linux. What is the problem, you ask?

How do you install new software on Linux easily, in a uniform manner that won't scare off a shy Windows user? This area often needs attention, and we turn a blind eye because we're used to using apt or something similar. Are systems like apt really sufficient though? What if the program I want to install isn't within a distributions's archive? What if it's too old? What if I want a newer version than my distribution's archive provides, without upgrading a gig's worth of my whole system to satisfy all the other niggling dependencies? What if my distro dies off and its archives disappear? What if I simply want to do *the same thing* on each system?

Zero Install is the next in line for tackling this issue where projects like Autopackage failed, but will it tickle the fancy of the larger Linux audience?

Installation Thankfully, a large number of binaries are available, and they will probably cover your system's needs. I grabbed the Etch .deb, and it worked without any hassles. If your system isn't covered though, the site includes a source tarball that contains a Python script, plus instructions on how to use it. There aren't any real obscure dependencies, so chances are the base package will install without any issues.

Usage Initial usage is more of a command-line affair, which puts the Zero Install System in a different league from Autopackage immediately. Once the Zero Install Injector has been installed, you can install packages simply by typing `0launch` and pasting the URL of the package into the shell after it. However, finding the page of available packages took me a minute—it's available at **0install.net/injector-feeds.html**. Once you've found a package that interests you, copy the URL of the package and do as follows:

```
$ 0launch http://insertyourURLhere
```

An installer window will pop up, displaying the package name and any dependencies you may require. In a few seconds, a window may appear, presenting you with a trust key (a GPG signed key), asking you whether to allow this key to run, which is similar to when your browser asks whether to accept a site's Authentication Certificate. As there aren't a great deal of packages available yet, trusting these keys is fine for now, but should they become popular, you will want to examine closely the key presented. Once the key business is out of the way, press Run, and the download of the new package will start along with any other dependencies. Once the download has finished, the new program should launch right away. If not, any error messages will appear in the shell.

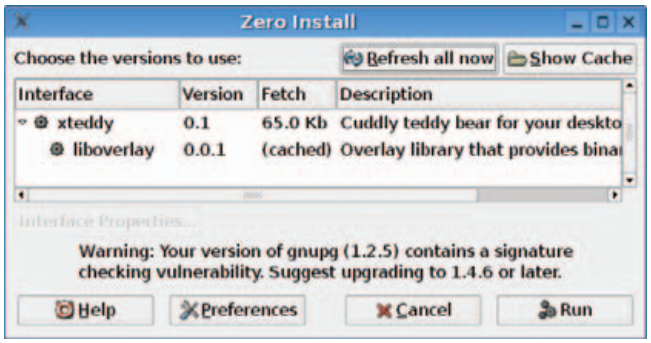

Figure 1. Zero Install chases down dependencies along with the new program.

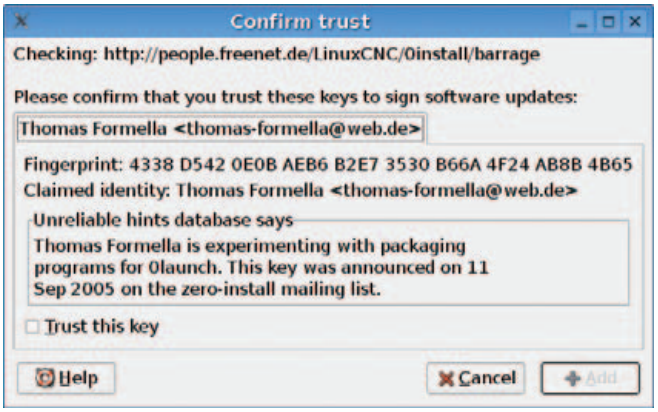

Figure 2. Zero Install presents an interesting trust key.

This is all okay for the first time, but any other attempts to run the new program will require the same arduous steps each time. Thankfully, with some clever scripting, a local link is made that puts a filename into your path without the need for root privileges. It will require you to enter the URL once more though, coupled with the command `0alias` and your chosen alias name, as follows:

```
$ 0alias alias http://insertyourURLhereagain
```

As a real-world example, I had success with a game called *Barrage*, and the shell input looked like this:

```
$ 0alias barrage
http://people.freenet.de/LinuxCNC/0install/barrage
```

Now I can run the program in the future simply by entering `barrage` at the command line. Included on the package page is a selection of tools for simplifying some of these tasks, but the above steps are still required for installing them.

Zero Install definitely has an interesting interface with its own unique take on distro-independent packaging. I'm guessing many people will be turned off by the command-line nature of this beast, especially with the copying and pasting from a Web browser (command lines and GUIs have never made the best of comrades). Also, many of the tools seem to be based on the Rox file manager—a great lightweight system but still relatively obscure to the larger Linux audience.

Personally, I mourn the demise of Autopackage, an outspoken project that received a great deal of hostility from the traditional distro packagers, such as Debian, that ultimately sparked its demise. Other similar projects take a more pragmatic approach—some with a more "Windowsy" installer (not necessarily a bad thing), others as unique as this one. Zero Installer may gain popularity simply by not being Autopackage and subsequently not angering the apt-get overlords. However you see it, I hope all these distro-independent packaging projects are sending a message to the developer community that not everyone is happy with the idea of being reliant on repositories, and a major change is required soon in software installation methods. This issue won't go away.

deco—Archive File Extractor (hartlich.com/deco)

deco is great for people sick of typing `tar -zxvf`, `-jxvf` and so on. According to the project's Web site, "deco is a generic archive file extractor that has a consistent command-line interface (`deco 1.tar.bz2 2.zip 3.flac 4.rar 5.deb` will just work) and consistent behavior (it never deletes archives after extraction, it extracts relative to the current working directory, and it extracts just verbosely enough, all unless explicitly requested otherwise). It provides automatic handling of extractor gotchas by creating an extraction directory if there is more than one file or directory at the archive top level and by being able to fix strange permissions. Dozens of archive file extensions are supported out of the box, and adding support for others requires very little work."

Installation At the time of this writing, deco is available only as a source tarball; however, installation is easy and unlikely to cause any hassles. After extracting the archive and entering the new directory, doing a standard:

```
$ ./configure
$ make
(if not root) $ su
# make install
```

worked with no issues, and probably will do the same for you, as it doesn't have a large amount of dependencies.

Usage The general usage is simply:

```
$ deco filename.tar.gz
```

That's about all there is for most people—short and sweet. But, what tricks lie under the hood? There are all sorts of neat optimizations.

For instance, usually Linux projects are placed in a directory within an archive to keep source directories from becoming cluttered. Unfortunately, archives sometimes have files placed straight in them, without being placed in a directory. This fills up your source directory with all sorts of unwanted files that also may be overwritten. deco

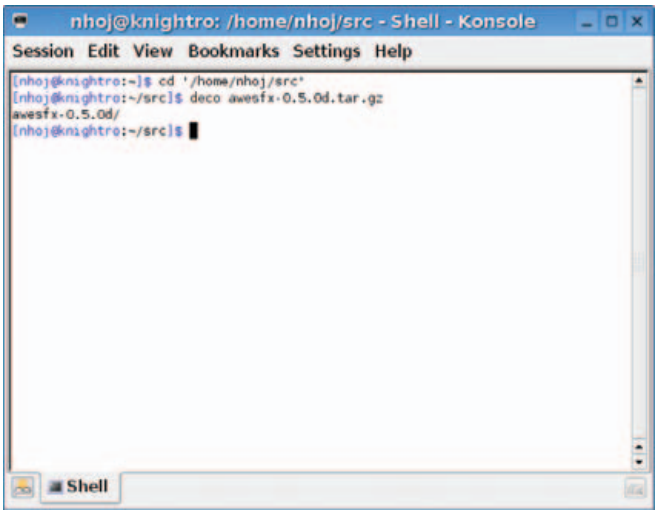

Figure 3. deco is probably the easiest archive extractor I've used.

places an archive's extracted contents within a directory to keep things clean. Cleverly, if an archive already has its contents contained within a directory, deco extracts the archive as is. If not, deco places them within a directory named after the filename, minus its extension.

For example, if I had a file called tuesday-jam-session.tar.gz, deco would place the contents under the directory tuesday-jam-session.

If you want further control, such as deleting the archive after extraction and so on, this also is possible with a series of command-line switches, available on the project's Web site. Even if you're happy with the way it works already, it's worth reading the site to see some of the other options available, and also what neat tricks and shortcuts lie under the hood.

Something to keep in mind is that the deco project doesn't try to re-invent the wheel—it isn't monolithic. It's reliant on having the necessary external extraction tools available, such as unrar for .rar files and so on. However, this is the approach taken by most archive tools, so most people expect that anyway. Nevertheless, it wouldn't take a great deal of work to include all these external programs in one big package, so any enthusiasts of the project may want to do just that. Although it's currently available only via source, hopefully it will make it into most distro archives soon.

Overall, deco is a lovely little program that is likely to save many a tired, caffeine-fueled coder some midnight grief and make computing just that little bit nicer.

orDrumbox (www.ordrumbox.com)

orDrumbox is a small, Java-based drum-machine applet that runs on Linux, Windows and Mac OS X. Designed less for the drummer and more for the desktop DJ, orDrumbox quickly makes funky mid-tempo electronic tunes with beats and inserted samples. Developed using Java, this drum machine is highly portable and lightweight, which is ideal for DJ enthusiasts jumping between machines and showing their friends.

Installation As far as packages go, the only Linux binary available is an .rpm (not handy as I have a Debian-based system). Source code is available, but it is zipped and for Java, and not everyone will have a compatible compiler. I downloaded the .rpm and converted it to a

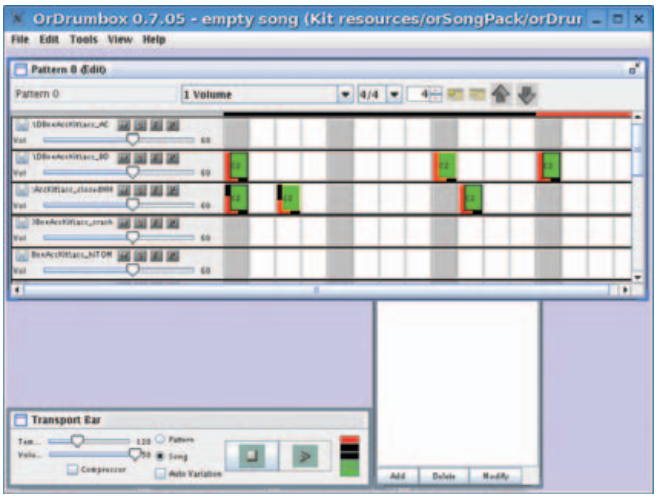

Figure 4. Surprisingly, just clicking randomly probably will make a halfway decent beat.

TECH TIP Check to See If a Script Was Run as root

If you have scripts that need to be run as root, you can check for this at the start of the script with:

```
if [[ $UID -ne 0 ]]; then
  echo "Must be run as root"
  exit 1
fi
```

If you use sudo, you even could restart the script with sudo if it was not run as root:

```
if [[ $UID -ne 0 ]]; then
  sudo -p "Restarting with sudo.  Password: " sh $0 $*
  stat=$?
  exit $stat
fi
```

The sudo command runs the script as `sh $0 $*`. The sh is included in case the script does not have the execute bit set.

—MITCH FRAZIER

Designed less for the drummer and more for the desktop DJ, orDrumbox quickly makes funky mid-tempo electronic tunes with beats and inserted samples.

.deb using alien, which is not difficult; check the alien man page for more info. Thankfully, it converted and installed with no major issues. When I started the program though, it required a particular version of Java, jpackage-utils (see **www.jpackage.org**, also available on **rpmfind.net**). This had no Debian file either, so I had to use alien on this package too. Luckily, there were no complaints here either, and after these two steps, the program simply worked.

Usage To start the program, enter `orDrumbox.sh` into your shell. If all goes well, the program now should be working. If you look in the top half of the orDrumbox screen, there should be a window called Pattern 0 (Edit)—this is where most of your work will happen. If you look to the right of the box containing a 4 at the top of the window, you'll see a gray and yellow box. Hover your mouse over it, and it will say, "create new track". Press this a large number of times (14 and up for the default drum kit), as each line creates a new instrument with which to play. On the left of each line are the controls for each instrument, including volume and so forth. On the right is the Note Editor area.

With the Note Editor, double-click any of the boxes, and they will change from white or gray to green and red. The green tells you what note will be played, and you'll see there are two red sliding bars: one going from bottom to top, the other from left to right. The bottom-to-top slider controls the note velocity, and the left-to-right slider determines the note and octave played (or the pitch). It defaults to C2, but it can be tuned up or down accordingly. Click randomly in any of the boxes, then click the large play icon in the bottom center of the screen. A beat will start playing—probably a strange one. Try changing the pitch and velocity randomly, as well as adding new notes and removing old ones to see how it affects the beat. To remove any notes, simply right-click in the note's box and choose delete note.

This should be enough to get you started on beats, but you'll need the user manual to get more involved and create whole songs. Check the manual available on the Web site, and try out some of the custom drum kits available too. There are some limitations with the scalability of the program, and the biggest limitation is that it's limited to 120BPM. This is enough for most electronic and dance music, but it's unsuitable for genres like punk, speed metal and so on. The sounds that are provided with these kits really are geared for more electronic genres anyway and will sound strange with anything rock-based, so those into fast rock genres will want to stick with something like Hydrogen. Overall, this is a fun little utility that will find its way into the hearts of many a home DJ.■

John Knight is a 23-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.

Do you have an interesting project, something useful, handy or even mind-bending? Send e-mail to knight.john.a@gmail.com.

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Running Ubuntu as a Virtual OS in Mac OS X

Our intrepid writer installs and tests Ubuntu Linux within both VMware Fusion and Parallels Desktop on Mac OS X. Can you really run both Linux and Mac OS X simultaneously and achieve nirvana?

DAVE TAYLOR

Let's start right off by tackling the most pertinent question for this article: why the heck would someone want to run Linux on a Mac system that already has a very nice Linux distro hidden beneath Mac OS X? Built atop NetBSD, there's quite a bit of Linux sitting there waiting to be utilized in the system, including niceties like crontab, robust account management and much more.

Go to Applications→Utilities, and you'll even find X11, a tightly integrated version of the popular Linux windowing system that plays nicely with the graphical interface that defines the so-called Mac experience. What more could a geek want?

The best answer is simply to quote Sir Edmund Hillary, or perhaps misquote him slightly. Why run Linux on a Mac? "Because you can." If it just feels too wacked to you, take a deep breath and proceed to the next article in the magazine—no harm done.

Still with me? Great. So let's look at the two ways you can run Linux. You can set up a Mac to dual boot, using Apple's Boot Camp system, which is included with Leopard 10.5 and available for download if you're still running Panther (10.4) from Apple's Web site, but somehow that seems clunky at best given the great virtualization capabilities on modern Apple hardware. As a result, I'm going to focus on getting Linux up and running simultaneously with running Mac OS X.

Two robust applications let you run another operating system within a virtual environment on your Mac: Parallels Desktop and VMware Fusion. The former is a Mac-only company, but the latter might well be familiar to those of you who have run Windows within Linux or Linux within Windows, and so on. I've personally used both products for many years.

I settled on Ubuntu, a Linux distro that has been gaining market share during the past few years and is one of the most popular available. It's also preconfigured for both Parallels and VMware Fusion, so that makes it even better. Free operating systems (that is, anything but Microsoft Windows) can be downloaded easily from vendor sites as a preconfigured data image, alleviating the need to install anything at all—simply download.

Both companies refer to these operating system data images as virtual appliances, and I do so throughout the rest of this article too. You can find Parallels' virtual appliances at **ptn.parallels.com**, and VMware Fusion's virtual appliances are at **www.vmware.com/appliances**.

VMware Fusion Download

Each repository is impressively broad. For example, the VMware Fusion catalog offers you the ability to download Ubuntu 8.04 alpha 1 or 2, Gentoo 2007.0, PCLinux S, GEubuntu 7.10, OpenSUSE Alpha0, Ubuntu 7.10 Jeos with VMware tools already installed, Linux Mint 4.0 Daryna, and many more Linux distributions, all configured and ready to go. Perhaps even more interesting, you also can download gOS 1.0.1-bagvapp, described as "Google-Wal-Mart's Ubuntu Gutsy-based OS for 'Green PC'". What Wal-Mart's doing with its own Linux distro, I will leave for another article.

I downloaded Ubuntu 7.10 (Gutsy Gibbon) Desktop—English for VMware Fusion (657MB). Interesting to note, the description states, "perfect to test drive Ubuntu or as a secondary operating system running within Windows." Windows? We'll see how portable these operating system virtual appliances are I guess. At least it includes a useful set of apps: OpenOffice.org 2.3, Firefox 2, Evolution 2.12, GIMP 2.4, GCC 4.2.1, GNOME 2.20 and X.Org 7.2, all atop Linux kernel 2.6.2.

Downloading files of this size takes us into the world of file sharing: you either can download a single monolithic file in RAR format (RAR stands for Roshal Archive, named after inventor Eugene Roshal) or grab the same file through BitTorrent, which requires a BitTorrent client. I strongly recommend the latter, and I recommend Transmission as the client to use (**transmission.m0k.org**). It took me a little less than two hours to download this file.

Parallels Desktop Download

While the Fusion Virtual Appliance was slowly chugging down the pipe and I was waiting for the black helicopters of the MPAA or RIAA to show up and kick in my door (just kidding, mostly, on that last one), I popped over to the Parallels virtual appliance directory. Although better organized, it had considerably fewer appliances available, and there was, in fact, only one reference Ubuntu option, described simply as Ubuntu Desktop. Digging a bit further revealed that it was version 7.04 and was helpfully described as "The virtual appliance is the default Ubuntu Desktop Linux installation. There are various GNOME-based applications."

That's what I wanted, nonetheless, and at 727MB it was broken into either four 199MB RAR files (yeah, that doesn't add up to 800MB, but you know what I mean) served

up by hyperfileshare.com or eight files of 100MB from rapidshare.com. I have to say that this is a significant mistake on the part of Parallels, as these file repositories are confusing, and not having the file accessible through the BitTorrent network is a massive drag. The download is more of a hassle, although it downloaded faster: less than an hour when I, uh, borrowed the network connection at the local café. The biggest problem is that downloads cannot be resumed, while BitTorrent is designed to handle frequent outages, which effectively means you never need to download the same byte twice.

An important thing to note when you do download these virtual appliances is the default user account and password for the OS. For the Parallels virtual appliance, it's ubuntu and the password is 123, and for the VMware Fusion virtual appliance, it's jars, with the password jars. Forget those and you'll be digging through your Web browser history to find the pesky information.

Unpacking Virtual Appliances

While everything was downloading, I made sure I had downloaded and installed both apps properly, VMware Fusion 1.1 and Parallels Desktop 3.0 Build 5582.0. Both offer fully functional 30-day demo licenses, so you can try Ubuntu in both environments without paying a dime. I used fully licensed commercial versions of the two programs, but they're functionally identical.

Once the virtual appliance files were downloaded, as shown in Figure 1, it was time to unpack them and double-click to see what would happen. Remember, Macs are the computers for the rest of us, so it really should be this easy if the vendors have done their work correctly.

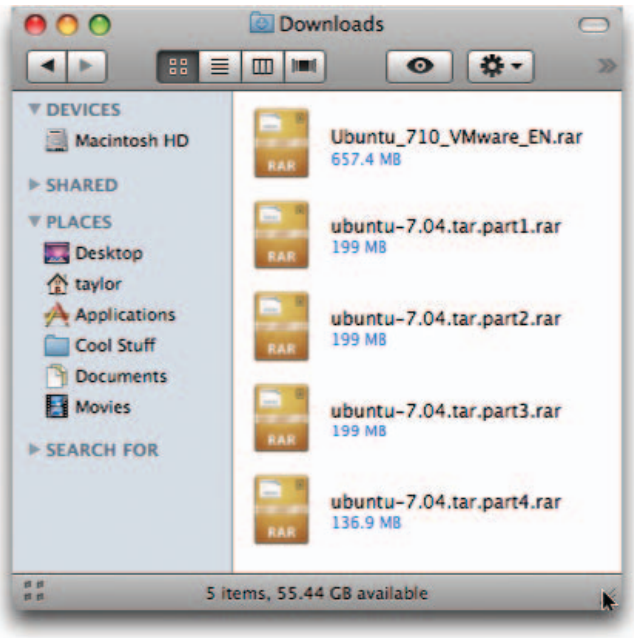

Figure 1. Both the VMware Fusion and Parallels Desktop virtual appliances download as RAR archives, easily handled with Mac OS X.

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Community One developers.sun.com/events/communityone	75	PHP Tek www.phparch.com	73
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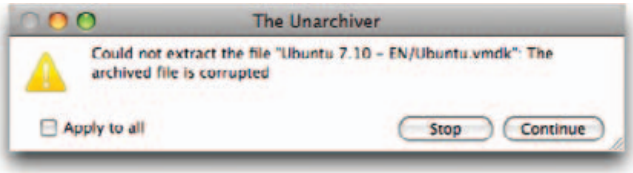

Figure 2. The first Ubuntu virtual appliance download for Fusion was corrupted, which is darn frustrating after waiting for a 657MB download to complete.

Figure 3. It's always exciting to watch a progress bar. This one shows Parallels Desktop virtual appliance Ubuntu 7.04 unpacking from the RAR archive into a .tar.gz file.

To unpack the RAR archives, I installed and used an application called The Unarchiver, which you can grab from **www.versiontracker.com**, among other places. I encountered a glitch while unpacking VMware, as shown in Figure 2. I optimistically clicked on Continue, but it didn't work. None of the files extracted were larger than a few dozen KB. Plan B was to download a different Ubuntu virtual appliance, Ubuntu Gutsy Gibbon 7.10 Desktop. And this time, it didn't use BitTorrent, so I watched it slowly download a 468MB image, just to find an archive file ending with .7z, which I'd never seen before. The Unarchiver claimed to deal with 7z archives, but rejected this as corrupted too. Before I gave up though, I downloaded yet another app, 7zX, and after almost 20 minutes, it unpacked successfully.

Although the Parallels download comes in four parts, with cheery names like ubuntu-7.04.tar.part1.rar, RAR-friendly apps like Unarchiver automatically concatenate the files. The end result is ubuntu-7.04.tar.gz, which can again be double-clicked on and unpacked to ubuntu-7.04.tar, which again unpacks (why am I reminded of Russian nesting doll puzzles), finally, into the files we seek. The end result is a folder called ubuntu that contains all

Why run Linux on a Mac? "Because you can."

the necessary files. You can see the files unpacking properly in Figure 3.

Now it's time to double-click on the virtual appliance images and see what happens. In the case of Parallels, I clicked on ubuntu.pvs, and about a minute later, I was presented with the login window shown in Figure 4. I logged in, and it all looked great, but there was no

Figure 4. Parallels Desktop running Ubuntu—we're ready to log in.

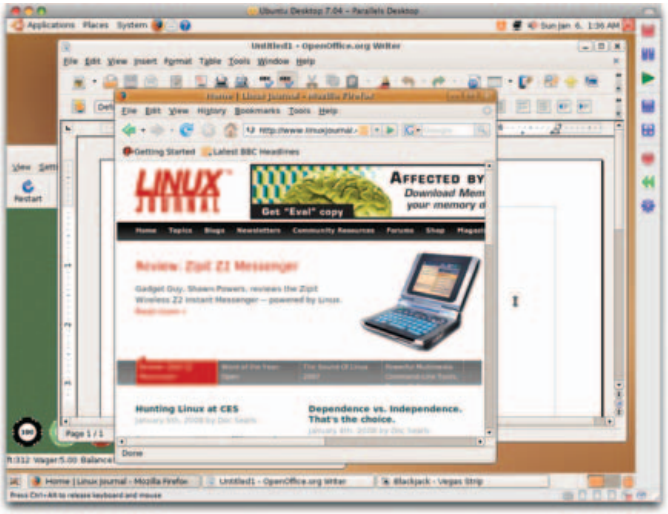

Figure 5. Parallels Desktop running Ubuntu within the Mac OS X world, logged in, on the network and quite usable.

network connection, which was solved by changing the network option in Parallels Desktop itself from bridged to shared networking (NAT), then clicking network connection on the Ubuntu menu bar. A few seconds later, and you can see the results in Figure 5.

With the VMware Fusion archive, it wasn't as obvious what needed to be double-clicked to get started, but Ubuntu-7.10.vmx seemed like a good choice. It worked, as shown in Figure 6, but notice that the window was far bigger than the Fusion parent window. Additionally, VMware Fusion complained that the VMtools hadn't been installed, which was a surprise given that it's a download I found at the VMware site. Also, the account and password pair didn't work, because it was a different VA image from what I originally had planned. I guessed and lucked out: ubuntu

Figure 6. VMware Fusion running Ubuntu. By default, the Ubuntu virtual appliance had a ridiculously high resolution set, far bigger than the Fusion window itself. You can see that by how the login prompt isn't centered.

Figure 7. VMware Fusion running Ubuntu within Mac OS X. Once tweaked, it worked perfectly in the virtualization environment.

and ubuntu worked, and after fussing with screen resolution settings—but not having to tweak the network settings—I had Ubuntu working within VMware Fusion too, as shown in Figure 7.

Did It Work and Was It Worth It?

In the end, I did have a fully functional Ubuntu Linux running within each of the two virtualization environments—one was sufficiently fast that when I put it into full-screen mode on my 2.3GHz MacBook Pro running Mac OS X Leopard 10.5.1, I really could use it for editing documents, surfing the Net and experimenting with Ubuntu and Linux graphical apps. In fact, I was rather surprised by how snappy the operating system was within these environments, as I'd run Microsoft Windows XP and Windows Vista within the virtualization world and had found it functional, but not comparable to a real PC. Linux within the virtualization world, however, was quite pleasantly snappy and very usable.

Remember, Macs are the computers for the rest of us, so it really should be this easy if the vendors have done their work correctly.

This leaves us the fundamental question with which we started, why? If you have a logical reason to run a full Linux distro on your Mac for testing or experimentation, or to gain access to applications not otherwise available within the Mac OS X world, this is a satisfying path to travel.■

Dave Taylor has been involved with UNIX and Linux since 1980 and was a contributor to BSD 4.4, among other distributions. He runs a popular tech blog at www.AskDaveTaylor.com and also writes the shell scripting column Work the Shell for *Linux Journal*. You can reach him on-line at www.intuitive.com.

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```

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```

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—MATTHEW MARTIN

Mobile IPv6 with Linux

Augmenting IP with movement awareness.

SALAH M. S. AL-BURAIKY

Free software is freedom, and so is mobility. In an age of embedded devices, nomadic users and omnipresent wireless connectivity, augmenting the venerable Internet Protocol (IP) with movement awareness and adaptability is due. IP's founding architects designed it with the assumption that the Internet node is static. This simplified the design by enabling a single field, the IP address, to signify both location and identity. A sending machine refers to a receiving one by the IP address (the identification role), and routers in the network use the IP address to direct traffic to the right path (the topological role). In this age of portability and nomadicity, this conflation of functions introduces a contradiction. For routing to do its job, the address needs to change according to the location; for the address to be used as an identifier, it must remain fixed.

Mobile IP (MIP), an extension of IP, provides a solution for that problem. The Internet Engineering Task Force (IETF) has been actively developing MIP for both IPv4 and IPv6 since the 1990s. The Mobile IPv6 (MIPv6) standard advanced from draft status to Proposed Standard (PS) status in 2004. Since then, optimizing and securing MIPv6 has become an active standardization and development area. A cost-effective, flexible and insightful vehicle for getting hands-on experience with MIPv6 is to experiment with the Mobile IPv6 for Linux (MIPL) package that the Helsinki University of Technology (HUT) has been developing since 1999.

The purpose of this article is to get you, the brave roamer, primed in MIPv6 by experimenting with MIPL. It assumes basic understanding of IPv6 and wireless LAN networking, and it consists of two parts: the first introduces MIPv6, and the second introduces MIPL.

MIPv6

IP mobility means the ability to handle movement gracefully. Movement, in the context of MIP, is an event or an operation that causes a machine to change its IP address. It is a movement from one IP subnet to another. Physical movement could cause it, but that isn't the only way a machine could "move" in the context of MIP. At the same time, physical movement doesn't necessarily translate to a network layer movement. Movement within a single wireless cell, for example, doesn't cause a subnet change and, thus, isn't movement from MIP's perspective. Movement is problematic for traditional IP. It forces a machine to change its IP address so as to belong to the new subnet to which it has just moved. Movement changes the machine's identification. It tears down TCP connections, such as Web-browsing sessions, because the IP address is one of the parameters that identifies a TCP connection. This makes for a rough roaming experience, as sessions have to be re-established each time a handover happens.

MIP deals with movement by decoupling identity from location. MIP provides each Mobile Node (MN) with two addresses: a permanent (long-term) address that embodies identity, called the Home Address (HoA), and a temporary (short-term) address that embodies location, called the Care-of Address (CoA). The HoA remains fixed, while the CoA freely changes according to the location of the node. MIP provides a mechanism to map between the two addresses dynamically. A moving machine (Mobile Node) changes its CoA each time it moves from one subnet to another, but it maintains its HoA and uses it to provide any node communicating with it, called a Correspondent Node (CN), with a stable destination address.

The mapping between the HoA and the CoA is called binding and is the central concept underlying MIP. The message that establishes the binding is called a Binding Update (BU). A table that tracks bindings is called a Binding Cache (BC). Sending Binding Updates and maintaining Binding Caches is the essence of MIP. All other aspects of the MIP protocol are to scale, secure, optimize and generally enhance the way bindings are established and used.

To provide a concrete description of MIP, let's look at the interactions between the participants in MIP in its most basic mode of operation (without Route Optimization). At its home network (home link), the MN uses its address (the HoA) in the standard fashion. MIPv6 kicks in upon movement detection. When the MN notices that its current default router has disappeared (it can no longer hear the router's advertisements) and that a new router is now chirping, it concludes that it has "moved" and uses the new prefix (subnet ID) to configure a new address (a new CoA) that belongs to the new subnet. It then sends a BU to a special router on the home link, called the Home Agent (HA), telling it that the HoA it "owns" is now bound to that new CoA. The HA records the mapping between the HoA and the CoA in its BC. Adding an entry to the BC is called registration. Traffic destined to the HoA, from any CN on the Internet, is routed to the home network because the HoA topologically belongs to it. There, the HA intercepts it and tunnels it to the MN's CoA address registered in the BC. Return traffic is reverse tunneled from the MN back to the HA and then sent from the HA to the CN. This way, the MN becomes always addressable by its HoA.

MIPL

MIPL consists of two components: a kernel-space component, in the form of a kernel patch, and a user-space component, in the form of a Mobility Dæmon (mip6d). The dæmon implements most of the functionality. It discovers location, detects movement, sends and processes BUs and maintains the BC. The MIPL patch provides the kernel support required for the dæmon to perform those functions. The MIPL patch adds, for example, support for the Mobility Header protocol (MH), which is the IPv6 extension header that transports BUs and Binding Acknowledgments (BAs) and other binding-related

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messages. In addition to the MIPL package, we'll need to install the Router Advertisement Dæmon (radvd), as MIPv6 relies on the auto-configuration provided by router advertisements to detect movement and configure CoA addresses among other mobility-related tasks.

To explore the basic operation of MIPv6, let's use MIPL to create a simple MIP network consisting of two MIPL-patched Linux machines: a router, called denali, and a laptop, called raven. The laptop is a typical x86 machine that has a single 802.11b wireless interface and will be our MN. The router is a fanless, headless, single-board computer (Soekris Net4521) that has two 802.11b wireless interfaces, each hosting a different wireless network (ESS/Extended Service Set) and a different subnet. One router interface will be acting as the HA, and the other will be acting as a visited (foreign) network. Figure 1 shows the two machines used, and Figure 2 shows the logical setup.

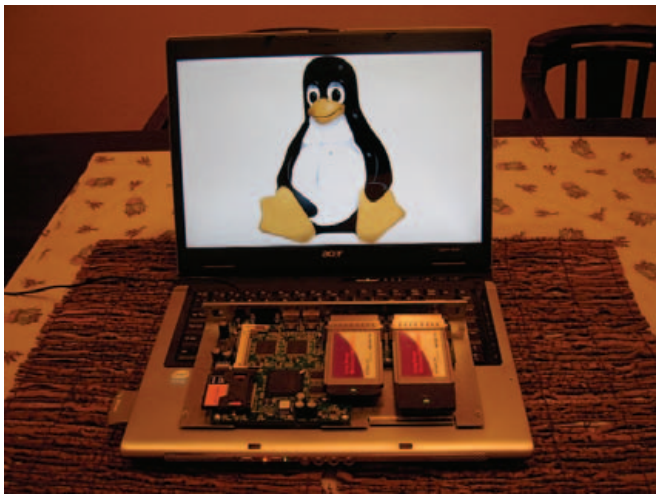

Figure 1. Mobile Node Laptop and Its Home Agent on Top of It

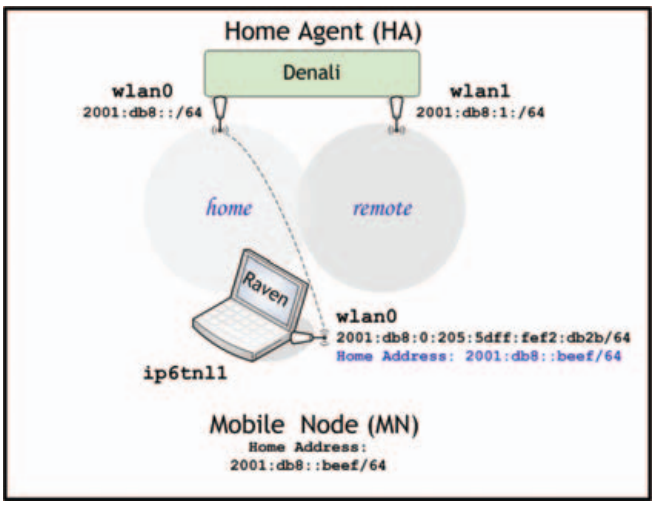

Figure 2. The MN on the Home Link (before Moving)

For simplicity, let's leave out advanced configurations, such as IP Security (IPsec) and Route Optimization (RO), and establish only the most basic MIP setup. We'll not use a standalone CN.

Installation—Kernel-Space

Installing the kernel part of MIPL for both the HA and the MN is exactly the same. First, download the kernel source tree against which the latest MIPL patch was taken (2.6.16, in my case), and patch it with the MIPL patch (version 2.0.2, in my case). Configure the kernel with the features needed for each machine, ensuring that the following configuration features are included (the script chkconf_kernel.sh, included in the MIPL user space tarball, can do the checking for you):

- NET_KEY, NET_KEY_MIGRATE, XFRM and XFRM_USER XFRM_ENHANCEMENT: those add Internet Key Exchange (IKE) support that is needed for dynamically configuring IPsec. IPsec can be used optionally to secure MIPv6.
- IPV6_MIP6: this adds support for the Mobility Header (MH) protocol and the other IPv6 protocol extension headers MIPv6 demands.
- IPV6_ADVANCED_ROUTER: this enables the selection of advanced routing capabilities, such as policy routing.
- IPV6_MULTIPLE_TABLES: this adds support for policy routing, an advanced routing feature that enables routing based on fields other than the destination address.
- IPV6_SUBTREES: this adds source routing support, which is needed for sending traffic directly to the Mobile Node (without passing through the Home Network) when MIP is operating the Route Optimization (RO) mode.
- IPV6_TUNNEL: IPv6 in IPv6 tunnel, which is needed for the HA to MN communication.

Build, install and reboot into the new kernel:

```
[raven]# wget
http://www.kernel.org/pub/linux/kernel/v2.6/linux-2.6.16.tar.bz2 &&
tar -jxf linux-2.6.16.tar.bz2 &&
gzip -d mipv6-2.0.2-linux-2.6.16.patch.gz &&
cd linux-2.6.16 &&  patch -p1 < ../mipv6-2.0.2-linux-2.6.16.patch &&
make menuconfig
[raven]# make && make install
```

Installation—User-Space

To build the Mobility Dæmon, follow the steps you would do for any autotools built package: `unzip`, `untar`, `cd` to the directory of the package, `./configure`, `make` and then `make install` (read the included INSTALL document for the details). Follow the same procedure for building and installing the Router Advertisement Dæmon, radvd. With that finished, you should have both MIPL components (kernel and user-space) and radvd installed, and you now are ready to start configuring.

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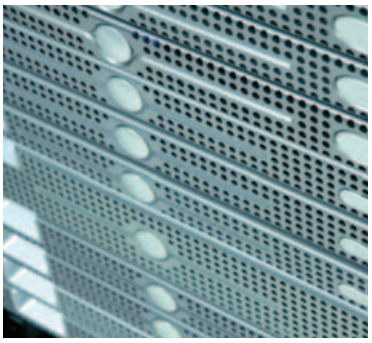

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Configuration

To start off simply, let's begin without Route Optimization (RO), without IPsec and with a manually configured HA address in the MN. Once we have the basic setup working, we can enhance and expand it incrementally. Keep in mind that in the real world, like on the Internet or in enterprise networks, RO and IPsec are essential. In production networks, you also might desire other extensions, such as Fast Mobile IPv6 (FMIPv6) or Hierarchical Mobile IPv6 (HMIPv6), although those aren't implemented by MIPL.

Let's configure local parameters first, then Layer 2 parameters and finally Layer 3 parameters.

First, let's do the Home Agent configuration (denali), Host State (sysctl). At the outset, we need to put the HA in the right state of mind and configure the HA machine to operate as a router, so we need to turn on packet forwarding. We'll do this by setting the variable /proc/sys/net/ipv6/conf/all/forwarding, using one of the following two commands:

```
[denali]# echo "1" > /proc/sys/net/ipv6/conf/all/forwarding
[denali]# sysctl -w net.ipv6.conf.all.forwarding=1
```

You could make those settings permanent across reboots by editing /etc/sysctl.conf.

Now, let's configure Layer 2 (the Data Link Layer) parameters (Listing 1). We'll assign each wireless interface a different wireless network ID (ESSID) and sufficiently space their frequency channels apart to avoid inter-cell interference.

Our next step is to configure the Layer 3 (Network Layer) parameters. This includes addressing, configuring the Router Advertisement Dæmon and configuring the Mobility Dæmon. To configure addressing, use the commands shown in Listing 2.

To configure router advertisements, edit the /etc/radvd.conf file, as shown here:

```
interface wlan0
{
        AdvSendAdvert on;
        AdvIntervalOpt on;

        MaxRtrAdvInterval 10;
        MinRtrAdvInterval 1;
        MinDelayBetweenRAs 1;
        AdvHomeAgentFlag on;

        prefix 2001:db8::/64
        {
        AdvOnLink on;
        AdvAutonomous on;
        AdvRouterAddr on;
        };
};
```

```
interface wlan1
{
        AdvSendAdvert on;
        AdvIntervalOpt on;

        MaxRtrAdvInterval 10;
        MinRtrAdvInterval 1;
        MinDelayBetweenRAs 1;
        AdvHomeAgentFlag off;

        prefix 2001:db8:1::/64
        {
        AdvOnLink on;
        AdvAutonomous on;
        AdvRouterAddr on;
        };
};
```

In the stanza pertaining to wlan0, you can see that we have enabled router advertisements on the interface by setting AdvSendAdvert. We also have configured the interface to operate as an HA by setting AdvHomeAgentFlag. The other wireless interface, wlan1, is configured similarly, except that AdvHomeAgentFlag isn't set. Note that the more frequent router advertisements are, the faster movement can be detected, but they generate more overhead.

Listing 1. Configuring the Data Link Layer—Home Agent

```
[denali]# iwconfig wlan0 essid "home" channel 3
[denali]# iwconfig wlan0 essid "remote" channel 8

[denali]# iwconfig wlan0 ; iwconfig wlan1

wlan0     IEEE 802.11b  ESSID:"home"
          Mode:Master  Frequency:2.422 GHz  Access Point: 00:02:6F:06:0B:CF
          Bit Rate:11 Mb/s   Sensitivity=1/3
          Retry min limit:8   RTS thr:off   Fragment thr:off
          Encryption key:off
          Power Management:off
          Link Quality:0  Signal level:0  Noise level:0
          Rx invalid nwid:0  Rx invalid crypt:0  Rx invalid frag:0
          Tx excessive retries:97  Invalid misc:342   Missed beacon:0

wlan1     IEEE 802.11b  ESSID:"remote"
          Mode:Master  Frequency:2.447 GHz  Access Point: 00:02:6F:06:46:10
          Bit Rate:11 Mb/s   Sensitivity=1/3
          Retry min limit:8   RTS thr:off   Fragment thr:off
          Encryption key:off
          Power Management:off
          Link Quality:0  Signal level:0  Noise level:0
          Rx invalid nwid:0  Rx invalid crypt:0  Rx invalid frag:0
          Tx excessive retries:10  Invalid misc:6767   Missed beacon:0
```

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Now launch the router advertisement dæmon, radvd:

```
[denali]# radvd -C /etc/radvd.conf
```

To configure the Mobility Dæmon, we need to edit the /etc/mip6d.conf file, as follows:

```
NodeConfig HA;

## If set to > 0, will not detach from tty
DebugLevel 0;

## List of interfaces where we serve as Home Agent
Interface "wlan0";
UseMnHaIPsec disabled;
```

Notice that we merely indicated that the machine is an HA and specified the interface that will be operating as an HA. By launching the Mobility Dæmon, the router is set to fulfill its duty as a faithful HA:

```
[denali]# mip6d -c /etc/mip6d -d 7
```

Now, let's move on to the Mobile Node Configuration (raven), Host State (sysctl). Just as with the HA, we'll start by establishing the mindset of the MN. First, we must configure the MN to accept Router Advertisements (RAs) to be able to configure a CoA and discover and track default routers on the link automatically:

```
[raven]# echo "1" > /proc/sys/net/ipv6/conf/all/accept_ra
[raven]# sysctl -w net.ipv6.conf.all.accept_ra=1
```

To make the changes permanent across reboots, edit /etc/sysctl.conf.

Next, let's configure Layer 2 parameters. We'll configure the MN as a wireless client (a managed wireless node) of the Home network:

```
[raven]# iwconfig wlan0 mode managed essid "home"
[raven]# iwconfig wlan0

wlan0     IEEE 802.11b  ESSID:"home"
          Mode:Managed  Frequency:2.422 GHz  Access Point:
00:02:6F:06:0B:CF
          Bit Rate:11 Mb/s   Sensitivity=1/3
          Retry min limit:8   RTS thr:off   Fragment thr:off
          Encryption key:off
          Power Management:off
          Link Quality=48/92  Signal level=-63 dBm  Noise level=-100 dBm
          Rx invalid nwid:0  Rx invalid crypt:0  Rx invalid frag:0
          Tx excessive retries:0  Invalid misc:175   Missed beacon:0
```

And, finally, let's configure Layer 3 parameters. We'll start by assigning the HoA to the wireless interface:

Listing 2. Configuring the Network Layer Parameters—Home Agent

```
[denali]# ifconfig wlan0 inet6 add 2001:db8::/64
[denali]# ifconfig wlan1 inet6 add 2001:db8:1::/64

[denali]# ifconfig wlan0 ; ifconfig wlan1

wlan0     Link encap:Ethernet  HWaddr 00:02:6F:06:0B:CF
          inet6 addr: 2001:db8::/64 Scope:Global
          inet6 addr: fe80::202:6fff:fe06:bcf/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:205 overruns:0 frame:0
          TX packets:204 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:0 (0.0 b)  TX bytes:27604 (26.9 Kb)
          Interrupt:11 Base address:0x100

wlan1     Link encap:Ethernet  HWaddr 00:02:6F:06:46:10
          inet6 addr: 2001:db8:1::/64 Scope:Global
          inet6 addr: fe80::202:6fff:fe06:4610/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:64 overruns:0 frame:0
          TX packets:207 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:0 (0.0 b)  TX bytes:28068 (27.4 Kb)
          Interrupt:11 Base address:0x140
```

```
[raven]# ifconfig wlan0 inet6 add 2001:db8::beef/64
[raven]# ifconfig wlan0 ; ifconfig ip6tnl1

wlan0     Link encap:Ethernet  HWaddr 00:05:5D:F2:DB:2B
          inet6 addr: 2001:db8::beef/64 Scope:Global
          inet6 addr: fe80::205:5dff:fef2:db2b/64 Scope:Link
          inet6 addr: 2001:db8::205:5dff:fef2:db2b/64 Scope:Global
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:141 errors:0 dropped:0 overruns:0 frame:0
          TX packets:51 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:16094 (15.7 Kb)  TX bytes:5592 (5.4 Kb)
          Interrupt:17 Base address:0x2100

ip6tnl1   Link encap:UNSPEC
            ➥HWaddr 20-01-0D-B8-00-00-00-00-00-00-00-00-00-00-00-00
          inet6 addr: fe80::205:5dff:fef2:db2b/64 Scope:Link
          UP POINTOPOINT RUNNING NOARP  MTU:1460  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:0 (0.0 b)  TX bytes:0 (0.0 b)
```

On the MN, an automatically created tunnel interface, called ip6tnl1 (IPv6 Tunnel 1), represents the tunneling process described above. This interface claims no global addresses when the MN is in the Home network and assumes the HoA when the MN is away.

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The primary mobility configuration parameters are the Home Address (HoA) and the Home Agent (HA) address. To configure them, we need to edit the /etc/mip6d.conf file as follows:

```
NodeConfig MN;

DebugLevel 7;

UseMnHaIPsec disabled;
DoRouteOptimizationMN disabled;
DoRouteOptimizationCN disabled;

Interface "wlan0";
MnHomeLink "wlan0" {
        HomeAddress 2001:db8::beef/64;
        HomeAgentAddress 2001:db8::;
```

Operation

Now the scene is complete, and we can start experimenting with mobility. Before we start, remember the following about MIP: movement detection is the trigger; binding updating (registration) is the action. We'll start by letting the MN move, then check whether movement was detected. Upon witnessing movement detection, we'll check whether a BU was established successfully. Figure 2 shows the network's state before moving. To simulate movement, we use iwconfig to switch the MN's wireless interface from one ESS (wireless cell) to another:

```
[raven]# iwconfig wlan0 essid "remote"
```

Upon moving, the wireless interface should acquire a new address, and a new default gateway should appear (Listing 3).

Using a packet capturing tool (sniffer), such as tcpdump, we should see a different router appearing on the link. The Mobility Dæmon log messages should indicate movement detection (md in the logs stands for movement detection). Now that the MN has detected movement and acquired a new CoA address, it should send a BU to its HA. A sniffer should be able to display the BU message as:

```
IP6 2001:db8:1:0:205:5dff:fef2:db2b > 2001:db8:::
 ➥DSTOPT mobility: BU seq#=54814 AH lifetime=262140
IP6 2001:db8:: > 2001:db8:1:0:205:5dff:fef2:db2b: srcrt
 ➥(len=2, type=2, segleft=1, [0]2001:db8::beef)
 ➥mobility: BA status=0 seq#=54814 lifetime=262140
```

In addition, the Mobility Dæmon should have a BU List Entry (BULE) that shows the HoA, CoA and HA addresses:

```
[raven]# telnet localhost 7777
Trying 127.0.0.1...
Connected to localhost.
Escape character is '^]'.
mip6d> bul
mip6d> bul
== BUL_ENTRY ==
Home address     2001:db8:0:0:0:0:0:beef
Care-of address 2001:db8:1:0:205:5dff:fef2:db2b
CN address       2001:db8:0:0:0:0:0:0
 lifetime = 262140,  delay = 249033000
 flags: IP6_MH_BU_HOME IP6_MH_BU_ACK
 ack ready
 dev wlan0 last_coa 2001:db8:1:0:205:5dff:fef2:db2b
 lifetime 262136 / 262140 seq 19428 resend 0 delay
 249033(after 249030s) expires 262136
 mps 2 / 3
mip6d>
```

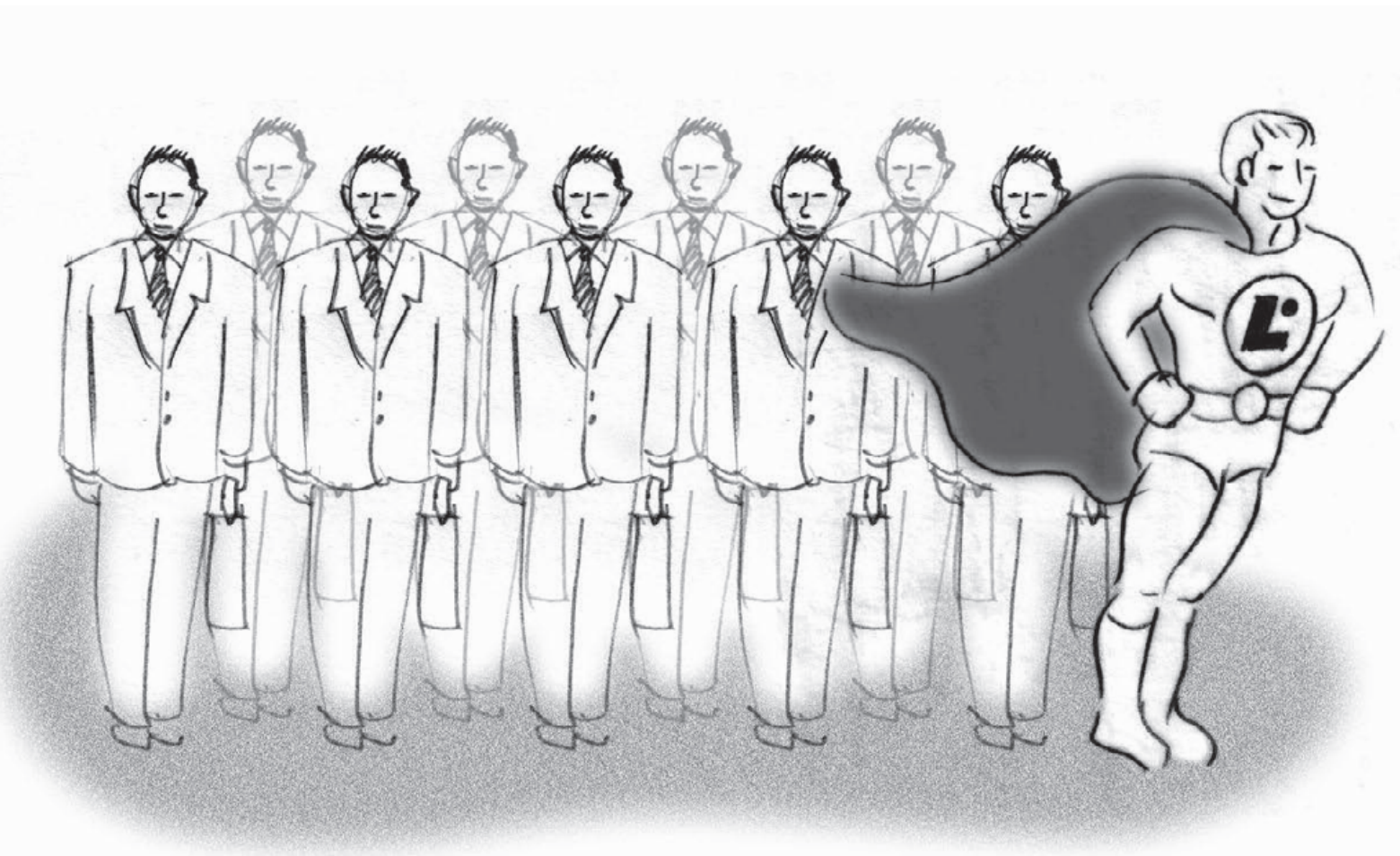
We can see whether the BU was received and accepted by looking at the HA's Mobility Dæmon log messages and by displaying the HA's BC:

Listing 3. Moving

```
... Before Moving (At the Home Network) ...
[raven]# iwconfig wlan0 | grep ESSID
wlan0     IEEE 802.11b  ESSID:"home"
[raven]# ifconfig wlan0 | grep inet6
          inet6 addr: 2001:db8::beef/64 Scope:Global
          inet6 addr: fe80::205:5dff:fef2:db2b/64 Scope:Link
          inet6 addr: 2001:db8::205:5dff:fef2:db2b/64 Scope:Global
[raven]# ifconfig ip6tnl1 | grep  inet6
         inet6 addr: fe80::205:5dff:fef2:db2b/64 Scope:Link
[raven]# route -A inet6 | grep ::/0
::/0                                        fe80::202:6fff:fe06:bcf
UGDA  1024    0         0 wlan0

... Triggering Movement ...
[raven]# iwconfig wlan0 essid remote

... After Moving (At the Foreign Network) ...
[raven]# iwconfig wlan0 | grep ESSID
                wlan0     IEEE 802.11b  ESSID:"remote"
[raven]# ifconfig wlan0 | grep inet6
          inet6 addr: 2001:db8:1:0:205:5dff:fef2:db2b/64 Scope:Global
          inet6 addr: fe80::205:5dff:fef2:db2b/64 Scope:Link
[raven]# ifconfig ip6tnl1 | grep  inet6
          inet6 addr: 2001:db8::beef/128 Scope:Global
          inet6 addr: fe80::205:5dff:fef2:db2b/64 Scope:Link
[raven]# route -A inet6 | grep ::/0
::/0                                        ::
U     128    0         0 ip6tnl1
::/0                                        fe80::202:6fff:fe06:4610
UGDA  1024   4         2 wlan0
[raven]#
```



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```
[denali]# telnet localhost 7777
mip6d> bc
mip6d> bc
hoa 2001:db8:0:0:0:0:beef status registered
 coa 2001:db8:1:0:205:5dff:fef2:db2b flags AH--
 local 2001:db8:0:0:0:0:0:0
 lifetime 262068 / 262140 seq 19429 unreach 0
 ➥mpa 13133 / 13221 retry 0
mip6d>
```

As shown above, the Mobility Dæmon provides a virtual terminal interface to its internal data structures that you can access by a establishing a Telnet session to port 7777. Figure 3 shows the network's state after moving.

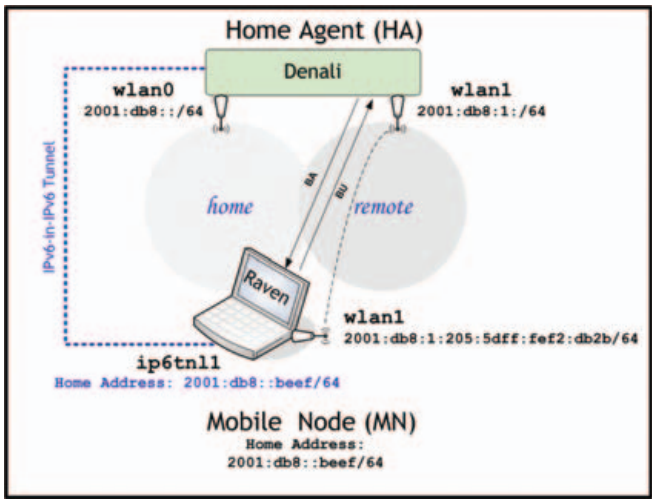

Figure 3. The MN on the Remote Link (after Moving)

Testing

We can't conclude a networking experiment without some action from our old crony ping. From the MN, we'll start by sending ping requests to the HA interface, while the MN is on the home link. We'll then move and see what happens. This exercise is shown as follows:

```
[raven]# ping6 2001:db8::

64 bytes from 2001:db8::: icmp_seq=7 ttl=64 time=3.72 ms
64 bytes from 2001:db8::: icmp_seq=8 ttl=64 time=3.70 ms
ping: sendmsg: Invalid argument
ping: sendmsg: Invalid argument
ping: sendmsg: Invalid argument
ping: sendmsg: Operation not permitted
64 bytes from 2001:db8::: icmp_seq=13 ttl=63 time=142 ms
64 bytes from 2001:db8::: icmp_seq=14 ttl=63 time=122 ms
```

Note that in responding to ping requests, the HA interface is actually acting as a CN. Note how, upon the handover, the MN loses connectivity for some time, called the handover latency, and then re-establishes it. Note also how the delay increases tremendously as the MN moves.

A more interesting test is to use a program that sends video like VLC or GnomeMeeting and visually assess how smooth the handover is. Although the ultimate goal of MIPv6 is to achieve smooth and lossless handover, in reality, there is a blackout period during which packets are lost or delayed. Much of the effort put into developing and standardizing MIPv6 is to enhance the smoothness of the handover and ultimately achieve seamless handover. As with any other technology, realizing the limitations is as crucial as recognizing the value.

Conclusion

The Internet Protocol, merged nets into the global metanet we called the Internet. IP provided connectivity that is independent on the underlying hardware and the served applications. The homogeneous addressing of IP and its simplicity enabled it to scale. MIP's goal is to bring to mobility the merits IP brought to connectivity. This means mobility that can scale to the size of the Internet, is application-independent and is available across heterogeneous wired and wireless access technologies. MIPL provides a free and flexible platform for you to participate in pursuing that vision. Happy and seamless roaming!■

Salah M. S. Al-Buraiky is a communication engineer working for the Data Network Engineering Division (DNED) of Saudi Aramco. His interests include UNIX systems and datagram networks. He is particularly interested in "beyond connectivity services", such as multicast, mobility, quality of service and IP security. He welcomes your comments at salah.buraiky.1@aramco.com.

Resources

RFC 3775, Mobility Support in IPv6 (the Base MIPv6 Standard): **www.ietf.org/rfc/rfc3775.txt**

RFC 3849, IPv6 Address Prefix Reserved for Documentation: **www.ietf.org/rfc/rfc3849.txt**

MIPL Home Page: **www.mobile-ipv6.org**

Linux MIPv6 HOWTO: **tldp.org/HOWTO/Mobile-IPv6-HOWTO**

Peter Bieringer's Linux IPv6 HOWTO: **ldp.linux.no/HOWTO/Linux_IPv6-HOWTO**

Linux IPv6 Router Advertisement Dæmon (radvd): **www.litech.org/radvd**

Updated, but Not Finalized, Linux MIPv6 HOWTO: **gnist.org/~lars/doc/Mobile-IPv6-HOWTO/Mobile-IPv6-HOWTO.html**

Linux Kernel Archives: **www.kernel.org**

Sysctl Documentation: /usr/src/linux-2.6.16/Documentation/networking/ip-sysctl.txt in the kernel source tree

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The Multiple Play

Why "triple play" is an obsolete telecom offering.

DOC SEARLS

Telephony, our theme this month, used to be a standalone utility. You got it from the phone company. The same went for cable TV. You got that from the cable company. Both were service monopolies—utilities, essentially. If you wanted something fixed, you called your sole provider, just like you called the water, gas or electric company.

But, the Internet was different. The first ISPs piggybacked their Net connections over phone lines. They'd install banks of modems to call or rent a T1 or a T3 line from a telco or somebody with a "backbone" connection and sell hunks of bandwidth on those. Now much of that old intermediation is gone, and most of us see the Net as something we get from the phone or cable company.

As hot as the Internet is, and as important as it has become to nearly every activity you can name (business, medicine, education, science, culture and so on), the telcos and cablecos treat it as a third-banana service behind telephony and television. When they bundle all three together, they call it triple play. And the Internet comes third.

In one of our features this month (see page 42), Bob Frankston talks about moving entirely past games like these. But, what to do in the meantime if we do want to play? Here near Boston, I have my own triple play of carrier choices: Comcast, RCN and Verizon. Out on the poles, Comcast wiring is coax. RCN and Verizon both deploy fiber-optic cabling. Sounds like an ideal competitive environment, right? Well, not quite.

At my elbow is the latest mailer from Comcast, a cable company. It pitches "Digital Cable + Phone + Internet". For the third item, it offers "Comcast High-Speed Internet with PowerBoost". Bandwidth is "up to 12Mbps!" No mention of upstream speed.

The next two mailers are from RCN. The first came just before the Super Bowl. RCN, which brags that it has been "all fiber optic for over a decade", just pitches cable TV with this one—$35 for 12 months. There's nothing about Internet at all. The second mailer pitches "10Mbps Blazing-Fast High-Speed Internet" and "100% Digital Cable TV". Again, no upstream speed.

I don't use either one of them, though I checked both out when we started renting here last September. The main thing I care about is Internet connectivity, and for that, neither Comcast nor RCN competed with Verizon's fiber-optic FiOS. So Verizon got my business. From FiOS, I'm getting 20Mbps down and 5Mbps up. The best RCN could do on the upstream side (which mattered most to me) was 2Mbps. Comcast didn't even say what its upstream speed was. (I just checked again on-line, and it still doesn't.)

What's amazing to me is that Greater Boston—specifically in the areas served by Verizon with FiOS and RCN with its fiber cabling—is thick with people like Bob and myself, who care far more about Internet connectivity than about TV or landline telephone. We have lots of tech and creative folks around here, in addition to the thickest concentration of educational institutions in the country, if not the world. Couldn't these carriers bother to customize better Internet offerings for a Net-savvy (and -hungry) local population?

I guess they don't have to. Even with three competitors, there seems to be enough business to go around. They aren't ready to abandon the scaled efficiencies of offering the same thing to everybody, across the whole country. And, as Bob points out, the flywheels of Business As Usual at telcos still spin on momentum imparted by railroads in the Victorian Age.

But, unlike Bob, I have some hope for them. The time will come when the workarounds that Bob's talking about—especially from folks such as *Linux Journal* readers—will have the carriers looking for ways to make money other than by tiered pricing for usage alone.

Is low-latency to servers an advantage? One can imagine applications where it would be. Well, these incumbent carriers not only have home connections, but also local real-estate holdings. They could provide Akamai-like low-latency Web services—or partner with the likes of Akamai to provide them. They could partner with Amazon's S3 and EC2 (both Linux-based) to offer local storage and compute back end.

Offsite backup is going to be a huge necessity and, therefore, a cause for business offerings. Think about what will happen as soon as ordinary folks start demanding, shooting and cooperatively editing truly high-definition video. Storage, mirroring and the rest of it will all be helpful, if not required.

Of course, the amount of business to be had here will increase with the openness of the Net itself. Today's crippled and asymmetrical throughput, based on the one-way model of television viewing, is a bug that needs to be squashed. So does the practice of blocking port 80 and otherwise preventing or discouraging Web servers at homes and businesses. When that happens, every customer, every user, becomes a potential partner. By necessity.

There is no limit to how many multiples of the current triple play will be made possible by a wide-open and free Internet. Here's hoping the carriers see that before they die under the rubble of their own fallen silos.■

Doc Searls is Senior Editor of *Linux Journal*. He is also a Visiting Scholar at the University of California at Santa Barbara and a Fellow with the Berkman Center for Internet and Society at Harvard University.

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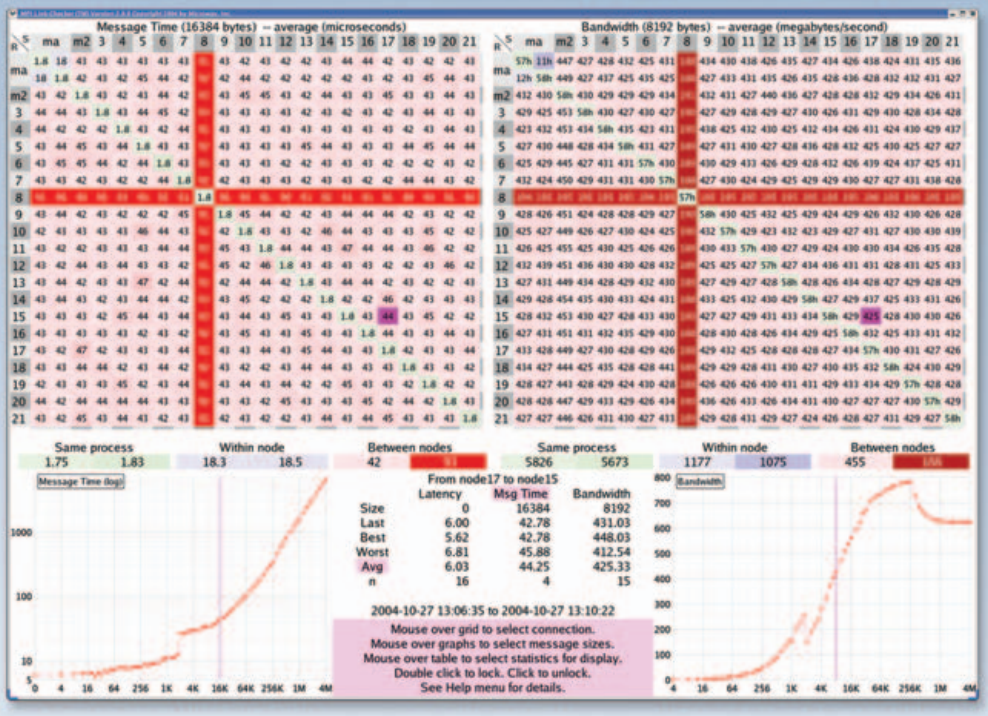

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