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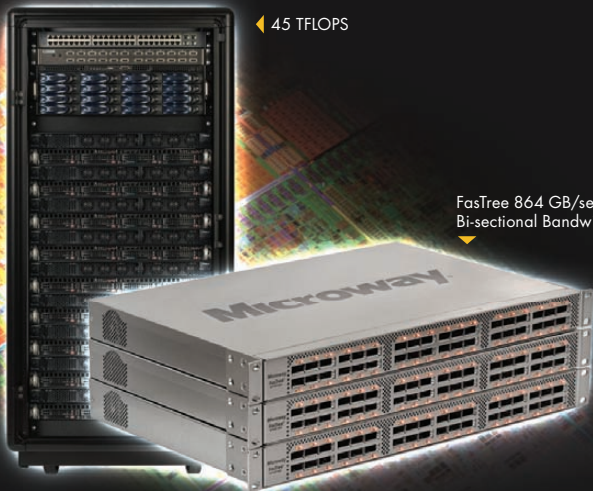
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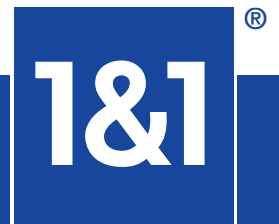
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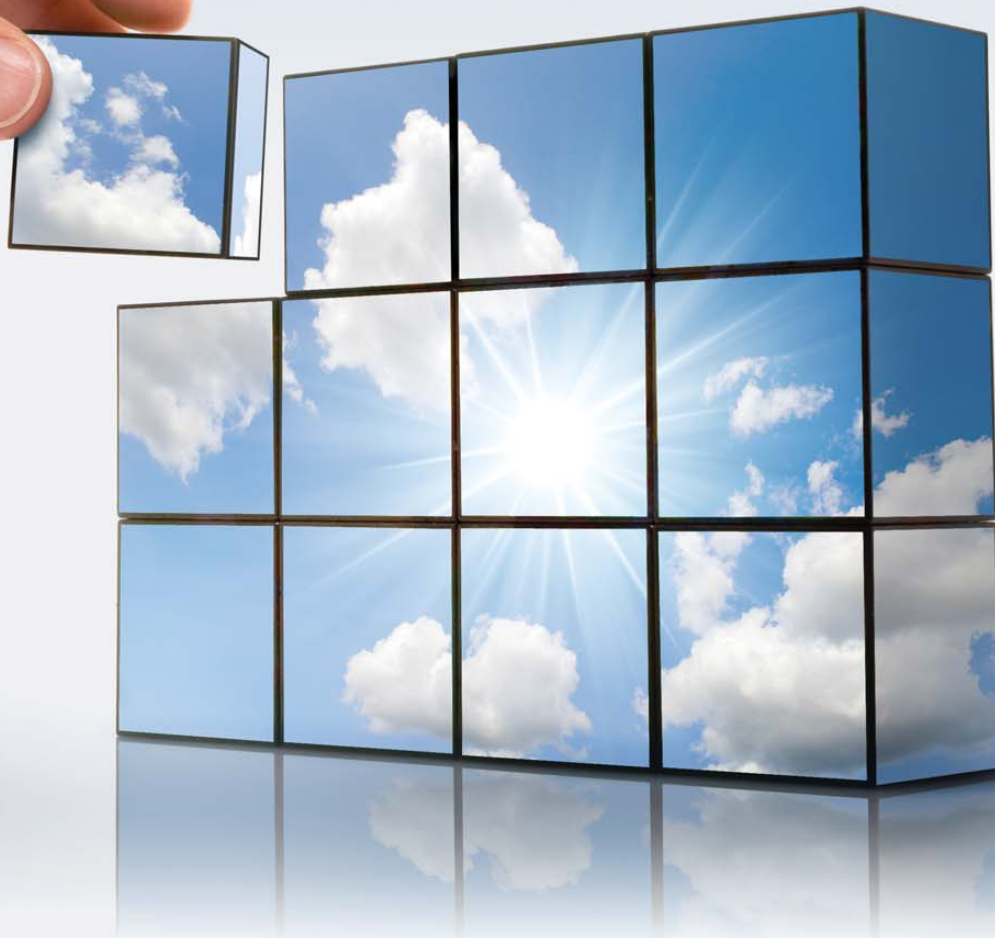


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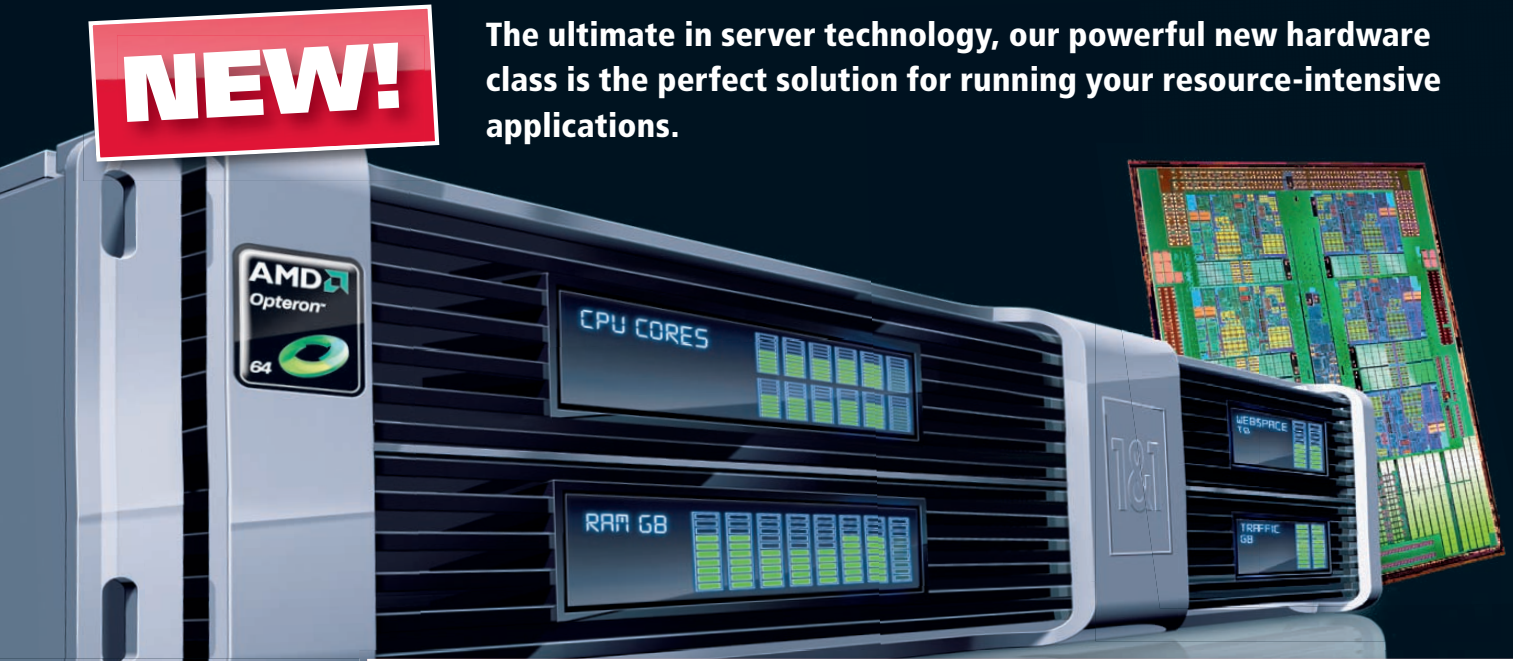
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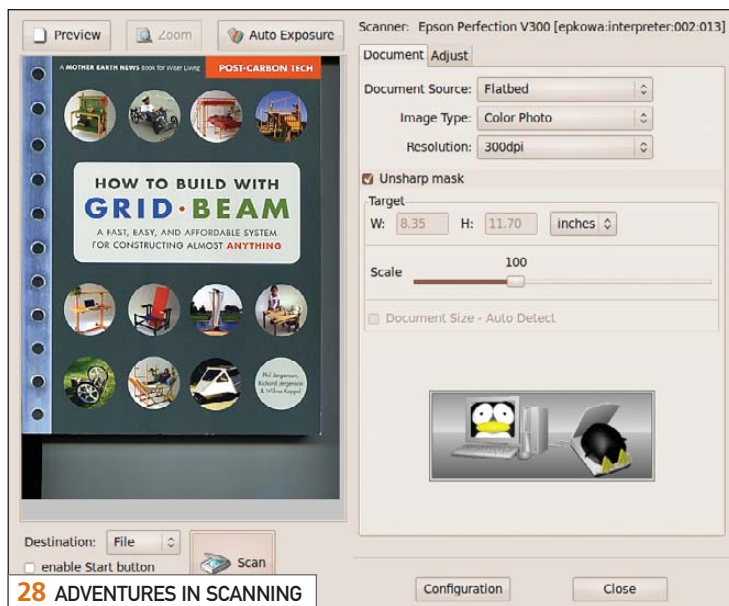
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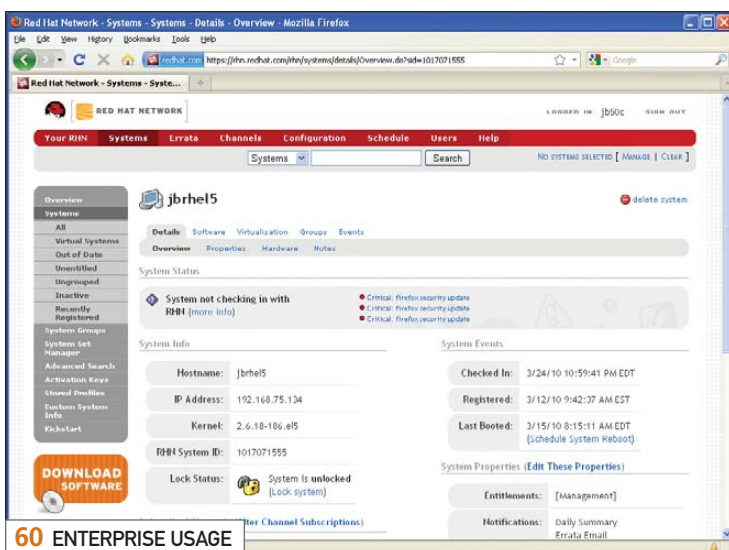
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# MPLS for the masses

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**Usually MPLS routers cost more than \$1000, but not anymore. MikroTik gives you the ability to use MPLS in any network. No more big box prices for MPLS! A chicken in every pot!**

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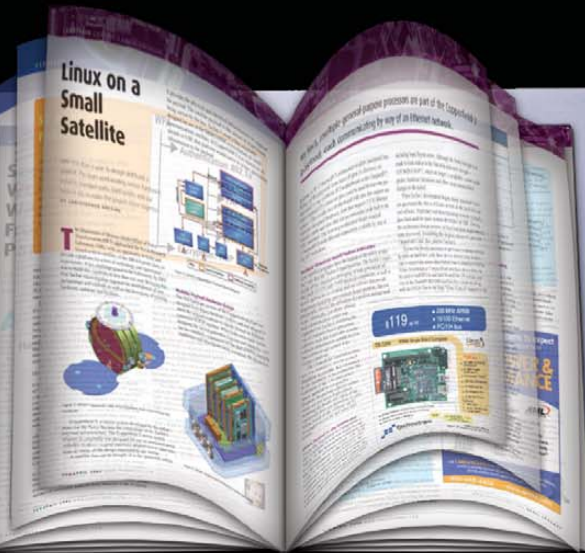
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SHAWN POWERS

## Linux Means Business—and Fun

**T**his month, we focus on Linux in the enterprise. No, not that *Enterprise* (I'm pretty sure I used the *Star Trek* joke last year). We're talking about large deployments of Linux. One awesome thing about such an issue focus is that it really doesn't apply only to folks administering huge networks. Most of the features scale down quite nicely for those of us administering a closet in our bedroom, a server rack in the basement or just a database on the couch. In fact, Reuven M. Lerner talks about CouchDB this month. Silly name aside, CouchDB is becoming more and more popular as a non-relational database. If you like what Canonical is doing with its syncing technology in Ubuntu One, you'll want to check out the underlying framework it uses—first and foremost, CouchDB.

Bill Childers has his head up in the clouds again, and this time he shows us how to set up our own cloud with Eucalyptus. Sure Amazon and that ilk are great if you don't have your own servers, but if you already own the hardware, why not make your own cloud? Bill shows how. If you already have your servers set up, perhaps you're just at the point when you need to administer them, whether they're in the cloud or not. Kyle Rankin, an enterprise sysadmin himself, presents a few more tricks of the trade with a series of crafty ways to use SSH.

Perhaps you're not interested in setting up a cloud, and you just want to make your existing servers (or cloud) do something useful. We have plenty of that this month too. Dave Taylor continues his series on scripting HTML forms, Michael Nugent talks about MySQL replication, and Daniel Bartholomew discusses SQL vs. NoSQL (where we get to watch Daniel battle his own version of Point/Counterpoint). Regardless of what services you offer on your servers, you need to be able to monitor them. Also in this issue, Paul Tader shows us Zabbix, a cross-platform monitoring tool that takes much of the sting out of setting up monitoring.

For some of us, Linux in the enterprise is

only a dream we'd like to see come to fruition. We labor over our Linux machines at home, yet at work, we're stuck with proprietary operating systems and closed-source programs. Jeramiah Bowling compares Microsoft Windows and Linux in the enterprise, pulling the rug out from under some common misconceptions and providing some real data we might use to demonstrate where Linux might be a better fit. Unfortunately, even if the logic is clear, sometimes politics are a bigger stumbling block than feasibility. Avi Deitcher writes about the whole process of introducing open-source software and ideals to business folks. It's often a difficult undertaking, and Avi has some smart tips.

What if enterprise Linux doesn't interest you at all? Don't worry; we understand. And, even if you work on Linux in the enterprise, sometimes it's nice to come home and enjoy your own Linux machines without worrying about clouds, monitoring, scalability and other 9-to-5-sounding words. Jono Bacon introduces us to Quickly this month. Quickly is a program that supplies templates, tools and a framework to allow quick desktop application development. If you've ever wanted to make your own applications, but didn't want to go through the frustration of the traditional development model, Quickly might be right up your alley.

We also have a review of the Coyote Point Application Balancer, Dirk Elmendorf covers desktop document scanning, and John Knight introduces some fresh projects. Plus, there are all the other articles that make *Linux Journal* such a fun magazine for geeks. So whether you're building your own cloud, tweaking your existing infrastructure or just killing time on the command line, this issue has you covered. ■

---

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

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## Tech Tip Video Tip

I recently started enjoying Shawn Powers' tech tip videos [on LinuxJournal.com], and I have one suggestion for a possible improvement in usability/accessibility. I don't think a full transcript is necessary, but a bulleted list of files, directories, commands and URLs mentioned in them might be cool. Thanks for any consideration.

--  
**Dallas Legan**

*I have gotten many similar suggestions for tech tip videos, and something along the lines of "show notes" for a one-minute video might make sense. The tech tips have been floundering of late (hopefully, by the time this prints that will be different) due to my house fire, but once I get back on track, I'll try to include appropriate text. If nothing else, it will make searching for the videos easier!—Shawn Powers*

## Not Writing Filesystems Often Is a Feature!

In the March 2010 Letters, Peter Bratton complained how explore2fs could not write NTFS files and recommended [www.fs-driver.org](http://www.fs-driver.org), a non-open-source driver. Perhaps not writing foreign format filesystems is a feature, not a limitation?

All software can be expected to have bugs, and filesystem bugs are especially devastating, as they easily can destroy a system. If I need interoperability between Windows and Linux, I often use an intermediate fat filesystem, where I can put files from both systems, and I won't be devastated if I uncover a bug.

It often is a good idea to mount foreign format filesystems -r (read-only). I do that on dual-boot machines when I run Linux.

--  
**marty**

## Just-in-Time Content

Thanks for a great magazine. The April 2010 issue on Software Development had an article on Selenium. I had just started looking for a Web automation and testing tool, and this article and our corresponding use of Selenium has saved me a lot of time. Thanks for content that applies directly to what we do. I love just-in-time editorial content. I can't wait to see what I will need for next month. Keep up the good work.

--  
**John Beauford**

## Re: Legally Using Linux

I wanted to comment on Luke's letter asking about Linux licensing on page 12 of the May 2010 issue of *LJ*. In his example, he mentions Red Hat, and says that it is hard to determine the licenses for everything and ponders if all the work is left up to the user.

I can tell you from the perspective of a Fedora, Red Hat and CentOS user that determining the license something is under is easy. For installed software, just do this:

```
rpm -qi {packagename}
```

That queries the information about the package, and one of the fields is the software license.

If a package isn't installed but you have

a copy of the .rpm where you can get to it, just add a p to the flag:

```
rpm -qip {package-filename}.rpm
```

Red Hat has lawyers, and it even has a person investigating licenses for the Fedora Project. Red Hat takes licenses and licensing very seriously and shies away from things that are known to be licensed under questionable terms. So, for example, Red Hat doesn't ship with any Adobe products pre-installed, nor MP3 playback nor decoder, just to name a few. There have been several occasions when Fedora has dropped a package because there was some uncertainty about the license. If you think Red Hat puts its customers at risk with the software it ships, you are mistaken. Red Hat has done its homework (see [www.redhat.com/legal/open\\_source\\_assurance\\_agreement.html](http://www.redhat.com/legal/open_source_assurance_agreement.html)).

For an example article on Fedora's license guy doing his homework, see the following *Linux Weekly News* article: [lwn.net/Articles/312262](http://lwn.net/Articles/312262). That certainly isn't the only article on the subject. There also is a project that has a goal of aiding in license verification, although it has been a while since I've read about it. I won't say anything other than check out the Web site: [fossology.org](http://fossology.org).

I think licensing on Linux is much easier than the EULAware no one reads on most proprietary OSes. I'm also not aware of any business nor end user using a mainstream Linux distribution that has gotten sued for license violation of products installed from the distro's stock repository. It just doesn't happen. That might change if Microsoft decides to go after Linux users for the violations of its patents, as it has claimed in the media.

--  
**Scott Dowdle**

*We discussed this letter in the Linux Journal Insider podcast as well [see [www.linuxjournal.com/podcast/](http://www.linuxjournal.com/podcast/)]*

**lj-insider** for our monthly podcast on each new issue]. Thank you for the info. It's greatly appreciated.—Ed.

### Dave Taylor's Trap, Part II

In the May 2010 issue, a letter titled "Dave Taylor's Trap" recommended against setting a trap on 0 (zero). A trap on 0 is quite useful. It is a trap on EXIT. The bash(1) man page states "If a sigspec is EXIT (0), the command arg is executed on exit from the shell." Trap on EXIT (0) is available in other Bourne shell-compatible shells, such as sh, ksh, dash and zsh. I recommend trapping on "0 1 2 3 15", as in the following example, to remove a tmp file when a script exits or is killed. The shell does not execute a trap on EXIT (0) while inside another trap, avoiding what otherwise would be a recursive loop if you left the EXIT trap set while trapping on it:

```
exitval=1
tmpfile='tempfile' || exit 1
trap 'rm -f $tmpfile; exit $exitval' 0 1 2 3 15
# do some work with $tmpfile
exitval=0
```

--  
**Paul Jackson**

### Dave Taylor's Trap, Part III

A letter in the April 2010 issue complained about Dave Taylor using signal 0 with the shell trap command, and he apologized for the "error". This is not an error; including signal 0 is a common and extremely useful feature of the trap built in. You and the letter-writer are correct that there is no actual signal 0, but in the case of trap, signal 0 specifies the event of normal termination of the script.

Therefore, one can use trap "cleanup\_code" 0 to invoke cleanup code upon normal exit. I use it all the time to get rid of temp files and other debris. Thanks for your helpful column.

--  
**bruce**

**Dave Taylor replies:** <slaps forehead>

*Thanks! I knew there was a reason that the trap 0 was a good idea, I just spaced on what it was. Now I can sleep well at night.*

### Using Text Editors for Writing Code

Dave Taylor's comment, in his May 2010 Work the Shell column on converting HTML forms, about using vi for a few code hacks, started me thinking about using text editors for writing code. Just how important is the choice of text editors when working with code? Emacs and vi appear to be the most frequent recommendations. Why are they so popular or recommended so often, and what about gedit, joe, Leafpad, pico or nano as a text editor for hacking code?

--  
**Philip S. Ruckle, Jr.**

### XDMCP

Regarding Michael J. Hammel's "Running Remote Applications" in the February 2010 issue, the author seems to mistake the purpose and workings of XDMCP. XDMCP allows you to select an X client from a list (using the XDMCP chooser) and to log in with the remote display (X server) preconfigured for the session.

On page 61, the author states, "The use of the -display option is tied to the configuration of XDMCP on the X server." This is not true; the -display option can be used at any login shell and can be pointed at any available X server. For example, a user can use an SSH login and enter the -display option to point at a different server. In fact, the -display option can be used to start an X client on an arbitrary X server. The only configuration required of the X server is that TCP connections must be allowed.

It appears from the article that TCP connections are enabled only for gdm/kdm; enabling TCP connections to the X server (at least in Ubuntu Karmic) can be done by removing the -no!isten tcp option shown in the

/etc/X11/xinit/xserverrc file.

It also is not necessary to switch runlevels to restart gdm (or kdm); the display manager is a special-purpose X server and can be "restarted" by killing the running xdm with a Ctrl-Alt-Backspace or by using the kill command at the command line.

One thing that was not clarified is that VNC is essentially a new X server with a network-based remote display. VNC originally was designed in exactly this way: the code to actually present a display was removed from X and the networking facilities added in. Running VNC will not usually share the current display; this is done with other tools.

--  
**David Douthitt**

### Point/Counterpoint

Regarding Kyle Rankin and Bill Childers' "/opt vs. /usr/local" in the March 2010 issue, there are a few facts that are missing or misstated in the exchange between these two brilliant minds.

First, the real contrast between /usr/local and /opt is the layout: /opt is used by putting all of the software's files in one directory, and /usr/local creates a new hierarchy with /usr/local/bin, /usr/local/sbin, /usr/local/etc and so on. This is hinted at but never explicitly stated.

Second, /usr/local is, in fact, older than /opt; /opt came along with Solaris, whereas /usr/local predates Solaris.

Third, none of the packages in Linux distributions put their files in /usr/local; rather, all put their files in /usr. Solaris packages put their files in /opt. If you use tar and gzip to compile from source, you'll find your files going into /usr/local. If you compile a custom Apache, you'll find the files in /usr/local (not /usr).

Finally, consider that HP-UX in recent years switched from /opt to /usr/local.

## [ LETTERS ]

The path for files compiled into /opt becomes quite large in most installations. Adding /usr/local files means adding two directories to the path: /usr/local/bin and /usr/local/sbin.

FreeBSD and other BSDs use /usr/local exclusively for added software, just as Solaris uses /opt. Linux doesn't use /usr/local unless you compile your own software.

Tell Kyle and Bill to keep up the good work.

--  
**David Douthitt**

**Kyle Rankin replies:** *Thanks for all of the extra background into /opt/ and /usr/local. I can tell you are an experienced and learned administrator, and not just because you agree with me.*

**Bill Childers replies:** *Thanks for the historical insight! It may be worthwhile to note that the Blastwave Solaris folks do create their own bin, etc and lib directories under /opt/csw for some of the reasons you specify in your letter. I do appreciate the multiple OS point of view you referenced, as my esteemed colleague tends to see the world through penguin-colored glasses.*

### Using Telnet to Send E-mail

Kyle Rankin's telnet e-mail works nicely (see Kyle's Upfront piece in the May 2010 issue), but the MAIL FROM: command does not conform to the actual SMTP RFC2821, so most SMTP servers reject it with a syntax error:

```
MAIL FROM: <bill.gates@microsoft.com>
```

will do the trick with the additional "<address>"!

--  
**Torsten**

**Kyle Rankin replies:** *I must work with too many postfix servers, as they are more forgiving of the syntax. Thanks for the clarification, and you get extra points for referring to the RFC.*

### Open Source for TV Broadcasting

This message is targeted toward Doc Searls. It seems for many years he has attended the annual NAB show in April, and then writes about the silos. *LJ* might be interested to learn more about how several broadcasters throughout the world, including one of Europe's largest, is using MLT for a playout server and contributing to it. This toolkit/library also serves as the engine for the up-and-coming video editors Kdenlive and OpenShot. It's something for Doc to learn about if he is attending the NAB show this year ([www.mltframework.org](http://www.mltframework.org)).

--  
**Dan Denedy**

## PHOTO OF THE MONTH

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



Me, the cannabis activist/geek chick at a recent cannabis-related event here in Montana. (Thank goodness I brought my *LJ* magazines with me.) Photos submitted by Heather Masterson, Missoula, Montana.



A view of the geekchick-mobile's license plate (I really can spell "chick" but was limited to seven characters).

# LINUX JOURNAL

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## diff -u

## WHAT'S NEW IN KERNEL DEVELOPMENT

More and more progress continues to be made on eradicating the **big kernel lock** (BKL). We've now reached the stage where only relatively few parts of the kernel still depend on the BKL. **Arnd Bergmann**, who's been maintaining his own source tree specifically targeting the BKL, recently announced that his own work, and the contributions of lots of other folks, had removed the BKL from the entire core kernel, and it was now possible to build a kernel that had no instance of the BKL at all. There still are some high-profile drivers that rely on the BKL though (for example, USB and VFAT), as well as a lot of more obscure drivers. Arnd also acknowledges that some of his BKL-removal patches may be superseded by other people's efforts in a particular area. For example, he took the BKL out of the **TTY layer**, but **Alan Cox** has been planning to do work on the TTY layer himself that probably would go into the official tree instead of Arnd's work. But, the upshot of all this is that the kernel is likely to become much more friendly to threaded applications in the fairly near future.

With the modern proliferation of virtual systems like **VMware**, **Xen** and **KVM**, people want to write code that supports their particular virtualization implementation within the host system. The result can be some duplicated features, and potentially an approach that favors the person's own preferred virtualization system over the generic services the kernel is supposed to provide. That seems to have happened recently, when VMware submitted some more work on its **balloon driver**. A balloon driver allows memory allocation to fluctuate, so the virtual system can release memory back to the host system, and then claim more memory later, at need. It's a polite way to be a

virtualization system.

In this case, however, **Andrew Morton** pointed out that an even more polite approach would be to extend the memory handling abilities the kernel already possesses. The code to handle system hibernation seemed to him like a natural starting point for that approach. The only drawback is that none of the virtual system developers had considered that possibility, so it would mean backtracking their plans. But, it seems like either that, or some similar extension of existing functionality, will be the new direction, at least for balloon drivers.

One of the most interesting aspects of kernel development is the balance struck between letting people contribute in the best way they can and keeping a rein on the messiness that can creep into a project when a lot of people are all pounding on it together. Recently, **Linus Torvalds** caught **Phillip Lougher** copying some ugliness from `include/linux/mm.h` into other include files needed for **SquashFS**. Phillip knew there was a problem with that ugliness, but he'd cleaned it up as much as he could, and any further effort would involve a major detour from his SquashFS work. And anyway, the mess already was in the code, so it didn't seem like such a high priority to him.

But, Linus adamantly refused to let the ugliness propagate further into the code. He wasn't blaming Phillip for it, but he asked Phillip to work on cleaning it up more, and asked **H. Peter Anvin** to get into it with him. The end result was a delay in accepting the SquashFS changes and a bit of a detour for Phillip, but the work was at least relevant to what Phillip wanted to do, and it was going to have a fairly large impact on the cleanliness of this part of the kernel.

—ZACK BROWN

Tablets,  
the New  
Netbooks

Tablet computers aren't new, just like tiny-form-factor computers weren't new. Much like with the Netbook craze, the new tablet computing craze has much to do with money and less to do with innovation. Don't get me wrong. I think we'll see tons of innovation, but it will be driven by consumers' pocketbooks (and



their willingness to open them) as opposed to some amazing new

concept in computer design.

I certainly thought Netbooks were the perfect place for Linux to gain a stronghold. Sadly, poor implementation by vendors and lack of a standard desktop caused Linux to be the ugly alternative to Windows—something that should make us all shudder. Maybe, just maybe, tablets will be our second chance.

Certainly, Apple's iPad has made a huge jump start into the hearts of spendy Americans. This time around, however, the Linux community has something we didn't have before: Android. Love it or hate it, Google has managed to provide a rather standard platform that is designed to work on mobile devices—and tablets!

So, to all my fellow Netbook owners who bought Netbooks just because they looked cool, let's buy tablets! I don't really care which one, but please, buy one that runs Linux.

—SHAWN POWERS



# NON-LINUX FOSS

Linux continues to make headway in embedded devices, but for many devices, it's just too heavy, and out of the box, it doesn't have real-time support.



NuttX is a Real Time Operating System (RTOS) for small- to moderate-size embedded systems. It strives to be standards-compliant (POSIX and ANSI) to the fullest extent possible for a deeply embedded environment. NuttX is fully preemptible and includes a filesystem, C library, networking and USB device support.

NuttX has been ported to numerous platforms/architectures ranging from small 8-bit systems, such as the 8052 and the M68HC12, to larger 32-bit systems, such as the ARM Cortex-M3.

NuttX can be built with Linux and with Cygwin. Depending on the options that are enabled, NuttX can be squished down to around 20K or so. Around 50K gives you room for a full-featured build.

NuttX was first released in 2007 and is actively developed. It has had 49 releases since then and currently is at version 5.2. NuttX is hosted on SourceForge at [nuttx.sourceforge.net](http://nuttx.sourceforge.net) and is licensed under a BSD license.

—MITCH FRAZIER



## Repo, Man

Sure, it was a cheesy 1980s movie, but more important, I'd like to focus on the "Repo" part of it. As Linux users, software repositories are second nature to us. For new users, however, that's not the case.

Take my father for instance. (Hi Dad!) He recently started using Linux on his desktop machine, and once he was comfortable with the base install, he wanted to try some other applications. As a longtime Windows user, he called me to ask where a person goes to download software, specifically AmaroK. The concept of preloaded software repositories was foreign to him, but I hope a rather exciting one once I explained it.

We often tout security, stability and freedom when we talk about why Linux is so great. It's funny that the little things we take for granted, things like "convenience", already are built in to our favorite operating system. I rambled on-line about this as well, and because my space here is limited, feel free to add your two cents on our Web site: [www.linuxjournal.com/content/linux-where-crapware-goes-die](http://www.linuxjournal.com/content/linux-where-crapware-goes-die).

```
apt-get install a_great_day!
```

—SHAWN POWERS

## LJ Index July 2010

1. Number of machines registered at The Linux Counter: **136,986**
2. Percent of Linux Counter machines running 2.0 kernels: **0.3**
3. Percent of Linux Counter machines running 2.2 kernels: **0.8**
4. Percent of Linux Counter machines running 2.4 kernels: **6.5**
5. Percent of Linux Counter machines running 2.6 kernels: **92.2**
6. Average uptime for machines registered at The Linux Counter (in days): **70.3**
7. Longest uptime of a machine registered at The Linux Counter (in days): **1,856.4**
8. Number of Distro Watch-listed distros whose names end in the letters "ix": **21**
9. Number of Distro Watch-listed distros whose names contain the acronym "OS": **14**
10. Number of Distro Watch-listed distros whose names contain the acronym "BSD": **9**
11. Number of Distro Watch-listed distros whose names contain the letters "buntu": **10**
12. Number of Distro Watch-listed distros whose names contain accented characters: **3**
13. Number of Distro Watch-listed distros whose names contain digits (0-9): **8**
14. Number of Distro Watch-listed distros whose names contain exactly one digit (0-9): **3**
15. Number of Distro Watch-listed distros whose names begin with a digit (0-9): **2**
16. Number of Distro Watch-listed distros whose names begin with the letter "Q": **1**
17. Number of Distro Watch-listed distros whose names begin with the letter "S": **30**
18. Number of digits that don't appear in any Distro Watch-listed distro name: **5**
19. Number of letters that don't appear as the first letter in any Distro Watch-listed distro name: **0**
20. Ranking of [stallman.org](http://stallman.org) in a Google search from "RMS": **4**

Sources: 1-7: [counter.li.org](http://counter.li.org) / 8-19: [Distro Watch](http://Distro Watch) + [grep](http://grep), etc. / 20: [Google](http://Google)

# Wi-Fi on the Command Line

More people than ever are using wireless networks as their primary networking medium. Great programs are available under X11 that give users a graphical interface to their wireless cards. Both GNOME and KDE include network management utilities, and a desktop-environment-agnostic utility called wicd also offers great functionality. But, what if you aren't running X11 and want to manage your wireless card? I don't cover how to install and activate your card here (for that, take a look at projects like madwifi or ndiswrapper). I assume your card is installed and configured properly, and that it is called wlan0. Most of the utilities mentioned below need to talk directly to your wireless card (or at least the card driver), so they need to be run with root privileges (just remember to use sudo).

The first step is to see what wireless networks are available in your area. A utility called iwlist provides all sorts of information about your wireless environment. To scan your environment for available networks, do the following:

```
sudo iwlist wlan0 scan
```

You'll see output resembling:

```
Cell 01 - Address: 00:11:22:33:44:55
    ESSID:"network-ssid"
    Mode:Master
    Channel:11
    Frequency:2.462 GHz (Channel 11)
    Quality=100/100  Signal level:-47dBm  Noise level=-100dBm
    Encryption key:off
    .
    .
    .
```

The details (address and essid) have been changed to protect the guilty. Also, the ... represents extra output that may or may not be available, depending on your hardware. You will get a separate cell entry for each access point within your wireless card's range. For each access point, you can find the hardware address, the essid and the channel on which it's operating. Also, you can learn in what mode the access point is operating (whether master or ad hoc). Usually, you will be most interested in the essid and what encryption is being used.

Once you know what's available in your immediate environment, configure your wireless card to use one of these access points using the iwconfig utility to set the parameters for your wireless card. First, set the essid, which identifies the network access point you want:

```
sudo iwconfig wlan0 essid network-ssid
```

Depending on your card and its driver, you may have the option to set the essid to the special value "any". In this case, your card will pick the first available access point. This is called promiscuous mode.

You also may need to set the mode to be used by your wireless card. This depends on your network topology. You may have a central access point to which all of the other devices connect, or you may have an ad hoc wireless network, where all of the devices communicate as peers. You may want to have your computer act as an access point. If so, you can set the mode to master using iwconfig. Or, you simply may want to sniff what's happening around you. You can do so by setting the mode to monitor and passively monitor all packets on the frequency to which your card is set.

You can set the frequency, or channel, by running:

```
sudo iwconfig wlan0 freq 2.422G
```

Or by running:

```
sudo iwconfig wlan0 channel 3
```

You can set other parameters, but you should consider doing so only if you have a really good reason. One option is the sensitivity threshold, which defines how sensitive the card is to noise and signal strength, and you can set the behavior of the retry mechanism for the wireless card. You may need to play with this in very noisy environments. Set the maximum number of retries with:

```
sudo iwconfig wlan0 retry 16
```

Or, set the maximum lifetime to keep retrying to 300 milliseconds with:

```
sudo iwconfig wlan0 retry lifetime 300m
```

In a very noisy environment, you also may need to play with packet fragmentation. If entire packets can't make it from point to point without corruption, your wireless card may have to break down packets into smaller chunks to avoid this. You can tell the card what to use as a maximum fragment size with:

```
sudo iwconfig wlan0 frag 512
```

This value can be anything less than the size of a packet. Some cards may not apply these settings changes immediately. In that case, run this command to flush all pending changes to the card and apply them:

```
sudo iwconfig wlan0 commit
```

Two other useful commands are iwspy and iwpriv. If your card supports it, you can collect wireless statistics by using:

```
sudo iwspy wlan0
```

The second command gives you access to optional parameters for your particular card. iwconfig is used for the generic options available. If you run it without any parameters (sudo iwpriv wlan0), it lists all available options for the card. If no extra options exist, you will see output like this:

```
wlan0      no private ioctl's
```

To set one of these private options, run:

```
sudo iwpriv wlan0 private-command [private parameters]
```

Now that your card is configured and connected to the wireless network, you need to configure your networking options to use it. If you are using DHCP on the network, you simply can run dhclient to query the DHCP server and get your IP address and other network settings. If you want to set these options manually, use the ifconfig command (see the man page for more information).

—JOEY BERNARD

# Dear Canonical, I Can Haz Ubuntu One Source?

I love Dropbox ([www.dropbox.com](http://www.dropbox.com)) and use it on all my computers, so I was excited to see Canonical do something similar with its Ubuntu One program. That excitement was quick to dwindle, however, when I realized that although the client software is completely open source, the server bits are not. Those of us running a huge network of computers can't set up our own Ubuntu One server internally, *and* we can't hope for the community to add support for other operating systems.

Ultimately, I wish Dropbox would become open source. That would not only give us cross-platform support, but also remove the "Ubuntu" slant that Canonical's product currently

sports. My suspicion, however, is that sooner or later, Google will realize Dropbox is the Gdrive it has never had—and buy it. Although that would be really cool, and more people would adopt the already-amazing Dropbox, it also would mean no chance of Dropbox coming to a Linux server any time soon.

So again, Canonical, please open the source to Ubuntu One. You still can offer your cloud solution, but we also can make our own little clouds in-house. Who knows, maybe the community will add features and functionality that you'll want to adopt yourself. We'll be happy to share back!

—SHAWN POWERS

ubuntu<sup>beta</sup>  
one

## LinuxJournal.com

This month, I'd like to take the time to acknowledge the many people involved with Drupal, the open-source Web project that powers LinuxJournal.com. Although most of the core project is the work of a small group of developers whose thousands of contributions are the driving force behind Drupal's evolution, there are thousands of people contributing code and modules to the community. These contributions are what allow me to produce LinuxJournal.com without a large Web team, and I am extremely grateful for them. Although I frequently cite Drupal's flexibility and power as the reason I am able to remain a one-person team, this is absurdly misleading. I am a one-person team with a support system of thousands, and I also can credit Addison Berry of Lullabot with getting me through many tough spots throughout the past year.

I believe Drupal is the best Web platform around, but I also believe that is a result of having the best Web community around. I am thrilled to be a small part of it.

With sites like WhiteHouse.gov adopting Drupal, this is an exciting time to be a Drupaler, and I encourage others to use it and get involved. Thank the community that makes your own work better, and don't forget to make your own contributions.

—KATHERINE DRUCKMAN

## They Said It

I think the biggest mistake most people make when they pick their first job is they don't worry enough about whether they'll love the work, and they worry more about whether it's a good experience.

—Steve Ballmer

Save early, save often.

—Alwin Lee and everyone else who uses Microsoft Word

From then on, when anything went wrong with a computer, we said it had bugs in it.

—Rear Admiral Grace Murray Hopper, US Navy

AOL is like the cockroaches left after the nuclear bomb hits. They know how to survive.

—Jan Horsfall, VP of marketing for Lycos

The Linux philosophy is "Laugh in the face of danger." Oops. Wrong One. "Do it yourself." Yes, that's it.

—Linus Torvalds

If Gore invented the Internet, I invented spell-check.

—Former Vice President J. Danforth Quayle

What is the difference between apathy and ignorance? I don't know and I don't care.

—World Entertainment War

My problem with Linux is, that it makes it very difficult to handle porn.

—Kshitij Sobti

(Posted on [thinkdigit.com](http://thinkdigit.com) on April Fools' Day 2010)



REUVEN M. LERNER

# CouchDB

## Getting started with CouchDB, an increasingly popular non-relational database.

The surge in interest in non-relational databases—often known collectively as NoSQL—is now impossible for Web developers to ignore. Whether you are looking at a non-relational database for reasons of scalability, availability, cost, performance or just because it's a shiny new toy, there's no denying that serious Web developers need to consider non-relational options when designing an application. In the past few months, every project on which I've worked has at least considered a non-relational solution, even when the final decision was to use a relational database.

In the previous two installments of this column, I looked at MongoDB, an object (or “document”) database with a somewhat relational feel. MongoDB stores objects, but its query language should look somewhat familiar to those of you who have long used relational databases. If you're willing to consider a more radical departure from the world of relational databases and query syntax, instead of using the map-reduce paradigm, easy replication and a straightforward RESTful API, you might want to consider CouchDB, now part of the Apache Software Foundation. Even if you don't use CouchDB in production environments, you may find (as I do) that its use of JavaScript, coupled with its implementation of map-reduce, helps you think in new and different ways about old problems.

### CouchDB Basics

Downloading and installing CouchDB is extremely easy. If it's not available via a simple `apt-get install` (or the `yum` equivalent) for your system, or if you simply prefer to install a source version, you can download it from the CouchDB home page at [couchdb.apache.org](http://couchdb.apache.org). The version I'm running is slightly out of date (0.10), rather than the latest production version at the time of this writing (0.11). Nevertheless, the differences aren't that great, especially for the simple examples shown here.

After I installed CouchDB with `apt-get`, I started it with the following standard command on my server:

```
/etc/init.d/couchdb start
```

That starts the CouchDB server on port 5984. By default, this means I can access the CouchDB server as:

```
http://127.0.0.1:5984/
```

If you are interested in accessing your CouchDB server from another system, you can modify the CouchDB configuration file (`/etc/couchdb/default.ini` on my machine) by going to the “`httpd`” section and replacing the name-value pair:

```
bind_address = 127.0.0.1
```

with your IP address instead of `127.0.0.1` (that is, `localhost`). Restart CouchDB, and it will be accessible not only to local HTTP clients, but also across the Internet.

Obviously, starting a CouchDB server on its well-known port and without any security restrictions is asking for trouble. If you are running a production instance of CouchDB, you should ensure that it cannot be accessed or modified by the general public. CouchDB comes with basic authentication options that make it possible to restrict access to databases, and you should look into those before deploying your system to a public server.

If you point your Web browser to your CouchDB server at port 5984, you will see the following:

```
{"couchdb": "Welcome", "version": "0.10.0"}
```

This response tells you several things. First, you see that all communication in CouchDB takes place using JSON, the JavaScript object notation that has become a lightweight method for communication among Internet applications. Although CouchDB is written in Erlang, an open-source language designed for distributed processing, nearly everything associated with it uses JavaScript. Functions (as you soon will see) are written in JavaScript, and both inputs and outputs are sent using JSON.

CouchDB is also RESTful—it uses the entire vocabulary of HTTP verbs to describe what should happen and a URL to indicate the object on which the action should take place. Most people are familiar with HTTP's GET and POST verbs, but less so with PUT and DELETE. CouchDB uses all of these, combining HTTP, JSON and REST for rich effect.

Thus, when you point your Web browser to your CouchDB server on port 5984, asking for the document `/`, you actually are issuing a GET request for the document named `/`. CouchDB's response describes the server, rather than an individual document. The response is an object (equivalent

to a “hash” or “dictionary” in languages such as Perl, Ruby or Python) with two keys. The first, “couchdb”, simply says “Welcome”. The second, named “version”, tells you the version of the server that is running—in this case, 0.10.0.

Let’s change the URL somewhat, going instead to the URL `/_utils`. If you go to that document, you’ll see a much more interesting response. Indeed, rather than receiving JSON, you will get a full-fledged Web page, with a CouchDB logo in the top right. This is Futon, the CouchDB Web-based interface. It is sometimes called the administrative interface, but it is also quite useful for experimenting with the database.

Along the right side of the main Futon page is the main “tools” menu. It normally comes up in the overview mode, but you can switch to a number of other screens by clicking on them. Most interesting to me is the test suite, which provides a Web-based interface to ensure that your CouchDB installation is working correctly. Although it is unlikely that your system has any problems, you still might want to run the test suite, just for personal satisfaction and thoroughness.

## Creating and Populating a Database

Going back to the overview screen, you should see a prompt at the top saying create database. Just as with most relational database systems, a single server may contain more than one database. Each database then may contain any number of documents, each of which has a unique ID and any number of name-value pairs.

So to get started, you need to create a new database. Click on the link, and an AJAX dialog box opens up, asking for the name of the database. I’m going to assume a database name of “atf” for this column, although you might want to choose something closer to your own name or interests. You may use any alphanumeric characters (plus some symbols) for a database name, keeping in mind that a leading underscore is used by internal CouchDB systems, meaning that you should avoid such names for your own work.

After you create a database, you’ll be brought to the browse database page. Click on the new document button to create a new document. CouchDB automatically gives the new document a unique ID value (key name “\_id”). You may change the ID to one of your liking, if you have a unique numbering or naming scheme that you prefer.

Then, you may add as many name-value pairs as you like, by clicking on the add field button. The name is assumed to be a string, but the value may be any legitimate JSON value—a number, string, array or object. If you enter an array (within square brackets) into the interactive Futon interface, upon

completion, it will be represented visually as an array. The same is true with a JSON object. After you enter it, the name-value pairs are displayed in an easy-to-read format.

Once you have added some fields to your document, click the save button.

I added a number of fields to a document describing me. The fields tab in Futon shows me these values in a nice, easy-to-edit format. If I want to see the document in its native JSON, I can click on the source tab and see it there:

```
{
  "_id": "0534ca63b70beb02d24b62ec4fe72566",
  "_rev": "4-bea8364f4536833c1fd7de5781ea8a08",
  "first_name": "Reuven",
  "last_name": "Lerner",
  "children": [
    "Atara",
    "Shikma",
    "Amotz"
  ]
}
```

Notice that in addition to the fields I already have mentioned, there is a “\_rev” field. That’s because when you save a document, the old version does not disappear. Rather, CouchDB keeps the old one around, much as a garbage collector handles memory in high-level languages, such as Ruby and Python. This means there can be multiple documents with the same “\_id” field, although only one is considered current—the one with the latest “\_rev” field value. The revision contains an integer as well as an MD5 hash value. You normally can look at only the integer to identify the revision, ignoring the hex portion of the string.

Do not mistake the revision tag as a means of keeping backups or for version control. The moment someone compacts a database, all of the old revisions are removed.

As with other non-relational databases, CouchDB allows you to add, remove and rename fields whenever you like. Each document in a database might have its own unique field names, although in practice, this is fairly rare. It is far more common for each document to have a common set of fields, perhaps with some variation in special cases. It is common to say that CouchDB is “schemaless”, but I think it’s safer to say that CouchDB (and other NoSQL storage facilities) allows the programmer to decide on the schema at runtime, rather than in advance—much as a dynamic programming language allows you to determine the type of a variable at runtime, rather than at compile time.

One thing that obviously is missing from a

JSON-based database is the notion of a foreign key—a pointer from one document, or record, to another. There is no built-in facility for linking one document to another, although there certainly are ways to use information in one document to view another document.

### Outside Futon

It's very nice that CouchDB comes with an easy-to-use, browser-based interface. However, this interface is clearly not what you want to be using from your applications. As I wrote above, CouchDB communicates with the outside world using JSON over HTTP. Any action that you just performed via the browser also should be possible via an HTTP client. You could use a library for a programming language; every major language has at least one CouchDB client. But a popular and easy-to-use option is the curl command-line program.

To send a simple GET request to my CouchDB server, I can write:

```
curl http://atf.lerner.co.il:5984/
```

And sure enough, I receive the same response as before:

```
{"couchdb":"Welcome","version":"0.10.0"}
```

Unfortunately, if something goes wrong, curl won't say much. For that reason, I generally prefer to use the `-v` option to curl (and most other programs, for that matter), which shows me the HTTP request and response as they take place. It also comes in handy to specify the HTTP verb you want to use (GET, in this case), so I'll do that with the `-X` option. Thus, I can write:

```
~$ curl -vX GET http://atf.lerner.co.il:5984/
```

And I see:

```
* About to connect() to atf.lerner.co.il port 5984 (#0)
* Trying 69.55.225.93... connected
* Connected to atf.lerner.co.il (69.55.225.93) port 5984 (#0)
> GET / HTTP/1.1
> User-Agent: curl/7.19.4 (universal-apple-darwin10.0) libcurl/7.19.4
> OpenSSL/0.9.8l zlib/1.2.3
> Host: atf.lerner.co.il:5984
> Accept: */*
>
< HTTP/1.1 200 OK
< Server: CouchDB/0.10.0 (Erlang OTP/R13B)
< Date: Mon, 12 Apr 2010 12:03:05 GMT
< Content-Type: text/plain;charset=utf-8
< Content-Length: 41
< Cache-Control: must-revalidate
```

```
<
{"couchdb":"Welcome","version":"0.10.0"}
* Connection #0 to host atf.lerner.co.il left intact
* Closing connection #0
```

You might notice that the “Content-type” response header indicates that what the server sends back is in text/plain format. So, although you might see the content as JSON, CouchDB itself indicates that it's sending plain text. This isn't a big deal, unless you are writing a program that specifically waits for JSON, so you might need to modify its expectations a bit.

You can request your Futon URL as well, using HEAD to avoid the long response:

```
~$ curl -vX HEAD http://atf.lerner.co.il:5984/_utils/

* About to connect() to atf.lerner.co.il port 5984 (#0)
* Trying 69.55.225.93... connected
* Connected to atf.lerner.co.il (69.55.225.93) port 5984 (#0)
> HEAD /_utils/ HTTP/1.1
> User-Agent: curl/7.19.4 (universal-apple-darwin10.0) libcurl/7.19.4
> OpenSSL/0.9.8l zlib/1.2.3
> Host: atf.lerner.co.il:5984
> Accept: */*
>
< HTTP/1.1 200 OK
< Server: CouchDB/0.10.0 (Erlang OTP/R13B)
< last-modified: Fri, 23 Oct 2009 12:40:09 GMT
< Date: Mon, 12 Apr 2010 12:04:43 GMT
< Content-Type: text/html
< Content-Length: 3158
```

In this case, you get a text/HTML response. And, of course, you know that Futon sends HTML for its response, because you already have been using it from a Web browser.

Now, let's try to look at the atf database, which I created earlier, that contains a single document (that is, record). How can I retrieve that information?

Well, I can start by asking for the database (leaving off the `-v` option now for space reasons):

```
~$ curl -X GET http://atf.lerner.co.il:5984/atf

{"db_name":"atf","doc_count":1,"doc_del_count":0,"update_seq":4,
 "purge_seq":0,"compact_running":false,"disk_size":16473,
 "instance_start_time":"1271067859057749","disk_format_version":4}
```

In other words, asking for a database gives basic information about that database, from the number of documents to the amount of space it consumes on the disk.

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```
~$ curl -X GET
http://atf.lerner.co.il:5984/atf/0534ca63b70beb02d24b62ec4fe72566

{"_id": "0534ca63b70beb02d24b62ec4fe72566",
 "_rev": "4-bea8364f4536833c1fd7de5781ea8a08",
 "first_name": "Reuven",
 "last_name": "Lerner",
 "children": ["Atara", "Shikma", "Amotz"]}
```

If I want to modify one or more fields in this document, or even add another field, I can do so with a PUT command. curl's -d option lets me specify a document on the command line:

```
~$ curl -X PUT
http://atf.lerner.co.il:5984/atf/0534ca63b70beb02d24b62ec4fe72566
-d '{"first_name": "Superman", "middle_initial": "M." }'

{"error": "conflict", "reason": "Document update conflict."}
```

Well, this is surprising. CouchDB is complaining that it cannot perform the update I need, because there is a conflict. Notice that it does not report the error using HTTP codes (such as 500), but rather by sending a JSON object back to me, containing the "error" key.

The reason CouchDB gives an error message here is that I haven't indicated which revision I am attempting to update. Without such a revision indicator, CouchDB assumes I have stale data and, thus, will not allow me to update the document. Only if I send my update with the current "\_rev" value will the update succeed. For example:

```
~$ curl -X PUT
http://atf.lerner.co.il:5984/atf/0534ca63b70beb02d24b62ec4fe72566
-d '{"_rev": "4-bea8364f4536833c1fd7de5781ea8a08",
     "first_name": "Superman", "middle_initial": "M." }'
```

CouchDB responds with:

```
{"ok": true, "id": "0534ca63b70beb02d24b62ec4fe72566", "rev":
"5-fe6fccb89b9512d26120fbd63dbb15c4"}
```

In other words, the update succeeded, incrementing the revision. If you try the same update again, you will get the same "update conflict" error message as before, because there can be only one update to a given revision.

Note that when you PUT an update to a document, you must update the entire document at once. Unlike the UPDATE command in a relational database, adding a new revision to a CouchDB document does not modify individual fields. Rather, it stores an entirely new document with the same ID and an incremented revision number. This means in this example, it's true that I have added the "middle\_initial" field successfully. However, I also have effectively removed the "children"

field, because I did not specify it in my PUT statement.

You can add an entirely new document to your database using the POST verb in HTTP. For example:

```
~$ curl -X POST http://atf.lerner.co.il:5984/atf
-d '{"first_name": "Atara", "last_name": "Lerner-Friedman"}
```

Sure enough, I get the following response, indicating that a new document was created:

```
{"ok": true, "id": "aeb6925eb23278f1b8e530ba67b0172d",
 "rev": "1-f0e336978a368f679ee7b280107bc2fb"}
```

I should add that I had a terrible time trying to use curl to create a document, all because of the quotes. It seems that you must use double quotes inside a JSON request (around the names of the keys and values). Single quotes result in a strange error message indicating that the UTF-8 encoding for JSON is invalid, which did not quite point me in the right direction.

## Conclusion

CouchDB is an increasingly popular non-relational database, offering a great deal of flexibility in storage and retrieval. This month, I explained how to create databases in CouchDB and do basic storage and retrieval using both the Web-based Futon interface and curl. Next month, I will demonstrate writing JavaScript functions that process and display the data, demonstrating the true power of CouchDB. ■

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## Resources

The home page for CouchDB is at the Apache Project ([couchdb.apache.org](http://couchdb.apache.org)). There, you can not only download the software, but also read documentation, from tutorials to an active wiki. The CouchDB Web site also has links to drivers for the various languages you're likely to use when working with CouchDB.

If you're interested in the JSON format used by CouchDB, you can learn more about it at the main Web site: [json.org](http://json.org).

Finally, two good books on CouchDB were released in the past few months. *Beginning CouchDB* by Joe Lennon and published by Apress is aimed more at beginners, but it has a solid introduction to CouchDB, Futon and how you might use the system. *CouchDB: The Definitive Guide* by J. Chris Anderson, Jan Lehnardt and Noah Slater, published by O'Reilly, is a bit more advanced and meaty, but it might not be appropriate for beginning users of non-relational databases.



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DAVE TAYLOR

# Simple Scripts to Sophisticated HTML Forms, Take II

## Parsing HTML files.

We've been digging into the Yahoo Movies database for the past few months, as you'll recall, building a command called `findmovie` that will have the following usage:

```
USAGE: findmovie -g genre -k keywords -nrst title
```

However, we slammed into a wall at 100kph last month in the simplest of calculations: how many titles match a given combination of query elements?

For example, how many action films are there that have "death" in the title? That'd look like `findmovie -g act death`, but making that count actually work is tricky, because the Yahoo Movies database output is different depending on whether there are zero matches, less than a page of matches or more than a page of matches. Examples of each output are "Sorry, no matches were found", "(All results shown)" and

**However, we slammed into a wall at 100kph last month in the simplest of calculations: how many titles match a given combination of query elements?**

"< Prev | 1 - 20 of 143 | Next 20 >", respectively.

Oh, and it gets worse. Sometimes when there's less than a full page of results, you'll see something like this: "< Prev | 1 - 3 of 3 | Next >" instead.

It's pretty much a huge pain in the booty, and even if you crack open the source, there's no handy spot that says "0" or "4" or "143". So, that's what I want to focus on this month—parsing an HTML file to isolate and identify this particular data point.

### Caching the Results

The first observation I have about identifying a solution is that we are going to need to cache (or save) the results, so we can parse it more than once to see what we find. This brings up the old shell scripting challenge of choosing a good, unique, temporary filename.

I'm old-school. I'm used to using `.$$` to use the process ID as the basis of the temp file, but

in fact, there are better solutions in modern Linux systems. Check out `mktemp` if you're on a BSD-based system. If that's not available, use `man` smartly: `man -k temp | grep '(1'` will extract the replacement that your distro has instead. Here's a typical use of `mktemp`:

```
appname=$(basename $0)
TMPFILE=$(mktemp /tmp/${appname}.XXXXXX) || exit 1
```

It looks pretty similar, but by using that many X characters, the program uses the PID and random letters, making the temp file impossible for a hacker to guess or anticipate. The version of this script I've been developing on my Mac OS X system had the following code snippet:

```
if [ $dump -eq 1 ] ; then
    exec /usr/bin/curl --silent "$baseurl${params}\&p=$pattern"
else
    exec open -a safari "$baseurl${params}\&p=$pattern"
fi
```

The problem here is that using `exec` to invoke a command replaces the shell script with the command in question, which isn't going to work. Instead, it's time to rewrite it:

```
if [ $dump -eq 1 ] ; then
    appname=$(basename $0)
    TMPFILE=$(mktemp /tmp/${appname}.XXXXXX) || exit 1
    /usr/bin/curl --silent "$baseurl${params}\&p=$pattern" \
        > $TMPFILE
else
    exec open -a safari "$baseurl${params}\&p=$pattern"
fi
```

That looks good. If we're dumping the file source, it'll go to the temporary file for later analysis. If it's a request that is supposed to launch the search results in a browser, it still uses the Mac OS X `open` command.

### Parsing the Results

To figure out what's going on, we need to account

for three different possibilities, each of which has a different “fingerprint” in the source file. Here’s a rough template:

```
if [ ! -z "$(grep -i "no matches were found" $TMPFILE)" ]
then
    echo there are zero results for that search.
elif [ ! -z "$(grep -i "Next&nbsp;&gt;" $TMPFILE)" ]
then
    echo got some results with case two.
else
    echo more than a page of results
fi
```

Here, I’m showing only output echo statements to give you a sense of the algorithm, but you can see that we’re just testing for a known string that hopefully won’t show up in other situations. Note the third test, though: `Next&nbsp;&gt;`; is some HTML weirdness. “nbsp” is a non-breaking space, and “gt” is the > symbol. Wrap ‘em in “&” and “;”, and you have HTML character entities.

To ascertain the total match count requires yet more parsing of the output. Search for “death race”, and you’ll find three matches, which end up looking like this:

```
<b>3</b>
```

Unfortunately, it’s rather buried in a more complicated pattern, because here’s a typical match:

```
<td align=right><font face=arial size="-2"><nobr>
↳&lt;&nbsp;&nbsp;&nbsp;Prev&nbsp;&nbsp;&nbsp;]&nbsp;&nbsp;&nbsp;<b>1 - 3</b>
↳&nbsp;&nbsp;&nbsp;of&nbsp;&nbsp;&nbsp;<b>3</b>&nbsp;&nbsp;&nbsp;...
```

I have to admit, I was stumped for a bit, which is why having geeky friends like Martin and Lucretia M. Pruitt is so darn helpful. I posed this puzzle on Twitter (I’m @DaveTaylor if you want to follow me), and after some false starts, they suggested a simple and logical solution: turn the `<b>` and `</b>` into individual character delimiters, then simply use `cut` to pull out the field we seek. Smart!

Here’s how that looks as a simple command sequence:

```
grep -i "1 - " $TMPFILE |
sed 's/<b>/~/g;s/</b>/~/g' |
cut -d\~ -f4
```

Armed with this, the ugly HTML sequence above quickly reduces down to the value 3, which is exactly what we want. One nuance, though. It turns out that this data appears both before and after the matches, so we need to slip `| head -1` to ensure that we’re parsing only one line and not duplicating

the data entry or confusing the new parser. This means we can create the following code:

```
if [ ! -z "$(grep -i "no matches were found" $TMPFILE)" ]
then
    matches=0
elif [ ! -z "$(grep -i "Next&nbsp;&gt;" $TMPFILE)" ]
then
    matches="$(grep -i "1 - " $TMPFILE | head -1 | \
sed 's/<b>/~/g;s/</b>/~/g' | cut -d\~ -f4)"
else
    matches="$(grep -i "1 - " $TMPFILE | head -1 | \
sed 's/<b>/~/g;s/</b>/~/g' | cut -d\~ -f4)"
fi
```

You can see how I’m differentiating the three cases and how the resultant code is fairly similar in the second and third cases. In fact, they don’t need to be separate cases, so the count is more easily calculated like this:

```
if [ ! -z "$(grep -i "no matches were found" $TMPFILE)" ]
then
    matches=0
else
    matches="$(grep -i "1 - " $TMPFILE | head -1 | \
sed 's/<b>/~/g;s/</b>/~/g' | cut -d\~ -f4)"
fi
```

If you initialized `matches` to zero, you actually can flip the logic of the first conditional and prune it down even further:

```
matches=0
if [ -z "$(grep -i "no matches were found" $TMPFILE)" ]
then
    matches="$(grep -i "1 - " $TMPFILE | head -1 | \
sed 's/<b>/~/g;s/</b>/~/g' | cut -d\~ -f4)"
fi
```

Nice. It’s a simple, straightforward and fine example of how if you keep thinking about what you’re really accomplishing with complex conditionals, they often can be not only simplified, but sped up too.

## Next Month

While writing these columns on working with Yahoo Movies, I’ve found my interest has been pulled in a different direction: a “name that tune” game. That’s what we’ll start working on next month. If you want to get a sneak peek at it and see how it evolves in real time (rather than here in *Linux Journal*), jump on Twitter and follow @SongTitle. It’s going to be fun! ■

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Dave Taylor has been hacking shell scripts for a really long time. 30 years. He’s the author of the popular *Wicked Cool Shell Scripts*, and he can be found on Twitter as @DaveTaylor and more generally at [www.DaveTaylorOnline.com](http://www.DaveTaylorOnline.com).



KYLE RANKIN

# Lightning Hacks—SSH Strikes Back

In this third Lightning Hacks roundup, check out how to automate screen connections, build reverse tunnels and use the elusive SSH command line.

**Every year** or so, I like to write a column I title “Lightning Hacks”. This column is inspired by the lightning talks common at most conferences. In a lightning talk, instead of having one speaker give a 60-minute presentation, multiple speakers give short 5–10-minute presentations. By the end of a lightning talk, you end up hearing about all sorts of cool topics that wouldn’t have gotten their own time slot. In this column, I get a chance to talk about a few cool “hacks” I’ve run across that wouldn’t fill an entire column by themselves.

In prior Lightning Hacks columns, I’ve covered a number of different topics, but this time I’ve decided to focus on only one: SSH. Like many system administrators, I spend a great deal of my day within SSH sessions, and over the years, I’ve found a few shortcuts and handy tips that I save in shell scripts so I don’t forget them.

## Automatically Load Screen-Like Sessions

This first hack seems really simple—after all, I am adding only one extra flag to SSH. Normally, if you want to ssh into a machine and run a program, you simply pass the program at the end of your SSH command:

```
$ ssh user@remotehost.example.org df
```

Yet, if you ever have tried to write a shell script that would automatically ssh in to a remote machine and launch mutt or screen or similar programs, you have seen the session either sit there or exit with some message like “Must be connected to a terminal.” I ran into this problem on my N900 palmtop when I wanted to launch two special terminal sessions: one that automatically reconnected to a remote screen session and another that loaded mutt. Yeah, that’s right. I still prefer mutt and irssi, even on a palmtop. Neither worked though until I added the `-t` flag:

```
$ ssh -t user@remotehost.example.org screen -dr
$ ssh -t user@remotehost.example.org mutt
```

The first example connects to the remote host

and re-attaches my remote screen session (I run only a single screen session on my host and then use `Ctrl-a c` to create windows within that session). The second example simply runs mutt. The `-t` flag forces pseudo-tty allocation. It turns out that when you run programs like screen or mutt, you need to force SSH to create a pseudo-tty.

## Route around Bothersome Firewalls

I know a million articles have been written about SSH tunneling, but this particular type of tunneling is so useful; however, I use it infrequently and forget the proper syntax. A problem you often may run into is needing to scp a large number of files between two servers (let’s say londonweb1 and seattleweb1), but for some reason, the two machines are firewalled off from each other. Usually, you have one server that is able to ssh into both machines (let’s call that server admin1), and if it were just one or two files that needed to be transferred, you could copy the files first from londonweb1 to admin1, then from admin1 to seattleweb1.

When you need to transfer multiple files (or perhaps pipe dd traffic) between the two sites, it can be impractical, if not impossible, to move data to an intermediary server first. That’s where SSH reverse tunnels come in handy. With a reverse tunnel, you launch an SSH session from your intermediary server (admin1 in this case) to the first server (londonweb1) and open up a local high port that is unused, such as 2222. Then, you tell SSH to tunnel all traffic on that port over to the remote server (seattleweb1). Once the tunnel is set up, you can use scp as you normally would, except you point it to localhost port 2222.

To set up the tunnel, I would run the following command from admin1:

```
kyle@admin1:~$ ssh -R 2222:seattleweb1:22 londonweb1
```

The arguments to `-R` can be easy to mix up. Note that the last server in the command (londonweb1) is the server to which I log in. The first argument to `-R` is the port to open up on that server (2222). The next

two arguments list to which server and port to forward any traffic (seattleweb1 and 22, respectively).

Once I log in to londonweb1, I can use scp (or rsync) like I normally would, but I point it to localhost port 2222:

```
kyle@londonweb1:~$ scp -r -P 2222 /var/www/mysite localhost:/var/www/
```

When I initiate this scp command, all the traffic enters the tunnel and goes to admin1, and then from there, it is forwarded to port 22 on seattleweb1. Keep in mind that this means if these machines are far apart, your bottleneck will be the slowest link between the servers.

If you are a security-minded individual in charge of a network, you may not like how easy it is to route around your basic firewall rules. It's important to realize that reverse tunnels also can be used to connect from inside your network to a person's home machine, so even with incoming firewall rules set, a user still could tunnel in.

### Adding SSH Tunnels on the Fly

A lesser-known feature of SSH is that you can enter an internal command-line mode in an existing session and add extra tunnels. Let's say you already have an SSH session

open from admin1 to londonweb1, and now you want to add the reverse tunnel without having to log out. First, press ~C (that's the ~ character and then a capital C) to open the SSH command line. Then, you can add extra port-forwarding commands as though they were part of the original SSH command line. When you are done, simply press Enter to return to the regular shell:

```
kyle@londonweb1:~$  
ssh> -R 2222:seattleweb1:22  
Forwarding port.
```

```
kyle@londonweb1:~$
```

This also could be useful if you use regular SSH tunnels (the -L option) as a poor-man's VPN and realize that, for instance, you need to set up an extra VNC or RDP tunnel to a new server. When you use the SSH command line, you won't have to close and break any existing sessions you have. ■

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DIRK ELMENDORF

# Adventures in Scanning

## Has scanning under Linux improved?

**Like many geeks**, I dream of a paperless office. I don't know when that phrase first came into use, but a quick scan around both my home and work office convinced me it's still a long way off. To add insult to injury, the fax machine as a means of business communication seems to be a zombie technology that refuses to die. All too often when I deal with businesses, they cheerfully tell me to fax something to a number they provide. That is all well and good, but because I made the switch to VoIP (Voice over IP), which does not support faxing, I am forced to make trips to the local Kinko's more than I would like to admit. Time has moved on, and a number of businesses now will accept a PDF file with scanned versions of the documents. This fills me with both joy and terror. I'm happy I don't have to find a landline with a fax machine, but I'm terrified of scanning under Linux. I haven't done it in a very long time (years), mostly because my experience was so bad and frustrating, I resolved to leave it as one of those things I cannot do under Linux.

### Finding Your Scanner

You already may have a scanner lying around, but I didn't. I searched the Internet where all roads led to the SANE (Scanner Access Now Easy) Web site, so that's where I started. SANE is the main clearing house for information related to scanners and scanning. It has a big list of devices that shows how well they are supported, but the list is less helpful than it looks, primarily because it focuses on listing all the scanners that are known to work, including many that are no longer manufactured. I spent a lot of time trying to find a scanner that was both on the list and available from Amazon.com. I then found the best path was to go to the Ubuntu forums and search for recommended scanners. If you use another distribution, check its forum or assume that if it works for Ubuntu, it will work with any other modern distribution (although that's not always a safe bet). My main criteria were size (smaller the better), USB (is there another interface now?) and cheap (less than \$100).

After some searching, I found recommendations for the Epson v300 and the Epson v500. On Amazon.com, the v300 was available for \$89, and the v500 was \$165. I am sure the v500 is awesome, but given that I mainly wanted to use it for documents, I didn't think I needed to pay double. I was a little confused because the scanner is called a photo

scanner, but the dimensions showed that it could scan a full sheet of standard letter paper. It even has a hinge so you can scan from a book.

### The Moment of Truth

I hooked up the scanner to the computer. I'm not sure what I expected to happen, but nothing did. I realized I needed something actually to use the scanner. It turns out that the word scanner means security scanner a lot more often than image scanner. This made locating software a little more difficult. I found out that I already had packages for sane and xsane installed. xsane is the graphical front end to the SANE library, and it gives you a GUI to control your scanner. Because it was already installed, I started with xsane. Right off the bat, I hit a problem. By default, xsane connected to /dev/video0, which is my Webcam.



Figure 1. xsane

After a little more research, I ended up at Avasys. It provides drivers and a software utility for talking to my new scanner. I had to download a 64-bit deb for iscap and esci-interpretor. I clicked on Image Scan! for Linux, and the program told me it wasn't able to talk to the scanner. I was beginning to have flashbacks to the last time I tried using a scanner. Remaining calm, I power-cycled the scanner and tried the application again. This time, it started up without complaint. I was able to click Scan, and a scan of a book cover showed up. I was able to scan to several different file types: TIFF, JPEG, PNM, PNG and PDF. I was a little disappointed

that the PDF option didn't allow me to store more than a single page in the file.



Figure 2. Image Scan!

As a bonus, the driver package I installed fixed the problem with xsane. Now when it starts, it gives me the option to choose my Webcam (weird) or my

scanner. This also solves the problem of not being able to scan multiple pages into a single PDF, because xsane has that feature. The key is to change xsane into multipage mode before I start scanning. This allowed me to scan several pages and save them as a single PDF.

### Another Option

I am running Karmic (9.10), but by the time this article is printed, Lucid (10.4) will be released. Simple Scan is being included as part of the release. Simple Scan is a new scanning tool focused on making scanning, in a word, simple. Because it currently is available as part of a PPA (Personal Package Archive), adding it to my system was easy:

```
sudo add-apt-repository ppa:robert-ancell/simple-scan
sudo apt-get update
sudo apt-get install simple-scan
```

The first time I tried Simple Scan, it failed. That was a bit frustrating, but it was my own fault. I had xsane open at the same time. It turns out that each application claims ownership over the device. Once I

### Powerful: Rhino



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- Three year manufacturer's on-site warranty
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### Tablet: Raven



#### Raven X200 Tablet

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closed xsane, Simple Scan worked like a champ. It really is simple, and it can do photos or text. Plus, it made making a multipage document as easy as just continuing to scan. xsane gives you incredibly fine-grained control. There probably are situations where I would be glad it includes a histogram of the image, but when all I am trying to do is sign a contract, scan it and e-mail a PDF, Simple Scan fits the bill.

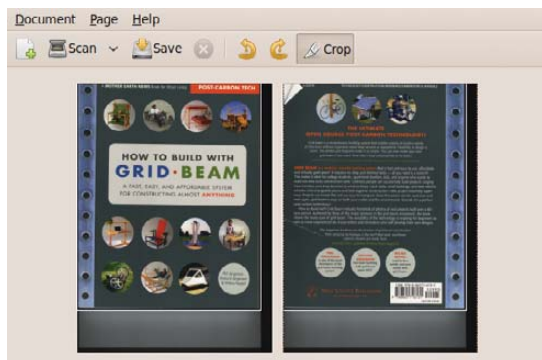


Figure 3. Simple Scan

One word of warning before I move on. After spending some time using Simple Scan, I hit a problem. Simple Scan depends on the `convert` command from ImageMagick to make a multipage PDF from a series of scans. On Karmic, this results in a segmentation fault. I was able to locate a bug report confirming that this problem has been resolved for Lucid, but

## Updates for Previous Columns

### Updates on Qimo:

My instructions for getting Qimo to use more modern packages were not detailed enough [see “A Desktop for Our Little Penguin” in the February 2010 issue]. Unfortunately, the original computer I built died before I could get the files off the drive. The good news is that Qimo 2.0 should be out by the time you read this. That version will be in sync with Lucid (10.4) and save you a lot of hassle.

### Updates on APT Caching:

Eric Cooper, the author of *Approx*, contacted me about my comments that his software did not handle multiple computers at once [see “Installation Toolkit” in the March 2010 issue]. He pointed out that the criticism might have been from an earlier version. The current version of *Approx* uses `inetd/xinetd`, so they do not suffer from that limitation. That means you have several good choices for caching packages on your network! Sorry for the mistake Eric. That’s what I get for reading a blog and being in a hurry.

not for Karmic. There are three options: upgrade to Lucid, pull in only the Lucid packages, or pull in an updated ImageMagick from Raimar Sandner’s PPA (see Resources). Long term, I plan to upgrade to Lucid. For now, I just used Sandner’s PPA to pull in a fixed version. I was able to confirm that this works.

### Success Breeds Success?

After having such a pleasant experience getting my scanner working, I realized I was up for more of a challenge. At my office, I have an HP LaserJet 3055. It’s one of those multifunction copier, scanner, fax and printer machines. The v300 scanner I used at home was connected directly to my Linux box. In the case of the HP, I have to connect over the network. Will it be as simple to set up as the single-function Epson?

At first, I wasn’t sure where to start. There didn’t seem to be any tools to detect the scanner on the network. Then I realized I had already been through this process. Step one with the scanner is finding out whether special drivers exist. In this case, the key phrase is “HP Linux Imaging and Printing” system, or HPLIP for short:

```
sudo apt-get install hplip-gui
```

Once that is done, I needed to run `hp-toolbox` to configure the network printer. This provides a handy icon in the GNOME alert bar that lets you select actions for the multifunction printer. By choosing Scan, it automatically starts xsane. I found the configuration under Preferences in the HP system tray application to change it to Simple Scan as the default application. For some reason, it refused to find the HP scanner when I launched it from the system tray. At the moment, I’ll chalk that up to something that will get ironed out, as a bug report says the switch will be official in Lucid (see Resources). On the plus side, now that the HP is completely installed, I can start xsane or Simple Scan and then choose the HP for scanning. Scanning under Linux really has come a long way.

### The Final Challenge

I now have both scanners working, so I decided to dig a little deeper into scanner configuration. My Epson scanner has three hardware buttons: PDF, Email and Copy. It would be cool if I could press the PDF button and have it automatically start Simple Scan and start scanning. To do that, I needed to use a tool called `scanbuttond`. This is a daemon that runs in the background and monitors the status of the scanner buttons. It then allows you to trigger scripts based on the button pushed:

```
sudo apt-get install scanbuttond
```



I started the daemon by running:

```
scanbuttond -f
```

The application still logs to `/var/log/syslog`, but the `-f` option keeps it in the foreground, so it is easier to kill as I work through the configuration issues. Right away, things got off to a bad start. My log file quickly filled with:

```
Apr 1 21:30:24 barqs scanbuttond: rescanning devices...
Apr 1 21:30:24 barqs scanbuttond: no supported
  devices found. rescanning in a few seconds...
Apr 1 21:30:26 barqs scanbuttond: rescanning devices...
Apr 1 21:30:26 barqs scanbuttond: no supported
  devices found. rescanning in a few seconds...
```

Now I know why they provide a `-q` option to quiet the log messages. The problem seems to be that the system doesn't know how to detect my scanner. After spending some time on Google, I determined that the way to solve the identification problem is to modify the source of `scanbuttond` to detect the scanner. Using `lsusb`, I was able to code to add to `scanbuttond`. I recompiled the package and got a notification that it found my scanner.

After all of that, I learned that even more work was needed. `scanbuttond` uses `libusb` to communicate with the scanner. This allows it to talk to the scanner without locking it up (the way `xsane` and `Simple Scan` do). As a result, in order to get the button presses, you have to know precise codes to send to the scanner to get a response. Once I realized that, I was able to confirm that the Epson scanner I have acts completely differently from the other scanners that `scanbuttond` knows about. If I knew more about USB debugging, I might have had a shot at fixing the problem.

### Conclusions

It was a little disappointing that I couldn't get the buttons on the scanner to work, but that ended up being the only roadblock in the whole process. The main lesson is to get the driver for your scanner, then worry about the rest. Scanning under Linux has improved a lot since I last played with it, and I'm really excited to take something off the list of things I have to do on another operating system. ■

Dirk Elmendorf is cofounder of Rackspace, some-time home-brewer, longtime Linux advocate and even longer-time programmer.

## Resources

SANE: [www.sane-project.org](http://www.sane-project.org)

SANE—Supported Devices:  
[www.sane-project.org/sane-supported-devices.html](http://www.sane-project.org/sane-supported-devices.html)

Avasys: [www.avasys.jp/lx-bin2/linux\\_e/scan/DL1.do](http://www.avasys.jp/lx-bin2/linux_e/scan/DL1.do)

Bug Report: ImageMagick crashes when using `adjoin` to make a multipage pdf (karmic): <https://bugs.launchpad.net/ubuntu/+source/imagemagick/+bug/551484>

Raimar Sandner's Ubuntu Karmic ImageMagick: convert jpg to pdf segmentation fault: [homepage.uibk.ac.at/~c705283/archives/2010/03/19/ubuntu\\_karmic\\_imagemagick\\_convert\\_jpg\\_to\\_pdf\\_segmentation\\_fault/index.html](http://homepage.uibk.ac.at/~c705283/archives/2010/03/19/ubuntu_karmic_imagemagick_convert_jpg_to_pdf_segmentation_fault/index.html)

Bug Report: scan utility should now be `simple-scan`:  
<https://bugs.launchpad.net/ubuntu/+source/hplip/+bug/539015>

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- WWW  
2000s  
- Web 2.0  
- Social Media  
2010s  
- CLOUD . . . . .

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## The Linux Box's Enkive

Former President Nixon would have balked at Enkive, a new open-source e-mail archiving and retrieval application from The Linux Box. That's because Enkive captures e-mail messages as they arrive or are sent to ensure they are retained before a worker can delete them in an e-mail client. This feature helps organizations address the issues of compliance with laws and regulations governing communications, as well as litigation support. It permits recovery of e-mail in full support of an organization's retention policies. In addition, storage costs are reduced by eliminating the capture of redundant messages and attachments.

[www.linuxbox.com](http://www.linuxbox.com)



## RackForce's ddsCloud Enterprise

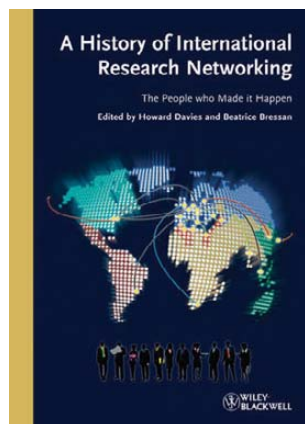
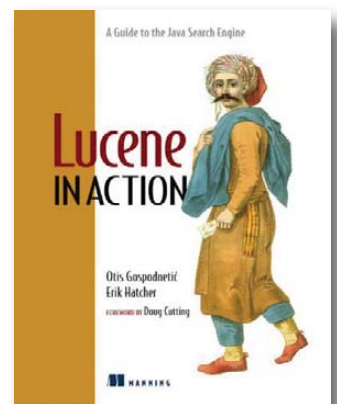
The team at RackForce has announced availability of ddsCloud Enterprise, an enterprise-level hosted private cloud solution. RackForce describes ddsCloud Enterprise as a fully virtualized network, storage and compute capacity in an on-demand model that utilizes best-in-class technologies from Cisco, IBM, Microsoft and VMware. Built on RackForce's new state-of-the-art GigaCenter infrastructure, the firm says the results are "unprecedented scalability, flexibility and greenness". ddsCloud Enterprise leverages virtualization and unified fabric to combine computing, network and storage into one seamless system. When compared with previous computing models, RackForce asserts that it has seen deployment times reduced by 85%, customer costs by up to 30% and a carbon footprint merely 1/50th the size of other cloud offerings located in conventional North American data centers.

[www.rackforce.com](http://www.rackforce.com)

## Lucene in Action, 2nd Ed. (Manning)

The editorial duo of Erik Hatcher and Otis Gospodnetic has updated the book *Lucene in Action* from Manning Publications to a new 2nd edition. The 500-pager is touted as the definitive guide to Lucene, an open-source, highly scalable, super-fast search engine that developers can conveniently integrate into applications. Since the first edition, Lucene has grown from a nice-to-have feature into an indispensable part of most enterprise apps. The book explores how to index documents; introduces searching, sorting and filtering; and covers the numerous changes to Lucene since the first edition. All source code has been updated to current Lucene 2.3 APIs.

[www.manning.com](http://www.manning.com)



## Howard Davies and Beatrice Bressan's *A History of International Research Networking* (Wiley)

Publisher Wiley calls *A History of International Research Networking* "the first book written and edited by the people who developed the Internet", and it covers the history of creating universal protocols and a global data transfer network. Editors Howard Davies and Beatrice Bressan, two veterans of the CERN particle physics research lab, are two of many insiders who contribute with perspectives never before published on the historic, technical development of today's indispensable Internet.

[www.wiley.com](http://www.wiley.com)



## cPacket's cVu320G Network Appliance

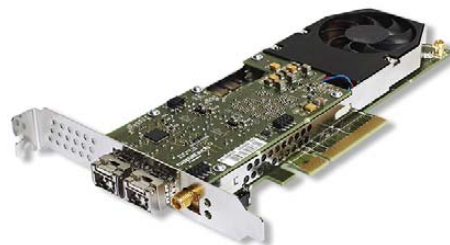
The company cPacket is now marketing the cVu320G network appliance, a solution for data centers, service providers and telecommunications that enables on-demand capacity management, resource allocation and real-time troubleshooting of bursts and spikes. The cVu320G provides complete packet inspection filtering, flexible traffic aggregation, selective duplication and flow-based load balancing, as well as granular, wire-speed performance monitoring for 32 10-Gigabit links. cPacket's rationale for the application is threefold: first, today's data centers struggle with the growing stampede to 10 Gigabit and the increasing virtualization of platforms and services; second, monitoring tools have not kept pace with these developments, and, as a consequence, data centers are being overwhelmed with huge volumes of complex traffic, which they no longer have the visibility to control; and third, the consequences include intermittent and frequent congestion, performance degradation and major service disruptions to end users that are becoming increasingly common. The solution is based on cPacket's unique, 20-Gigabit "complete packet inspection" chips and Marvell's 10-Gigabit Presteria switch.

[www.cpacket.com](http://www.cpacket.com)

## Napatech's NT20E2 Network Adapters

With the introduction of the NT20E2 Capture adapter and NT20E2 In-line adapter products, Napatech recently unveiled what it calls "the world's first 2x10 Gbps Intelligent Real-time Network Analysis adapters". Napatech has positioned the NT20E2 In-line for applications that require both capture and transmit in real time, such as intrusion prevention systems and policy enforcement applications operating at 10Gbps line-speed. The former is complemented by the NT20E2 Capture adapter, which provides full 20Gbps packet capture throughput over the PCI-Express Gen 2 bus. The NT20E2 is drop-in-compatible with existing NT20E cards and is supported by the same driver software as other Napatech network adapters on Linux, FreeBSD and Windows.

[www.napatech.com](http://www.napatech.com)



## Synaptics Gesture Suite

A big welcome to the Linux family is in order for Synaptics, whose Gesture Suite Linux (SGS-L) for its TouchPads is now available on a number of Linux variants. The solution allows OEMs that offer Linux-based solutions to provide their users "a powerful and intuitive way to be more productive and interactive with their Linux-based notebook systems". SGS-L supports a wide range of pointing enhancements and gestures, including two-finger scrolling, PinchZoom, TwistRotate, PivotRotate, three-finger flick, three-finger press, Momentum and ChiralScrolling. It is provided free of charge to Synaptics OEM/ODM partners when ordered with Synaptics TouchPad and ClickPad products.

[www.synaptics.com/go/SGSL](http://www.synaptics.com/go/SGSL)

## Numerical Algorithms Group's NAG Library for SMP and Multicore

Application developers seeking two essential things—better use of the processing power of multicore computer systems and an easy way to migrate existing applications to multiprocessor architectures—can go and get the Numerical Algorithms Group's NAG Library for SMP and Multicore. The company points out how mathematical and statistical algorithms optimized for performance on multicore architectures have become key to progress in various aspects of technical application development and computationally intensive problem solving. The library contains more than 1,600 routines, including more than 100 new ones for this release.

[www.nag.com](http://www.nag.com)

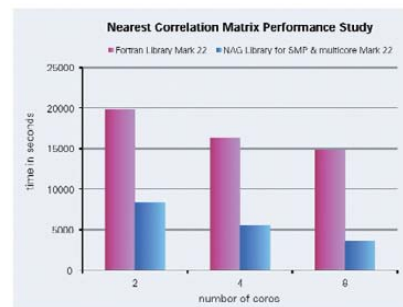


Figure shows the speed increases of using the NAG Library for SMP & multicore—NAG routine used: 'Nearest Correlation Matrix'. Problem size of N=10,000.

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# Fresh from the Labs

## marave—Stylish Text Editing

[code.google.com/p/marave](http://code.google.com/p/marave)

If you're the kind of person who's been using Blackbox and its derivatives for the past decade, the kind of person who has just a single CD in a spotless but stylish car, the kind of person who likes minimalism but with effortless style, then boy, have I got a project for you. To quote the marave Web site:

Inspired by ommwriter and other similar projects, marave (it means "nothing" or "it doesn't matter" in guaraní) aims to be a simple, clean text editor that doesn't distract you from your writing.

You can have a nice background, or just a color. You can have a real-time spellchecker or not. Syntax highlighting or not. You can have background music, keyboard feedback or silence. marave will try to be the way you want it to be.

**Installation** Project maintainer Roberto Alsina is hoping to integrate marave into most distros soon, but for now, the only packages available are for Arch Linux and Fedora. If you use another distro, your only option is the source, but that's okay, because installing the source is pretty easy.

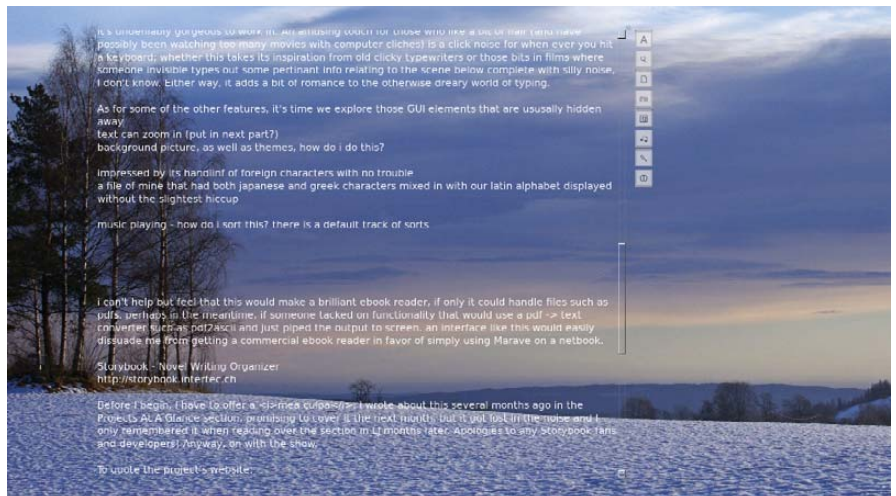
In terms of requirements, the documentation says you need the following libraries:

- GNU source-highlight ([www.gnu.org/software/src-highlight](http://www.gnu.org/software/src-highlight)).
- Source-highlight-qt ([srchiliteqt.sourceforge.net](http://srchiliteqt.sourceforge.net)).
- SIP, which should come with PyQt.
- A C++ compiler.

Assuming you're going with the source, head to the Web site, grab the latest tarball, extract it, and open a terminal in the new folder.



marave makes the dull world of text editing romantic and immersive with beautiful minimalism—quite a mix.



marave can use different themes (or none at all), as well as play Internet radio. Here, I'm using it to edit this month's article.

If your distro uses sudo, enter:

```
$ sudo python setup.py install
```

If your distro doesn't use sudo, enter:

```
$ su
# python setup.py install
```

Once that's done, run marave with the command:

```
$ marave-editor
```

**Usage** The first thing you'll notice when you're inside is that the entire desktop has disappeared and you are in a single full-screen program. This is unabashed full-screen editing, designed to immerse you and cut out distractions. As if to reinforce this ethic, the few existing GUI elements on the side disappear until you move your mouse again, leaving you with only your text, a blinking cursor and a scroll bar.

But, enough of the straight minimalism. What really impresses me is the look of the thing. It's a sleek and

undeniably gorgeous environment in which to work. An amusing touch for those who like a bit of flair (and have possibly been watching too many Hollywood movies) is a click noise for whenever you press the keyboard, adding a bit of romance to the otherwise dreary world of typing.

As for some of the other features, it's time we explore those GUI elements that usually are hidden away to the right of the scroll bar. The first button at the top allows you to change the font, as well as the color. The magnifying button has a submenu to zoom your text in and out, which is actually one of my favorite features of this program. The blank sheet of paper button has a menu with all the usual functions of loading, saving and so on.

Further down is an icon that looks like a camera. The left and right buttons switch between desktop backgrounds, including various snowy nature themes and what appears to be a Debian background. The color wheel at the right also allows you to adjust the background color and get rid of the background picture completely, if you so desire. The next button gives you amusing control over what sort of keyboard click noise you'd like (or whether to disable it). Next up, there's a music button that lets you play what I think is streaming music (as well as turn it off). I'd go into this more, but space and documentation are kind of lacking.

Second from the bottom is a button that looks kind of like a cricket bat, which appears to bump the text around, but I'm not sure I can elaborate much further on it. I found there are a number of GUI customization options to move around all of your working elements, such as the text area size and placement, but I also ran into some confusion (I deleted the config file to reset in the end, after getting myself into some UI trouble). And as I already mentioned, documentation still is lacking.

Something that really impressed me was marave's handling of foreign characters. A file of mine that had both Japanese and Greek characters mixed in with the Latin alphabet displayed without the slightest hiccup.

I can't help but feel that with a bit of modifying, marave also would make a brilliant ebook reader if it could

handle files such as PDFs. Perhaps if in the short term, someone tacked on some code that would use a PDF-to-text converter, such as pdf2ascii, and then just piped the output to screen? An environment as cool as this one, with a full-screen interface, no intruding GUI elements and zooming text, easily would dissuade me from getting a commercial ebook device in favor of simply using marave on a basic Netbook.

What ultimately draws me to the project is that it doesn't just have minimalism and simplicity, it has minimalism and simplicity combined with beauty and a palpable design ethic. marave has soul, and I love that.

## Storybook—Novel Writing Organizer

[storybook.intertec.ch](http://storybook.intertec.ch)

Before I begin, I have to offer a *mea culpa*. I wrote about this several months ago in the Projects at a Glance section, promising to cover it the following month, but it got lost in the noise, and I remembered it when reading over the section in *LJ* months later. Apologies to any Storybook fans and developers! Anyway, on with the show.

To quote the project's Web site:

Storybook is a free (open source) novel-writing tool for creative writers, novelists and authors that will help you keep an overview of multiple plot-lines while writing books, novels or other written works.

Storybook assists you in structuring your book. Store all information about your characters and locations in one place. Then, use the included Storybook features for managing chapters, scenes, characters and locations. A simple interface is provided to enable you to assign your defined characters and locations to each scene and to keep an overview of your work with user-friendly chart tools.

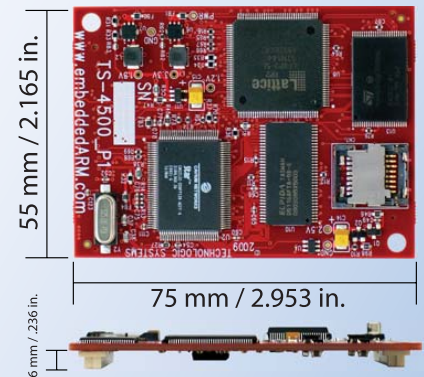
**Installation** As far as requirements go, the only one that jumped out was Java 6 (Storybook won't work with Java 5 or earlier), which shouldn't be much hassle.

Available from the Web site is what

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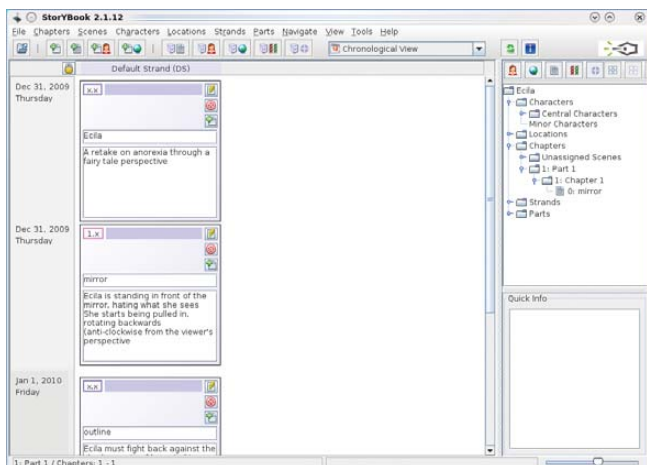
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Storybook is a clever tool designed to help you structure a book and keep track of characters, scenes, locations and so on.



Given that characters typically are the most important part of a story, Storybook's character options are wonderfully thought out. Note the color assignment option—a brilliant touch for creative types.

appears to be a distro-neutral tarball. Download and extract the file, and open a terminal in the new folder. Once there, enter the following command to run it:

```
$. /storybook.sh
```

**Usage** Although I can't really give you a whole rundown on how to use Storybook (that would require an article all its own), I at least can introduce you to the main elements and highlight the coolest parts of the program. Thankfully, the Web site has a very good tutorial, so have a gander if you want to explore

things further.

When you first enter the program, it prompts you for a project title. Once you're past that, you'll be in the main screen where you can start exploring. The largest part of the window is called the Chronological View, which shows your scenes in chronological order (as this project is still new, this window essentially will empty for the meantime).

To the right, in the top section, is the Object Tree. This shows all the objects involved in this story thus far (such as characters, scenes, locations and so on) in a hierarchical order. In the bottom section is the Quick Info area, which pretty much does what it says—provides info for each object you're looking at in the upper pane (the Object Tree).

As for actually taking your first steps in Storybook, you need to begin with new characters, scenes and so on. The toolbar at the top with the icons will be your best friend here. The first icon is Open (ignore for now), but continuing right are New Scene, New Chapter, New Character and New Location. Each of those has very well thought-out dialog screens that link to other sections of the program.

For instance, the New Scene dialog allows you to link individual or multiple characters to a scene, as well as individual or multiple locations. The New Location dialog lets you be very detailed, giving you the chance to assign a name, address, city and country to this

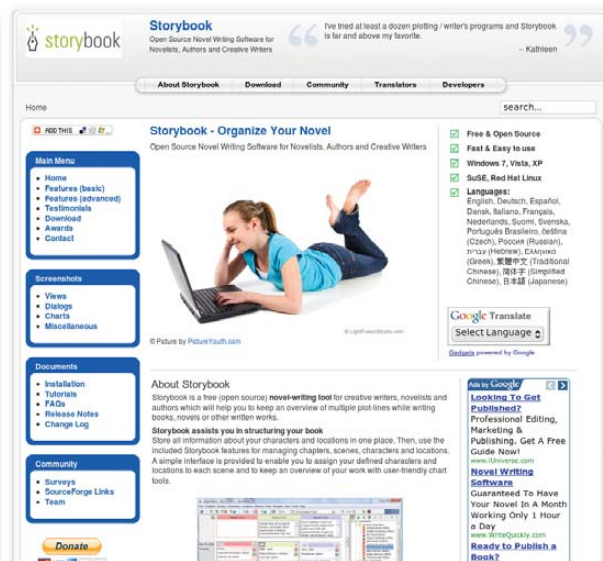
location, as well as a large description box to flesh out as many details about this place as possible.

However, it's the New Character dialog screen that's particularly well thought out. Each character can be assigned everything from first and last names, abbreviations, gender, birthdays, date of death and occupation. They even can be assigned a color. But, the most important feature is defining whether they are a Central Character or a Minor Character, which then affects the rest of the information throughout Storybook—masterful.

But what is the point of all this categorization, you may ask? Well, it allows you to see patterns in your story and give it structure much earlier in the process than a bare-bones, traditional pen-and-paper approach would allow. Are you overusing a character? Have you broken a piece of continuity somewhere or perhaps lost or missed out on some vital context to the story? Storybook likely will show it long before you see it yourself. ■

**John Knight is a 25-year-old, drumming- and climbing-obsessed maniac from the world's most isolated city—Perth, Western Australia. He can usually be found either buried in an Audacity screen or thrashing a kick-drum beyond recognition.**

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Although the Web site shows a girl using Storybook, trust me, this one's really for adults.

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**DebConf10**  
New York City

<http://debconf10.debconf.org/>

DebConf10 logo by Valessio Brito, Jimmy Kaplowitz, and Moray Allan was inspired by a design by Brian Gupta.

**DebConf space is very limited, last minute registrants are encouraged to consider the corporate registration option.**

DebConf is the annual conference for Debian contributors and interested users. DebConf 10 is being held in New York City from August 1-7, 2010. Featuring international speakers and participants, DebConf is an event filled with highly technical talks, presentations, coding parties, discussions and workshops.

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## HARDWARE

# Coyote Point Offers Application Balancing for Virtual Servers

Stressed budgets and the high demand for Web applications have made efficiency in the data center priority number one, creating the need for inexpensive load balancing, application balancing and SSL-acceleration products. Does Coyote Point have what it takes to succeed in the enterprise? FRANK J. OHLHORST

Thanks to the low cost of open-source solutions and the falling prices of hardware, network managers are finding it easier than ever to build out networks and grow the capabilities of the data center. Network managers quickly can meet the increasing demands of Web services, remote access, VPNs and many other services by provisioning new inexpensive servers with open-source software, which has fueled the exponential growth of server clusters and Web applications. However, many network managers are discovering that just throwing additional servers into the mix is an inefficient way to balance loads across server farms. High server demand can create a cascade effect across the servers, with a services request sent to the primary server and moving on to the next server only after the primary server has become saturated.

What's more, server virtualization solutions magnify the problem. Virtualization makes it even easier and quicker to build out multiserver solutions, yet virtualized servers still rely on that same round-robin approach to meet high demand. That proves to be very inefficient and a waste of processor cycles, and it negates most energy savings offered by virtualization.

Many data-center administrators have turned to third-party products to help mitigate those load-related inefficiencies, creating a healthy market of load-balancing and traffic-acceleration solutions. Numerous products, ranging from open-source software to hardware appliances that cost tens of thousands of dollars, are all fighting for market share and promise to be the best way to manage loads across servers and sites. However, traffic-balancing products are not created equally and selecting the correct load balancer can be fraught with uncertainty.

Coyote Point Systems entered the fray more than 15 years ago, with the ideology that network traffic management was the key to maximizing bandwidth and services availability to endpoints. Contrary to what other vendors were doing in the 1990s, Coyote Point chose to go the route of building traffic management capabilities into an appliance. The goal was to replace bulky software solutions with an easy-to-manage device.

Although Coyote Point was a pioneer in the world of traffic-shaping and load-balancing appliances, other companies, such as F5 Networks, Barracuda Networks and Cisco also have focused on providing hardware-based load-balancing

Equalizer Model	E250Gx	E350Gx	E450Gx	E650Gx
Ethernet Connectivity	2 GigE (1000base-T)	12 GigE (1000base-T)	12 GigE (1000base-T)	20 GigE (1000base-T) + 2 SFP
Throughput	600 Mbps (L4)	850 Mbps	1.0 Gbps	1.8 Gbps
Layer 4 Load Balancing	✓	✓	✓	✓
Layer 7 Load Balancing	✓	✓	✓	✓
Layer 7 Persistence	✓	✓	✓	✓
Match Rules (content switching)	N/A	✓	✓	✓
SSL/HTTPS Performance	180 tp/s (Software)	500 tp/s (Software)	8,500 tp/s (Xcel-II hardware)	14,000 tp/s (Xcel-II hardware)
SSL/HTTPS Throughput	100 Mb/s	400 Mb/s	800 Mb/s	825 Mb/s
HTTP GZIP Compression	N/A	N/A	N/A	Express Hardware 1 Gb/s Throughput
Envoy (GLSB) Global Server Load Balancing	N/A	Optional	Optional	✓ Envoy GSLB Included
Equalizer VLB	VLB Basic Included	VLB Basic Included	VLB Basic Included	VLB Advanced Included
Supported Clusters	64	Unlimited	Unlimited	Unlimited
Real Servers per Cluster	16	32	128	512
Layer 7 Performance	8,500 tp/s	50,000 tp/s	75,000 tp/s	110,000 tp/s

Figure 1. Feature Chart





Figure 2. Coyote Point E650GX

solutions, creating a crowded field of contenders, where each vendor is looking to tout specialized capabilities to become the appliance of choice.

Coyote Point has chosen to up the ante with the launch of a new series of load-balancing appliances, which are virtual server-aware. What's more, the company is looking to shift the focus from layer 4 load balancing to application load balancing, where the appliance is aware of payload as well as raw traffic. Coyote Point's application load-balancing appliances can shape traffic and efficiently distribute loads across multiple servers, even if those servers

are virtual in nature. The growth of virtualization solutions in the data center has made it critical for traffic-shaping and load-balancing appliances to integrate with virtual server solutions.

Coyote Point offers four different appliances. Those four appliances differ based upon design traffic load and sub-features, yet all share the same management console and basic feature set.

### Application Load Balancing—the Coyote Point Way

I tested the E650GX (V8.6) load-balancing appliance for ease of use, feature set, performance and suitability to task. I

found that the device is very simple to install; the physical portion of the installation consists of plugging in the device and routing the appropriate Ethernet cables to the unit. The E650GX is Coyote Point's top-of-the-line appliance and sports 22 Gigabit Ethernet interfaces for connecting server clusters.

I spent more time figuring out my cabling than I did configuring the device. Making sure your cabling goes to the appropriate servers is one of the most important steps for deploying a Coyote Point appliance. You have to be certain that you are plugging your server farm in to a load-balancing port on the

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device. In complex environments, it is easy to forget that a particular network segment is plugged in to a different router or switch from what you originally thought. However, on smaller networks, you simply can plug in the connection from your firewall to the external port on the E650GX and then plug each segment of the LAN in to the internal ports on the device. All ports on the E650GX are Gigabit Ethernet and support full duplex operation. That means it is very unlikely the device will introduce any bottlenecks into the LAN or WAN connections, and none were detected during performance testing.

I found the rest of the setup process

## Coyote Point's application load-balancing appliances can shape traffic and efficiently distribute loads across multiple servers, even if those servers are virtual in nature.

plug-and-play easy. After I connected all the cables, I was able to access the E650GX's management console using a Web browser. The management console is based on AJAX technologies, creating a rich user interface, which is easy to navigate and sports context-sensitive help. The interface was designed using the Dojo toolkit, a JavaScript development toolset, which helps give the management interface a professional look and feel.

The E650GX works pretty well right out of the box. All you need to do to start

load balancing is to set up some basic parameters. One of the first steps to complete is the definition of your server clusters. For example, if you have nine servers running a Web application, you would plug each of those servers into an internal port on the E650GX appliance. The next step consists of defining your server clusters. For example, you may want to divide those nine servers into three clusters. That proves very easy to do and easy to modify, if you need to change anything. All clusters are defined logically, allowing a great deal of flexibility.

I found that the E650GX offers many options when it comes to load balancing. You can use "Match Rules and Custom

Load Balancing Policies" to build policies based upon layer 4 requests, layer 7 requests or even create custom policies using Boolean logic. The layer 4 policies offer basic load-balancing capabilities, based on parameters, such as least connections, fastest response, adaptive and round-robin, as well as an agent-based algorithm that is accurate if the agent is run on each server. Layer 7 policies actually look at the content of the traffic to determine how to load balance it. For example, certain protocols

or applications can be used to trigger a load-balancing policy to route traffic to a particular cluster. Policies based on Boolean logic take into account particular requests, based on a series of administrator-defined events. Those policies can be used to reroute traffic if a server fails to respond (failover routing) or to route based on a schedule.

Once you have defined your clusters, you then can define rules to handle traffic flow and load-balancing decisions. Coyote Point calls those definitions Smart Events. The rules are based on a number of parameters, such as server load, traffic type, server weighting and connection persistence. The underlying technology that allows the E650GX to make traffic-routing decisions is very complex.

However, the E650GX does an excellent job of hiding that complexity by using rule-creation wizards and a commonsense procedural layout to make rule definition very easy. That ease of configuration is rarely found in software-only load-balancing solutions and allows even newbie network administrators to set up basic load balancing with the E650GX.

I found that one of the most impressive features of the E650GX was the unit's ability to work with VMware's vSphere products. That brings application load balancing and traffic shaping to the world of virtual servers. Coyote Point has built support for VMware's APIs, allowing the E650GX to judge the load on a virtual server, then route requests bases on virtual loads and administrator-defined load-balancing policies. What's more, Coyote Point has included support for IPMI-capable servers. The Intelligent Platform Management Interface (IPMI) is a specification that allows third-party products to power on and power off servers, as well as remotely execute other commands. Simply put, you can define a policy that automatically turns on a server when traffic loads hit a certain level, and then shut off that server once traffic load drops.

I also found it very easy to segment LANs using the product's VLAN capabilities. Administrators define VLANs based on IP address segments, and the unit's built-in routing capabilities keep traffic isolated on a VLAN for local requests. That can help reduce latency and speed up requests by keeping the appropriate traffic on the same logical segment.

Ease of use permeates the interface, making it simple to set up many, if not

Performance was tested using a Spirent Avalanche 2900 configured to generate traffic load on the E650GX. The goal of the performance testing was to rate layer 7 HTTP transactions per second, layer 7 HTTPS throughput, layer 4 maximum concurrent connections and layer 4 connections per second. Those metrics are a good indicator of the processing power of the device, as well as the overall capacity of the device.

- Layer 4 connections per second: 160,000 CPS
- Layer 4 maximum concurrent connections: 17.5 million
- Layer 7 HTTP transactions per second: 110,000 TPS
- Layer 7 HTTP throughput: 1,300 Mbps
- Layer 7 HTTPS transactions per second: 14,000 TPS
- Layer 7 HTTPS throughput: 825 Mbps

all of the unit's capabilities. You also will find that ease of use present in the device's dashboards and reporting menus. The dashboards offer a quick snapshot of how the device is performing and what traffic is flowing across the device. Reports offer a historical reference of many monitored parameters and can be useful for fine-tuning the unit.

Although the E650GX's primary focus is on application load balancing, the unit also includes other features that help speed up network access and reduce latency. Those features include SSL acceleration, HTTP compression and global/geographic load balancing. SSL acceleration helps reduce the latency found in HTTPS requests by offloading the packet encryption on to the device. HTTP compression helps reduce latency by compressing and optimizing HTTP requests, while global/geographic load balancing can be used to balance traffic across geographical clusters, placing requests on servers that are closest to the user, as far as latency and bandwidth are concerned.

Administrators supporting e-commerce solutions will appreciate the E650GX's ability to deliver persistent connections. E-commerce transactions rely on a reliable connection between the client PC and the server providing the transaction—if either endpoint loses track of each other or is routed incorrectly, the e-commerce transaction will fail. The E650GX solves that problem by creating a persistent connection between the client PC and the server using cookies, which are inserted into the HTTP returned to the client. That ensures the client will return to the same server in the cluster.

The E650GX supports an active/passive failover model for sites that need guaranteed uptime. Failover works by transferring the Equalizer configuration to a backup device (which can be a lower-end model in the Coyote Point family), so that persistent client/server connections are maintained even when the primary unit fails.

Coyote Point has re-invented the idea of load balancing by shifting traffic shap-

ing, application-aware calculations. That approach has created a new market segment called application traffic shaping. Coyote Point also bundles in other advanced capabilities, ranging from SSL acceleration to VLAN definition to VMware vSphere support, making the device a complete traffic-acceleration solution. Coyote Point is very adept at providing an acceleration solution for most any server environment that can benefit from clustering and traffic management. The top-of-the-line E650GX has an MSRP of \$14,395 and comes with one year of support included. Although \$15K may seem like a big chunk of change, Coyote Point's price is less than half of what some larger competitors charge. ■

Frank J. Ohlhorst is a freelance technology journalist, professional speaker and technology business consultant who covers several topics for many major publications. Frank currently writes Virtualization and Application development articles for *Tech Target*, Operating Systems and Security articles for *Computer World*, Technology How-Tos for *Ars Technica* and Channel-focused product reviews for *ChannelTechCenter.com*. Frank also has been the Executive Technology Editor for *eWeek* and the Lab Director of CRN's Test Center.



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# Build Your Own CLOUD with EUCALYPTUS

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In the March 2010 issue, I wrote an article on how you could deploy Ubuntu 9.10 as part of Amazon's EC2 cloud computing service. Amazon's EC2 service can be useful, but what if you have a bunch of machines already and don't want your data outside your network? Or, what if you don't want to pay the ten-cents-per-hour fee that Amazon charges? That's where the Ubuntu Enterprise Cloud comes in. The Ubuntu Enterprise Cloud system ships with the Server Edition of Ubuntu 9.10, and it's based on the Eucalyptus cloud cluster software.

What exactly is Eucalyptus? Put simply, Eucalyptus is an open-source, Amazon EC2-compatible, cloud computing cluster package that can be run on commodity Linux machines. Although VMware and VirtualBox do similar things, Eucalyptus allows you to scale your cluster across multiple machines. When you run out of resources to run another VM, you simply can pop a new Eucalyptus server on your network, and you're off and running.

**BILL CHILDERS**

## Installing Your Ubuntu Enterprise Cloud

Now that you're all fired up, let's get started with the Ubuntu Enterprise Cloud (UEC). The easiest way to get started with UEC is to do a fresh installation of Ubuntu 9.10 Server with the UEC option. You need two systems at a minimum to build your first cloud. One will be the cloud controller (the master node that dispatches and monitors the instances of the virtual machines), and the other will be the node controller (where all the instances actually will run). Minimum configurations are listed in the installation documentation (see Resources), but I recommend a dual-core, 2GHz machine with 2GB of RAM and a 100GB disk as a realistic usable minimum for each. Note that you will need Virtualization Extensions (VT) enabled on the node controller machine. Eucalyptus requires that. Your systems can be either 32-bit or 64-bit (mine are both 64-bit), but be advised that although the 64-bit host can run a 32-bit instance, the opposite is *not* true.

First, let's install the cloud controller. To start the install, boot your machine off an Ubuntu 9.10 Server CD, select Install Ubuntu Enterprise Cloud at the boot menu, and then press Enter. That starts the standard text-based install, with a twist: along the way, you'll be asked what type of cloud installation mode you want—a "Cluster" or a "Node". Because you're installing the cloud controller first, select Cluster and press Enter. The installer will proceed normally, but it will ask you two more questions unique to the Ubuntu Enterprise Cloud installation: the name of your cluster (this is just a unique identifier like "testcluster") and a range of IP addresses on your LAN that the cloud controller can allocate to instances. Once you've done that, the installer will finish out much like a regular Ubuntu text-based install, and your machine will reboot. That's it! Your cloud controller is now on-line.

Next, you need to install a node controller. This is even easier. Boot the computer that will become the node controller from the same Ubuntu 9.10 Server CD, select Install Ubuntu Enterprise Cloud from the boot menu, and the installer should detect the cluster automatically and select Node within the installer. Simply press Enter to confirm you want to install a node and confirm your system's partitioning scheme, and the rest of the installation is completed for you. The installer even copies your login account over from the cloud controller.

Now that your nodes are up, you need to register the node controller with the cloud controller. Log in to the cloud controller, and run the command:

```
sudo euca_conf --no-rsync --discover-nodes
```

The cloud controller will auto-discover the nodes that are running the node controller service, and it will prompt you to register each by its IP address.

### Obtaining Access

Before you can use the cloud, you've got to register yourself with it and obtain credentials. Fire up a Web browser (either on the cloud controller or on another machine on the LAN), and go to this URL: <https://<cloud-controller-ip-address>:8443>. You have to use a secure connection, and you'll get a

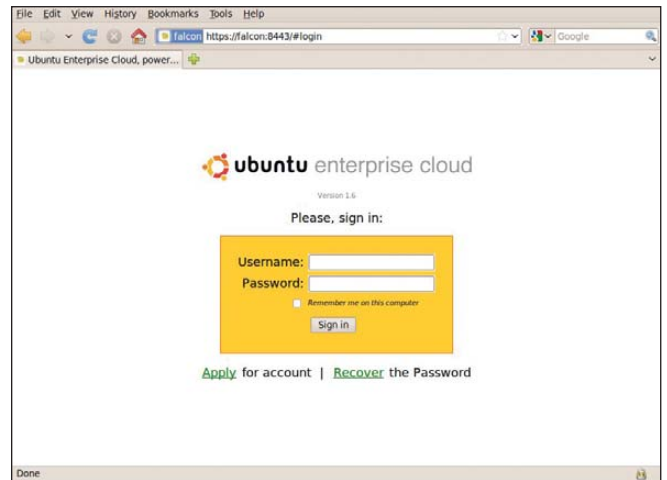


Figure 1. The Ubuntu Enterprise Cloud Login Page

security certificate warning from your browser. Once you accept the cert warning, use the user name "admin" and password "admin" to log in to the page (Figure 1). Then, you'll be prompted to change the admin password and fill in your e-mail address, so the UEC can mail you information about your instances.

Next, you need to get your credentials to a location where you can use them. I prefer to do this on the cloud controller, so run this script as your regular user on the cloud controller:

```
mkdir -p ~/.euca
chmod 700 ~/.euca
cd ~/.euca
sudo euca_conf --get-credentials mycreds.zip
unzip mycreds.zip
cd -
```

This drops your credentials for the UEC into the `~/.euca` directory. The credentials can be downloaded from the UEC admin portal to another Ubuntu machine for use if you so

## Virtualization Extensions— Make Sure They're Enabled!

Eucalyptus requires that the CPU on the node controllers have Virtualization Extensions (VT) enabled. Do yourself a favor and go into your BIOS and check that it is enabled. Simply grepping for "vmx" in `/proc/cpuinfo` isn't enough. The BIOS support must be enabled as well. When preparing to write this article, I burned up several days in testing to learn this fact. The virtual machine appeared to start, then terminated immediately with an obscure message in the `nc.log` file on the node controller like `[EUCAERROR] libvirt: Domain not found: no domain with matching name 'i-427C0881' (code=42)`. Simply flipping the BIOS switch that enabled Virtualization Extensions allowed the virtual machine to start properly. Verify your BIOS settings before installation!

## What's the Walrus—CooCooCaChoo?

Eucalyptus includes a service known as the walrus. The walrus service is a storage service that emulates Amazon's S3 storage. This article covers the default installation of Eucalyptus that runs the walrus service on the same system as the cloud controller. If you have a server with a lot of disk space, it's entirely possible to split the walrus service out and export hunks of disk space as volumes to the virtual machines. In other words, it's a free implementation of a virtual SAN for your virtual machines. Unfortunately, getting into the specifics of the walrus goes beyond what can be covered here.

desire. Next, you need to add the line `. ~/.euca/eucarc` to your shell's profile (`~/.bashrc` on an Ubuntu machine or the cloud controller) to source the `eucarc` file every time your shell starts. If you're on another machine aside from the cloud controller, you need to install the `euca2ools` package as well.

Now that the prep work is done, you can verify that the cluster is working properly by running the `euca-describe-availability-zones verbose` command:

```
bill@falcon:~$ euca-describe-availability-zones verbose
AVAILABILITYZONE   cluster1      192.168.1.116
AVAILABILITYZONE   |- vm types   free / max   cpu   ram   disk
AVAILABILITYZONE   |- m1.small   0002 / 0002  1    128   2
AVAILABILITYZONE   |- c1.medium  0002 / 0002  1    256   5
AVAILABILITYZONE   |- m1.large   0001 / 0001  2    512   10
AVAILABILITYZONE   |- m1.xlarge  0001 / 0001  2    1024  20
AVAILABILITYZONE   |- c1.xlarge  0000 / 0000  4    2048  20
```

## Installing Images on Your UEC

Although it's possible to make your own custom images to run on your cloud (see Resources for a link on bundling images), it's far easier to get one from the UEC "store" (Figure 2). Simply access the cloud controller at the URL

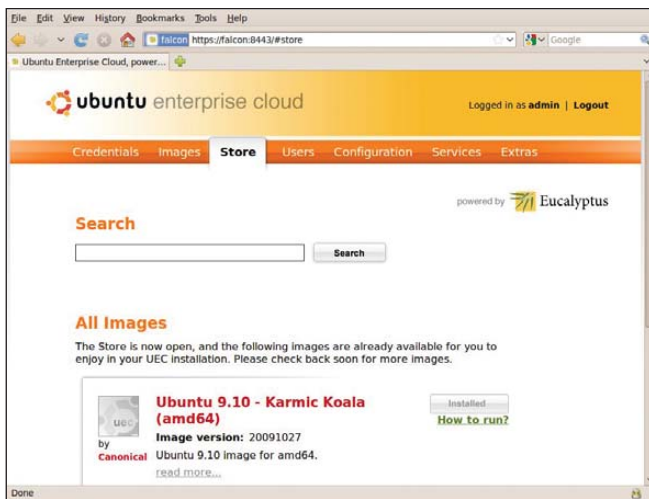


Figure 2. UEC Store

`https://<cloud-controller-ip-address>:8443/`, enter your login and password, click the Store tab, and you'll be presented with the UEC Store. Just find an image you'd like to install (at the time of this writing, there are only three), and push the Install button. Your image will download and install to your cluster automatically. Once that's done, you'll get a How to Run? link under the grayed-out Install button. If you click that link, you'll get the exact command line that will instantiate, or start, your selected image.

## Starting Your Image

Instantiating an image requires you to use the command line on the cloud controller (or wherever you installed your credentials). Before you run your first image, you've got to create an SSH keypair so you can log in to your instance as root once it's up and running. The key is stored and is common across all your instances, so this script needs to be run only once:

```
if [ ! -e ~/.euca/mykey.priv ]; then
    touch ~/.euca/mykey.priv
    chmod 0600 ~/.euca/mykey.priv
    euca-add-keypair mykey > ~/.euca/mykey.priv
fi
```

Next, configure the cloud to allow port 22 access (SSH) inbound for all instances. The following command will allow SSH from any source IP:

```
euca-authorize default -P tcp -p 22 -s 0.0.0.0/0
```

Now, you can fire up your first image:

```
bill@falcon:~$ euca-run-instances emi-DF841070 -k mykey -t c1.medium
RESERVATION   r-3409079E   admin   admin-default
INSTANCE      i-46780864   emi-DF841070
                                     0.0.0.0  0.0.0.0  pending mykey
                                     2009-12-10T06:26:09.471Z
                                     eki-F59010E3 eri-0A2A115C
```

The first time you instantiate a particular image, it'll be slow to start. Eucalyptus caches the image on the node controller, so there's a sizable amount of data that's got to move to the node. You can keep tabs on the status of your image by running:

```
watch -n5 euca-describe-instances
```

You'll see two IP addresses listed in the output of the `euca-describe-instances` command. One will be an IP on your LAN, and the other will be a private IP. Once the instance is listed as "running", you can `ssh` to it on the IP listed in the output. Note that it doesn't have a user account with a password on it, so you need to use the SSH key created earlier:

```
bill@falcon:~$ euca-describe-instances
RESERVATION   r-3409079E   admin   default
INSTANCE      i-46780864   emi-DF841070
                                     192.168.1.170  172.19.1.2
                                     running mykey 0 c1.medium
```

## DHCP Issues

The Eucalyptus cloud controller does run a DHCP server that will respond to requests from cloud instances. However, if you have a DHCP server on your LAN, it may be possible that your instances could receive a DHCP address from your other DHCP server rather than the cloud controller's DHCP server. You may want to tell your main DHCP server to ignore requests sent from the MAC addresses of the cloud instances. All of the cloud instances have MAC addresses that begin in d0:0d. On my DHCP server running dnsmasq, all I had to do was add a line to the dnsmasq.conf file that said `dhcp-host=d0:0d:*, ignore`.

```
2009-12-10T06:26:09.471Z
cluster1
eki-F59010E3 eri-0A2A115C
```

```
bill@falcon:~$
bill@falcon:~$ ssh -i ~/.euca/mykey.priv ubuntu@192.168.1.170
The authenticity of host '192.168.1.170' can't be established.
...
Are you sure you want to continue connecting (yes/no)? yes
...
Linux 172 2.6.31-14-server #48-Ubuntu SMP Fri Oct 16 15:07:34
UTC 2009 x86_64

...

System information as of Thu Dec 10 06:32:03 UTC 2009

System load: 0.0          Memory usage: 16%   Processes:      70
Usage of /: 29.6% of 1.98GB  Swap usage:  0%    Users logged in: 0

...
ubuntu@172:~$
```

At this point, you're in your instance, and it's a fully functioning system. You can `apt-get` packages like `apache` or do further system configuration if you want. When you're done, you can exit your SSH session, and then terminate the instance by finding the instance ID from the output of the `euca-describe-instances` command (in the example above, it's `i-46780864`) and running `euca-terminate-instances <instanceID>`. Your instance will then shut down.

This article barely scratches the surface of what's possible with the Ubuntu Enterprise Cloud. Although it's less flexible than other virtualization technologies like VMware or VirtualBox, it is API-compatible with Amazon's EC2 service, and it allows you to build networks of virtual machines far beyond what's possible with conventional virtualization solutions. If you require a scalable network of virtual systems that can be instantiated and terminated dynamically, the Ubuntu Enterprise Cloud and Eucalyptus are for you. ■

Bill Childers is an IT Manager in Silicon Valley, where he lives with his wife and two children. He enjoys Linux far too much, and he probably should get more sun from time to time. In his spare time, he does work with the Gilroy Garlic Festival, but he does not smell like garlic.

## Resources

Ubuntu Enterprise Cloud Documentation:  
<https://help.ubuntu.com/community/UEC>

Ubuntu Server 9.10 Download:  
[www.ubuntu.com/getubuntu/download-server](http://www.ubuntu.com/getubuntu/download-server)

Eucalyptus Home Page: [open.eucalyptus.com](http://open.eucalyptus.com)

Installing UEC Using the Installer CD:  
<https://help.ubuntu.com/community/UEC/CDInstall>

Installing UEC Using the Package-Based Install:  
<https://help.ubuntu.com/community/UEC/PackageInstall>

Bundling Your Own UEC Images:  
<https://help.ubuntu.com/community/UEC/BundlingImages>

Using the Walrus Storage Controller:  
<https://help.ubuntu.com/community/UEC/StorageController>

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# MySQL Replication

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MySQL has been running on Linux in the data center for many years, but MySQL replication still is not widely understood. Whether you're setting up a multinational asynchronous solution or a local cluster, there is a type of replication for your application.

**MICHAEL NUGENT**

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**MySQL databases** come in all shapes and sizes, but most often are deployed behind Web sites. As sites grow, the companies behind them often become concerned about uptime and want to move to a high-availability model. Unfortunately, by this point, options often are limited based on the data and database engines previously chosen.

The first decision to make when moving to a high-availability model is actually whether to do it. This may seem obvious, but it often is assumed that high availability always is a good option. Opting to move in this direction, also means adds significant complexity to the system as a whole. When deploying a clustered solution, the number of boxes increase. Thus, the number of individual failures will increase, even though the downtime of the clustered application decreases overall. In addition, as availability increases, cost increases. Adding a second box for failover doubles the cost of the server, and adding failover clusters in alternative geographies can double (or more) the operational cost of the entire data center. In addition to this, moving to an NDB cluster adds additional hardware itself.

Before considering the level of availability you need, consider the cost of downtime compared to the operational costs of running failover facilities. Very few facilities need to continue running if there is a global extinction event, and planning for that situation would require the budget of a large government. Planning for failure as a result of a multinational economic disaster is more reasonable, but it still requires the budget of a large multinational corporation. When planning for national and localized disasters, the cost becomes more reasonable for most companies to handle. Based on this end-of-the-world thought experiment and the needs of most users, concentration on the development of high availability for MySQL mostly focuses on the single geography cluster.

Although you can build clusters in many ways, using combinations of block replication and SAN storage, the official MySQL solutions are replication and NDB (Network DataBase) clusters. Each has pros and cons, and your choice is not based on newer or older developments within MySQL, but on what is right for your application. In addition to choosing a type of replication, the version of MySQL is also critical. Because of



## Before considering the level of availability you need, consider the cost of downtime compared to the operational costs of running failover facilities.

continuing software development, at least version 5.1 is required for many of the features described here. If your current database has a lower version, strongly consider upgrading the database software before implementing these solutions. Active development on version 5.0 ended in December 2009, and active development on version 5.1 will end in December 2010.

MySQL replication establishes a master-slave or master-master relationship between a pair of servers. These servers can be chained to build a circular set of many servers, or one master can be used for many slaves, but the relationship itself exists between only two. A single MySQL server can have only a single master. Replication is more flexible than NDB in terms of what types of engines and features can be used. Although NDB clusters are limited to NDB tables, replication can be used with almost any of the standard MySQL table types, including MyIASM and InnoDB.

Multimaster replication examples usually are set up with only two servers, but they can be done with any number in a circular set. To set up a circular set with three servers, the [mysqld] section of the my.cnf configuration file should include the following:

```
server-id=1           # This must be unique per server.
auto_increment_offset=1 # Must be unique per server but less
                        # than the auto_increment_increment
                        # value below.
auto_increment_increment=3 # Set to at least the maximum
                            # number of servers in the circle
```

The `auto_increment_offset` value determines the starting point for `auto_increment` columns and must be unique per server but less than the `auto_increment_increment` value. The `auto_increment_increment` value determines the interval between `auto_increment` values on a particular server. To prevent conflicts, set it to at least the maximum number of servers in the circle.

Now, to determine the next value in an `auto_increment` column, the server multiplies the next value expected in counting order by the `auto_increment_increment` value, plus the `auto_increment_offset` value. If `N` is the next expected value in a sequence (for example, 1, 2, 3, 4, 5 and so on), the next value for an `auto_increment` column becomes:

```

$$N \times \text{auto\_increment\_increment} + \text{auto\_increment\_offset}$$

```

In addition, add the following values:

- `log_slave_updates`: this tells the server to log updates from its master into its own log, so that the machine can act as both a master and a slave.
- `slave_exec_mode=IDEMPOTENT`: this feature is strictly optional. It allows the slave to skip errors. Although it can

be useful to make sure that slave replication does not stop due to an error, it can be dangerous, as it can cause the slave to desynchronize from the master, resulting in a different data set on each server. Use of InnoDB tables and transactions and rollbacks can help limit this possibility.

Once the my.cnf file is set up, each server needs to have the replication user granted access for replication and set to point at the master database:

```
server A mysql> GRANT REPLICATION CLIENT,
                  REPLICATION SLAVE,
                  SELECT, FILE, PROCESS,
                  SUPER RELOAD ON *.* TO 'replication'@'%s'
                  identified by 'replpass';
```

```
server A mysql> flush privileges;
```

```
server A mysql> change master to
                  MASTER_HOST="serverB.example.com",
                  MASTER_USER="replication",
                  MASTER_PASSWORD='replpass';
```

```
server A mysql> start slave;
```

```
server B mysql> GRANT REPLICATION CLIENT ... ; (as above)
```

```
server B mysql> flush privileges;
```

```
server B mysql> change master to
                  MASTER_HOST="serverC.example.com",
                  MASTER_USER="replication",
                  MASTER_PASSWORD='replpass';
```

```
server B mysql> start slave;
```

```
server C mysql> GRANT REPLICATION CLIENT ... ; (as above)
```

```
server C mysql> flush privileges;
```

```
server C mysql> change master to
                  MASTER_HOST="serverA.example.com",
                  MASTER_USER="replication",
                  MASTER_PASSWORD='replpass';
```

```
server C mysql> start slave;
```

In this scenario, server A gets data from server B, which gets data from server C, which gets data circularly from server A. Data can be inserted into any of the three servers and will be replicated to the other two. This doesn't speed up writes (except possibly for additional drive spindles), but it can add additional speed for reads if the application rotates between servers in the cluster. In addition, if there is hardware failure, the highly available nature of the cluster contains copies of data. Removing a dead slave can be as simple as using the "change master" statement to point at the grandfather server or replacing the dead server and simply copying a snapshot of the data.

In contrast to the loosely bound multimaster replication, NDB clusters can be viewed as a single entity. In fact, they're so tightly coupled, an NDB cluster entity can be used as a single server in a multimaster replication scenario. Although NDB is a huge advantage in terms of cluster synchronicity and management, the NDB engine does not support all the

features of other MySQL engines, and the NDB engine is the only one that can be used in an NDB cluster. The NDB engine does not support savepoints within MySQL and, thus, cannot support transactions and rollbacks. As a result of this, when an `ALTER TABLE` or `CREATE TABLE` command is issued, the table being altered should not be accessed. Although it locks the table on the current node, this is a local lock only and may cause data integrity problems or even crashes if the table is accessed on another node.

Before setting up software for an NDB cluster, hardware is a concern. Because the clusters can act as a synchronous unit and there is no encryption built in to the package, a private network or VLAN is a best practice to employ. If the idea is to use NDB in a Web application, the inter-database links should be separated from the links that are used to execute queries.

Networking in an NDB cluster can be set up in a number of different ways, but most users prefer standard TCP-over-Gigabit or higher-speed networks. 100Mbit networks will work, but they will be far less efficient for larger systems. 10Mbit networks are not supported. Although the replication configuration requires only the MySQL servers to be part of the setup, NDB requires management nodes and data nodes in addition to the MySQL servers. All of these should demonstrate the lowest latency possible. Jumbo frames also are a good idea on Gigabit networks, because fitting as much data into the packet as possible decreases the possibility of any kind of errors interrupting the synchronous transfer of data between NDB nodes.

In addition to networks, increased RAM is a necessity as caching becomes more of a priority to decrease network traffic. The best way to increase IO to disk is to increase spindles.

## Removing a dead slave can be as simple as using the “change master” statement to point at the grandfather server or replacing the dead server and simply copying a snapshot of the data.

Adding more, smaller disks will increase the IO throughput of any given node, but this is especially important on the data nodes, because these are the ones that have the actual data on disk. Increasing the number of data nodes also will increase the read speed of the cluster as a whole, but it will not increase the write speed significantly. If the database is behind a Web server, the read-to-write ratio is usually so high, this is exactly the kind of performance that is good for the application. If most of the application’s queries are for writing data, focusing on the speed of single nodes is the best strategy.

Before setting up the configuration for an NDB cluster, be sure that it is available in your distribution on MySQL. The `show engines` command should include an engine type of `NDBCLUSTER` with the `Support` column set to `Yes`. If this is not available, check your distribution for an external package, or install or compile the community package from [www.mysql.com](http://www.mysql.com).

The NDB configuration has three types of servers. The management server does configuration and monitoring of the cluster via the `ndb_mgmd` daemon. The data nodes store the data running the `ndbd` daemon, and the SQL nodes run the `mysqld` server itself. Although it is possible to run multiple

types of daemons on the same physical servers, it is not recommended in a production environment. The best practice is to separate all of them onto their own pieces of hardware.

NDB clusters consist of two configuration files. The first file, `my.cnf`, is the standard configuration file for MySQL. The second file, `config.ini`, is read only by the management server. The `config.ini` file includes configuration for the data nodes and is passed to them by the management server.

The additions to the `my.cnf` file are fairly straightforward:

```
[ndb_mgm]
ndb-connectstring=manage.example.com:1186 # The management server
[ndb_mgmd]
config-file=/etc/config.ini

[ndbd]
ndb-connectstring=manage.example.com:1186 # The management server

[mysqld]
ndbcluster # This turns the cluster on
ndb-force-send=1 # Sends buffers immediately
ndb-index-stat-enable=1 # Optimizes queries with NDB
# index statistics
engine-condition-pushdown=1

[mysql_cluster]
ndb-connectstring=manage.example.com:1186 # The management server
```

The `engine-condition-pushdown` option forces MySQL to send the query directly to the storage engine

instead of evaluating it in the `mysql` daemon. In an NDB cluster, this allows the NDB engine to spread queries across multiple data nodes.

A basic `config.ini` file also is fairly easy to write. It must be placed in the location specified by the `config-file` line in the `my.cnf` file:

```
# Management Node
[ndb_mgmd default]
DataDir=/var/lib/mysql-cluster # This is where the management
# server keeps data

[ndb_mgmd]
HostName=manage.example.com # The machine's hostname

[ndbd default]
NoOfReplicas=2 # There are 2 data nodes

[ndbd]
HostName=datanode.example.com # The machine's hostname

[mysqld]
```

```

HostName=datanode.example.com # The machine's hostname
DataDir=/var/lib/mysql       # This is where the data
                              # node keeps data

```

In this scenario, there are three servers, one of each type: a management server, a data node and an SQL node. Queries are sent to the SQL server, which then interoperates with the data nodes. Because the SQL servers can talk to multiple data nodes as necessary with the optimizer inside the NDB engine (set via the engine-condition-push variable above), this type of replication can operate on some SELECT queries far faster than the multimaster replication setup discussed above. On the other hand, NDB uses synchronous replication, so queries that write data, such as INSERTs and UPDATEs, can take longer, because the data must be written to each node on the cluster.

The problem of extending systems across various locations is well known in the industry. With Web servers and static content, this is a fairly simple situation. With cacheable content, this can be done using various caching services.

Dealing with MySQL across multiple geographies is complex at best. It is not reasonable to set up an NDB cluster with nodes in separate data centers. Even if there is dedicated bandwidth between the boxes in the cluster, the latency across the link will cause large delays in issuing write commands to the system.

The accepted way to set up a multi-geography NDB cluster is to have two separate NDB clusters, one per data center, and set up an asynchronous multimaster (or master-slave for failover only) replication system between the two. To do this, set up NDB clusters normally, add the auto\_increment statements to the my.cnf file, add replication user permissions, and issue the "change master" statement at the MySQL prompt.

This asynchronous relationship between geographies will create a great way to distribute your load across the systems, but it is still asynchronous. There can be cases where queries will return different results from the different locations where the data has not yet completed replication. If the application is a Web site showing photographs, this is generally not a problem. If the application is a bank, this inconsistency could result in large problems.

Building a MySQL cluster, either using replication or NDB clusters, is a difficult task to get right the first time. Doing it in a hurry or with existing data in the system makes it even harder. Setting up a few systems as a test lab is a necessity. Although virtual machines are a good platform for setting up the configuration of the system, testing end-to-end performance also is a necessity in order to verify that the application will not suffer from poor database performance. This requires time on the actual hardware with the actual data and, if possible, a file full of actual queries run on the system. Multi-geography setups are even more difficult with a small budget, and it is good practice to think hard about the operational expense of running a second location compared to the cost of downtime. Finally, as good as your replications and clusters are, they are not a substitute for backups. Save early; save often. ■

Michael Nugent has spent a good deal of his time designing large-scale solutions to fit into tiny budgets, leveraging Linux to fulfill the roles that typically would be filled by large commercial appliances. Recently, Michael has been working to design large multi-geography database solutions for growing startups in the Silicon Valley area. When not building systems, he likes sailing, MIG welding and hanging out with his cat, MIDI. Michael can be reached at michael@michaelnugent.org.



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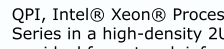
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# *The* **CHALLENGES** *of* **OPEN SOURCE** *in the* **ENTERPRISE**

*Enterprise and open source—are they peanut butter and jelly, working well together for a better world, or are they oil and water, meeting but never coming together? In this article, I explore the challenges of adopting open source in the enterprise. I look at the technical issues, the business challenges and the political hurdles.*

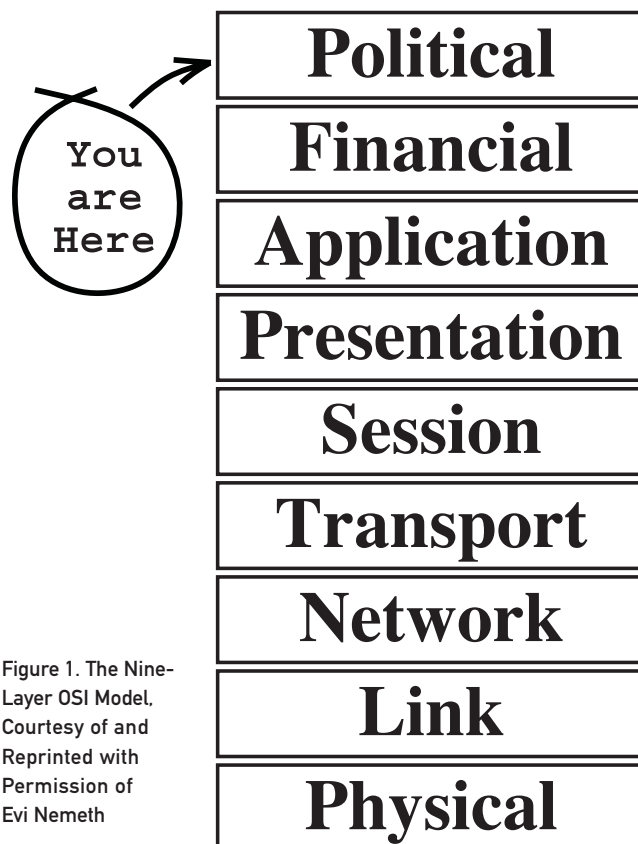
**AVI DEITCHER**

**T**here is an old Chinese curse, “may you live in interesting times.” Of course, we all want to live in interesting times, but sometimes the interesting part can be a bit much. The enterprise is an interesting place. On the one hand, real enterprises have technology budgets that are quite large, sometimes even running into billions of dollars. Much of that budget is for labour, meaning that a successful enterprise technology person can make very good money, while learning a lot on the way. Although your typical tech shop may have a few servers and program in, say, Ruby, with an HTML front end backed by MySQL, in an enterprise, you are likely to encounter, and learn, every technology out there. If you like Ruby, it is there; Java, most certainly; .NET, that too. If your preferences run to infrastructure, you are likely to find everything from Windows servers to Linux to UNIX variants to mainframes to the unexpected. As recently as 2001, I worked as head of enterprise management at a place that had a massive farm of DOS 3.1 PCs; those were “interesting times”.

On the other hand, enterprises don’t start or end with cool technology, and they are there to serve a business purpose. The most famous illustration of this is the Nine-Layer OSI Model by the legendary Evi Nemeth.

Sure, you may have the best solution to a problem, but in an enterprise, you need to get the budget approved—on a multi-year cycle, of course—and then you likely need to go before some sort of capital expenditure (CapEx) or major expenditure review (MER) committee. Everyone there views your request as competing with their priorities for 1) budget allocation, because even a \$1-billion IT budget is still finite, and 2) recognition and promotion, because after all, they want you to succeed, but they want their own projects to succeed even more. Finally,

enterprises have legitimate business support needs that may or may not be resolved by your open-source solution.



## Start with the Technical

At base, everyone interested in open source is interested in technology, so let's address the technical challenges first. As you may have noticed, enterprises spend a *lot* of money. Unsurprisingly, to quote Willie Sutton who used to rob banks because "that's where the money is", many commercial technology businesses build products to focus primarily on the enterprise and solve its unique problems, and they have very large sales and marketing budgets to sell them. On the other hand, open-source products often are built, at least initially, to solve very specific problems.

Thus, before advocating for open source, we need to understand if the open-source solution solves the problem as well as the commercial solution, given the entire requirements set. This includes not just the immediate technical problem, such as "serve up a Web page", but also the management challenges that can be unique to an enterprise, such as "replicate in real-time across 15 databases in ten countries around the world, while instantly alerting to any degradation and providing service-level agreement (SLA) reporting". In many cases, open source has indeed developed to the point where it truly can compete on a technical requirements level

with a simple router, or even a dedicated box with a few NIC cards running m0n0wall, such a solution is highly unlikely to work in a large enterprise. There, the complexity, traffic demands and management requirements, as well as a three-tier architecture (core, distribution and access layers) can be done far more cost effectively, and in some cases, only with a hardware solution. Clearly, open source is not about to run enterprise networks. Having said that, it is not impossible that a split could occur. Currently, enterprise network equipment manufacturers provide both the hardware and software to manage routing, some of which may be based on open source, such as Cisco ASA 8.x. It is possible that in the near future, a pure-hardware networking equipment manufacturer could be formed that would sell the hardware only, while software is provided via an open-source solution, in a manner similar to current servers.

The important takeaway from evaluating any technology is that it has to solve the immediate problem, such as serving Web pages, but also have the features required for an enterprise, such as management, logging and security. Rarely does it matter that the open-source product may be better or

## *In many cases,* **OPEN SOURCE HAS INDEED DEVELOPED TO THE POINT WHERE IT TRULY CAN COMPETE ON A TECHNICAL REQUIREMENTS LEVEL *with* COMMERCIAL PRODUCTS.**

with commercial products. In other cases, it is not yet sufficiently evolved, but it may be some day. And in some cases, it is literally impossible to solve the problem with open source. Let's examine two extreme examples.

1. Web servers: the dominant Web server for many years, of course, has been Apache. Although various competitors nip at its feet, such as IIS for Windows or nginx for sheer performance, Apache remains dominant for both intranet and Internet Web serving. In 2010, it is not hard to make the argument to adopt Apache for a Web server solution in the enterprise. It is mature, established, lots of well-known companies bet the business on it, and it has the various controls, hooks, logging and security that an enterprise demands. It is important to remember, however, that only a few years ago, Apache was *not* sufficient, and other commercial variants arose to fill in the gap, such as Apache Stronghold. The combination of a mature product, a complete enterprise-ready feature set and broad enterprise adoption make open-source Apache a selection as valid as any commercial solution.
2. Network infrastructure: in the old days, when we had to decide whether to route mail via UUCP or SMTP, we built our own firewalls. Routers simply were dedicated servers with multiple network interface cards (NICs) on which we ran software to route the traffic. Over time, however, the proliferation of networks and the demand for traffic-routing capacity and intelligent control exceeded the capabilities of these homegrown solutions. Special companies were formed to create specialized networking hardware. The most famous, of course, is Cisco. Although a small organization can make do

that you want to support the community that brought us Linux/Apache/whatever. For adoption in the enterprise, the rule remains, as it should anywhere, first solve the actual problem and everything related it.

## Move to the Business

In addition to solving technical problems, some of which are specific to an enterprise, there are unique enterprise business requirements as well. In a small IT environment or Web startup, no one wants a problem or outage any more than in an enterprise. However, the technical tolerance may be greater in a smaller environment, and it often is acceptable that the trade-offs require the lone in-house expert (that would be you) to "take care of the problem" in an emergency; often that is the actual crisis plan. In an enterprise, with postmortems, roles and responsibilities, and sometimes "pin the blame on the donkey", a support plan of "I will deal with it and work with on-line fora when it breaks" will not go over very well. The cost of error or failure is at least proportional and often even exponential to the size of the IT budget.

These challenges create a minor requirement known as a service-level agreement (SLA). IT promises its customers, whether internal or external, certain service levels. In order to meet those levels, there needs to be a predictable and reliable point of service for every element of technology. For HP servers, there is a service contract and spares; for routers, it is Cisco support or a partner; for open source, it is ... ? In many cases, the product is stable enough or distributed enough not to matter. In other cases, it matters greatly. "If it breaks, who will fix it?" is likely the number one question CIOs will ask. They are not being difficult; they simply are doing their jobs, determining whether they

can meet SLAs and what will be the true *fully* loaded cost of your open-source adventure.

In that respect, one of the more interesting business ideas in the last decade is Red Hat. Its products are almost entirely open-source products that can be downloaded for free from elsewhere. However, it sells versions with full support. Essentially, Red Hat has decoupled product development from product support. There is nothing particularly special about Sun that allows it and only it to support Solaris (at least since Solaris was made open source). Anyone with sufficient expertise can do so. Recognizing that truth is the key to providing support for open-source products, exactly as Red Hat has done for Linux. It sold more than a half-billion dollars in support subscriptions in 2009 for products that it, by and large, did not develop.

### Don't Discount Politics

Politics is the bane of every technologist's existence. Politics is about the subtle art of power interplays, personalities and compromise. Technology, on the other hand, is about science, the truth and the correct way. For a technologist, proving your point through tests and scientific answers is the right way to go, but this path only antagonizes outsiders. For politics does not care about the right answer, but about the one that meets people's needs, rational and emotional. The solution may very well not

to either replacement of the defective software or possibly refund of the cost of the software itself. If \$10,000 in software causes \$10MM in damage, the most you can get back is \$10,000 (maybe). I pointed out that the legal department had *already* been rendered irrelevant for this software, and not by me. Thus, the choice of solution would neither reduce their position, nor strengthen someone (me) who had reduced that positioning already.

Politics is the art of recognizing who wins and who loses with each decision. Understand the relationships, the power plays, who has the backing of the vendor you are explicitly discarding, who controls the budgets, and you will be in a better position to pick your battles and win them.

### Tying It All Together

Open source has had huge amounts of successful adoption in the enterprise: Linux, Apache, Xen, Perl, PHP, Java and the list goes on. Open source also has had failures, either failure to launch (where it does not get adopted) or explosion on the launchpad (where it is adopted and fails). When looking to adopt an open-source solution in an enterprise, it is important to remember the entire nine-layer model and answer three questions:

1. Does it meet all of the technical requirements, including those that are unique to running any technology in an enterprise?
2. Does it have sufficient support and maturity to meet the business requirements of the enterprise?
3. Can I move it through the process while taking into account the politics inherent in any enterprise?

If the answer to all three is positive, you have a good situation for promoting adoption of an open-source solution. ■

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## *"If it breaks, who will fix it?" IS LIKELY THE NUMBER ONE QUESTION CIOs WILL ASK.*

be the best one. It may not even really solve the technical problem, but it is the one adopted nonetheless.

Around six years ago, I was exploring solutions to a particular problem at a very large enterprise (around 100,000 employees). There were several solutions, but the one I was advocating was open source. The other leading candidate was proprietary. I had a very good relationship with the firm's attorney, with whom I discussed the issue. "Let's say the product fails spectacularly", she said, "and we lose \$10MM in business because of it, who do we come after? Who do we blame?" From her perspective, an attorney who is focused on the firm's legal needs, this is a perfectly valid reason to go for closed source, backed by a large company. From my perspective, I far preferred to go with the solution that would not only cost far less, but also would provide better performance, thus reducing the probability and expected cost of failure, let alone spectacular failure.

As an aside, it is also important to note that my perspective could be difficult for her politically. If we focus solely on reducing the probability and expected cost of failure, and accept damages due to failure as an unfortunate cost of doing business, then the legal department's value is concomitantly reduced. If she has any influence over the final decision, and she did, these issues, seemingly irrelevant to most technologists, must be taken into account. In this case, I actually did win her over by pointing to the End-User License Agreement (EULA). Like most such EULAs, there was a very strong limitation of liability. For example, if you read the EULA to Microsoft Windows XP Professional Edition, it clearly states that your Exclusive Remedy is limited

### Resources

Evi Nemeth: [www.cs.colorado.edu/~evi](http://www.cs.colorado.edu/~evi)

Nine-Layer Model T-Shirt: <https://www.isc.org/node/232>

Microsoft Windows XP Pro EULA: [www.microsoft.com/windowsxp/eula/pro.msp](http://www.microsoft.com/windowsxp/eula/pro.msp)

Cisco: [www.cisco.com](http://www.cisco.com)

m0n0wall: [m0n0.ch](http://m0n0.ch)

Red Hat: [www.redhat.com](http://www.redhat.com)

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# SQL

VS.

# NoSQL

NoSQL databases are all the rage, but the case to switch from SQL databases is not always as clear cut as you might have been led to believe. Know what's what, and then decide.

**T**he articles on NoSQL databases in Reuven M. Lerner's At the Forge column appearing in recent issues of *LJ* have been enjoyable. Because this is the Enterprise issue, I think it would be helpful to take a step back and look at the Linux database landscape and examine in particular the ongoing "battle" between SQL and NoSQL databases. By way of disclosure, I work for Monty Program, a company whose primary product is MariaDB, a community-enhanced branch of MySQL. That being said, I approached this topic with as open a mind as possible.

The rivalry between SQL and NoSQL has been building during the past year to the point where some people are predicting the end of the SQL era. Actually, the two camps are largely complementary, because they're designed to solve different problems.

**Daniel Bartholomew**



## The Case for NoSQL

So, what is the big deal about NoSQL databases? For one, they've introduced new ways (or perhaps re-introduced old ways) of thinking about what databases are and what they can do. For another, they're shiny and new, and all the cool kids seem to be using them. You could argue that Google's BigTable is the database that inspired the NoSQL movement. Or, maybe it was Amazon's S3. Both of them are closed source, but they were (or are) impressive enough to inspire open-source interpretations.

The current NoSQL field includes HBase, Cassandra, Redis, MongoDB, Voldemort, CouchDB, Dynomite, Hypertable and several others. Some have followed the model of BigTable, others follow S3's model, some are a mix of the two, and others are charting their own path. Some of these projects are more mature than others, but each of them is trying to solve similar problems.

Instead of having tables with columns and rows like you would find in a traditional RDBMS, most NoSQL databases are simple "key-value stores". Each piece of data that goes into the database is given a key, and when you want the data back, you use the key to get it. This simplicity is beneficial, because it helps busy sites achieve extremely low latency, even under high load, when paired with a large number of servers and a fast network. The simplicity of the key-value model also simplifies development.

A step beyond simply having keys and values are the so-called document databases. A document, in this case, is a collection of various fields of information. Each individual document can have a different number of fields of varying lengths. These databases are useful if you have a lot of semi-structured data, and they are a good fit for object-oriented programming models (for example, you can consider the database as a storage area for objects).

Why do traditional database users dislike these newcomers? D. Richard Hipp, the creator of SQLite, in a talk given at my local LUG, derisively called NoSQL databases "post-modern databases", because instead of giving you a definite answer to your question, they give you "an opinion" or their "best guess". His purpose was to paint

NoSQL databases in a bad light, and for most of the old-school database world, the NoSQL, non-relational, BASE model (see the What Is ACID? sidebar) is more than a bit heretical.

The heresy comes because historically, databases almost always have tried to implement the relational model and be fully ACID-compliant. If your transactions weren't ACID, or your database wasn't relational, the argument went, you couldn't call yourself a "real" database. Look at the MySQL vs. PostgreSQL flame wars for ample evidence of this thinking.

The problem though, is that being relational and ACID is not necessary for some use cases and can add unnecessary overhead, which you don't want if you are running a popular, heavily trafficked Web site. Many early users of MySQL knew this and were mocked for choosing MySQL over "real" databases like PostgreSQL. It is ironic now that MySQL has gained what every "expert" said it should have (ACID transactions), that a new movement has started up claiming that all the old database technology isn't actually necessary.

What is necessary for top-tier Web sites, according to proponents of NoSQL, is massive scalability, low latency, the ability to grow the capacity of your database on demand and an easier programming model. These, and others, are things which, according to them, SQL RDBMSes just don't provide in a cost-effective manner.

Most classic RDBMSes initially were designed to run on a single large server. That is how it was done in the late 1970s and early 1980s, and the idea exists in the design of many RDBMSes to this day. The P in CAP (see the What Is CAP? sidebar) is meaningless when the database is on a single server (the server is either up or down, rarely or never only partly up), and traditional RDBMSes have focused mainly on Consistency, aka ACID, with Availability thrown in if you mirror between database servers or use hardware with no single points of failure.

Some NoSQL databases also focus on the C and A parts of CAP. Unlike traditional RDBMSes though, these databases are designed from the ground up to be run on dozens, hundreds or even thousands of nodes

## Acronyms

Whenever the topic of databases arises, an alphabet soup is thrown around that would make NASA proud. Some of the acronyms I use a lot in this article include:

- **RDBMS:** Relational Database Management System.
- **SQL:** Structured Query Language, also used to refer to databases that use SQL as their query language.
- **NoSQL:** used to refer to a class of databases that are non-relational and do not use SQL as their query language. They could perhaps be better called Distributed Database Management Systems (or DDBMSes), but for now, the popular term is NoSQL.
- **ACID:** Atomicity, Consistency, Isolation, Durability (see the What Is ACID? sidebar).
- **CAP:** Consistency, Availability, Partition tolerance (see the What Is CAP? sidebar).

in a single data center. Partial partition tolerance for these databases is obtained by mirroring database clusters between multiple data centers. The advantage these databases have over a traditional RDBMS is that with the work spread over all of those machines, you can achieve ultra-low latency even when there are extremely high numbers of reads and writes, and with all those machines, you can analyze massive amounts of data quickly.

Other NoSQL databases focus on the A and P parts of CAP and are designed to span multiple data centers. True to CAP, strong consistency is impossible for these databases. Weak consistency is an especially heretical thought to the RDBMS old guard. Instead, these NoSQL databases implement eventual consistency, whereby any changes are replicated to the entire database eventually, but at any given time, a single node or group of nodes may not have

## What Is CAP?

The CAP Theorem, also called Brewer's Theorem, first was proposed by Eric Brewer in a July 2000 keynote at the ACM Symposium on the Principles of Distributed Computing. It was formally proved in 2002 by Seth Gilbert and Nancy Lynch of MIT. The CAP Theorem states that it is impossible for any shared-data system to *guarantee* simultaneously all of the following three properties: consistency, availability and partition tolerance.

Consistency in CAP is not the same as consistency in ACID (that would be too easy). According to CAP, consistency in a database means that whenever data is written, everyone who reads from the database will always see the latest version of the data. A database without strong consistency means that when the data is written, not everyone who reads from the database will see the new data right away; this is usually called eventual-consistency or weak consistency.

Availability in a database according to CAP means you always can expect the database to be there and respond whenever you query it for information. High availability usually is accomplished through large numbers of physical servers acting as a single database through sharing (splitting the data between various database nodes) and replication (storing multiple copies of each piece of data on different nodes).

Partition tolerance in a database means that the database still can be read from and written to when parts of it are completely inaccessible. Situations that would cause this include things like when the network link between a significant number of database nodes is interrupted. Partition tolerance can be achieved through some sort of mechanism whereby writes destined for unreachable nodes are sent to nodes that are still accessible. Then, when the failed nodes come back, they receive the writes they missed. In Cassandra, this is called hinted handoff. A database with good partition tolerance can span multiple data centers, whereas one with weak partition tolerance basically is bound to a single data center.

the latest data. Like the NoSQL databases, which focus on C and A, the focus for A and P databases is on low latency, high throughput and anything else that makes the Web site more responsive and a richer experience for users.

In addition to sometimes abandoning consistency in favor of scalability and latency, another way NoSQL databases break with tradition is in their abandonment of the relational model. To be fair, some data truly does not naturally fit the relational model. This could be because the data changes form or size often, or because the data is completely unstructured.

The final break with tradition in NoSQL databases is the thing that gave them their name. They don't use SQL. The reasons for dropping SQL usually revolve around it not fitting in with modern object-oriented development processes or some perceived difficulty in working with SQL. Sometimes the

excuse given for not using SQL is a simple "SQL sucks", which isn't really a reason. Stupid reasons aside, the SQL language was designed for use with relational databases, and NoSQL databases are mostly non-relational, so it makes sense that they don't use it.

### The Case for SQL

So what about plain-old SQL RDBMSes? Should they be retired from active service? Are they a relic from an earlier time? Not so fast.

First and foremost, ACID transactions most definitely are required in certain use cases. Databases used by banks and stock markets, for example, always must give correct data. Where money is concerned, guessing is not allowed. It is true that no one really cares if your latest tweet takes a couple minutes to show up in your Twitter feed, but the same cannot be said for a billing system or accounting database.

Another thing in favor of RDBMSes is their use of SQL. It's a common language, and if you need to move from one database to another, you usually can get away with making only minor changes to your application, and it will "just work". True, it may not be possible in all cases, depending on how you used or abused the SQL queries in your application, but the foundation for moving easily between different SQL databases is there, and the tools and libraries you can use to interact with your data are plentiful and robust. A unified NoSQL standard query language or API will never exist because every NoSQL database is so different.

On the NoSQL side, the only thing in common is that there is nothing in common. Each NoSQL database has its own set of APIs, libraries and preferred languages for interacting with the data they contain. With an RDBMS, it is trivial to get data out in whatever format you need using whatever programming language you like best. Your choice of a NoSQL database might limit you to one or a handful of programming languages and access methods.

Another thing RDBMSes have going for them is the relational model. The R in RDBMS traces its history back to research by E. F. Codd published in the June 1970 issue of *Communications of the ACM*. Since then, it has been expanded upon, improved and clarified. The relational model for databases is so popular because it is an excellent way to organize information. It maps very well to an enormous variety of real-world data storage needs, and when properly normalized, it is fast and efficient.

In the relational model, data is stored in tables with rows and columns. An address table, for example, might have columns for street name and number, city, postal code, state or province, and country. A name table might have columns for given names, family name, prefixes (Dr, Rev, Ms and so on) and suffixes (Jr, Sr, Esq and so on). Each row in the individual tables would represent an individual address or name.

The relational part (see the What Does Relational Mean in a Relational Database? sidebar) comes into play as you define which addresses relate to which names using a key. A key is a field (the intersection of a row and

column) or combination of fields in a single row that is guaranteed to identify uniquely that particular row in the table it is in. For the address table, you might have a column for keys from the name table. You can use this key to look up just those addresses in the address table that "belong" (by virtue of the key) to a certain name in the name table.

My example is pretty simplistic, but when combined with ACID transactions in an RDBMS, you achieve tremendous power, flexibility and reliability. There is a reason that businesses began using them decades ago and why open-source RDBMSes dominate the Web.

And, what about the Web? The primary argument many people use against RDBMSes is that they "don't scale", which simply isn't true. It is true that some individual RDBMSes do not scale very well or are harder to scale, but that doesn't mean every RDBMS cannot. RDBMSes are in use at every large company. The largest RDBMS installations routinely handle enormous traffic and petabytes of data.

This scaling myth is perpetuated and given credence every time popular Web sites announce that such-and-such RDBMS doesn't meet their needs, and so they are moving to NoSQL database X. The opinion of some in the RDBMS world is that many of these moves are not so much because the database they were using is deficient in some fundamental way, but because it was being used in a way for which it wasn't designed. To make an analogy, it's like people were using flat-head screwdrivers to tighten Phillips-head screws, because it worked well enough to get the job done, but now they've discovered it is better to tighten Phillips screws with an actual Phillips screwdriver, and isn't it wonderful, and we should throw away all flat-head screwdrivers, because their time is past, and Phillips is the future.

One recent SQL-to-NoSQL move involved Digg.com moving from MySQL to Cassandra. As part of the move, Digg folks blogged about how they were using MySQL and why it didn't meet their needs. Others were skeptical. Dennis Forbes, in a series of posts on his site (see Resources), questioned whether Digg needed to use a NoSQL solution like Cassandra at all. His claims centered on what he considered very poor database usage on the part of Digg

## What Does Relational Mean in a Relational Database?

In common usage, the relational part of Relational Database refers to (or is often assumed to refer to) the way tables are related to each other via keys. For the truly pedantic though, this is in fact incorrect. Relational here does not refer to *relationships* between tables, rather it refers to the mathematical concept of a relation, which is in essence what relational databases call tables. A relational database is a database based on the relational model.

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## What Is ACID?

ACID is the classic measure of determining whether your database is good. A transaction in a database is a single logical operation. An example would be inserting an address or updating a phone number in an employee database. Every database provides methods to do operations like those, but ACID formalizes the process.

Atomicity means that the transaction either succeeds or fails. If the transaction fails, it should fail completely, and the database should be left in the state it was in before the transaction started.

Consistency means that the database is in a known good state both before and after the transaction.

Isolation means that transactions are independent of one another, and if two transactions are trying to modify the same data, one of them must wait for the other to finish before it can begin.

Durability means that once the transaction has completed, the changes made by the transaction will persist, even if there is a system failure. A transaction log of some sort usually is used for this purpose. In MariaDB and MySQL, this is called the binary log.

So, what is the opposite of ACID? BASE (Basically Available, Soft-state, Eventual consistency), of course. BASE is a retronym coined by Dan Pritchett in an article in the *ACM Queue* magazine for describing a database that does not implement the full ACID model, with the main difference being that it is eventually consistent. The idea is that if you give up some consistency, you can gain more availability and greatly improve the scalability of your database.

combined with inadequate hardware. In his mind, if Digg had just designed its database properly or switched to using SSDs in its servers, it would have had no problems. His best quote is this: "The way that many are using NoSQL is like discovering the buggy whip at the beginning of the automotive era." Ouch.

Relational databases sometimes can be tricky to design properly. You have to know and understand your data deeply. But when they are designed properly, the performance can be orders of magnitude better compared to poorly designed databases. You also should not overlook the hardware on which your database runs. Databases love as much memory and processing power as you can throw at them, and the traditional spinning-platter disk drive has long been a limiting factor. Does the high performance of SSDs herald a new age of RDBMS performance? Many experts say yes. SSDs may be a game-changer in the database world.

### Does the high performance of SSDs herald a new age of RDBMS performance?

Relational SQL databases have been around for several decades. They have proven reliability and performance and a feature set that meets the requirements of 99% of the use cases out there. They even make excellent key-value databases, if that's the type of data you have. There are only very few companies that can't make a relational database work for them. You may not like to hear it, but with the law of averages, chances are your company is not one of them.

#### Conclusion

My advice? Don't think of SQL vs. NoSQL as an either/or question. Options are a good thing. Many alternatives exist, so if you are having issues with your chosen database, experiment with different products on both sides and run your own benchmarks.

Also look into how you are using your database. If the database was "bootstrapped" while you were creating your killer application or service, and it is starting to give you problems, you might have an easily solvable design issue at the root of your troubles. If

databases are not your thing, consult with an expert. RDBMSes have been around a long time, and there are plenty of experts.

Whatever you decide to do, don't think of NoSQL as your escape from the SQL RDBMS world. NoSQL databases are not a panacea. I asked my boss, Monty Widenius, the creator of MySQL, what his opinion on the whole NoSQL vs. SQL thing was. His answer: "Non-SQL gives you a very sharp knife to solve a selected set of issues. If you find SQL too hard to use, you should not try Non-SQL."

His basic point is that if you don't understand SQL RDBMSes, you'll probably end up hurting yourself by jumping into NoSQL. Key-value stores like those found in NoSQL databases do work for certain kinds of data, but they don't work well at all for other kinds. It is instructive to point out that the companies that use and have championed NoSQL databases have not given up on SQL RDBMSes. They continue to

use them in vital roles.

Finally, many of the NoSQL ideas are based on old technology. Key-value stores have been around for more than 20 years, for example. New this time around are things like map-reduce (some claim that even this is an old idea), which spread the workload over many computers. In that sense, NoSQL databases really should be called distributed-DBMSes (DDBMSes?). Basically, distributed RDBMSes, without the R.

Whatever you call them, NoSQL databases are solving problems that were considered "solved" by many in the RDBMS world a long time ago. They're just solving the problems in a different way, and they have a different set of requirements. If this new-old way solves an issue you're having, great! On the flip side, if your current RDBMS is meeting your needs, don't feel like you need to jump on the bandwagon. ■

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Daniel Bartholomew works for Monty Program as a technical writer and system administrator. He lives with his wife and children in North Carolina and often can be found hanging out on both #linuxjournal and #maria on Freenode IRC.

## Resources

### SQL Databases:

MariaDB: [askmonty.org](http://askmonty.org)

PostgreSQL: [www.postgresql.org](http://www.postgresql.org)

### NoSQL Databases:

Cassandra: [cassandra.apache.org](http://cassandra.apache.org)

CouchDB: [couchdb.apache.org](http://couchdb.apache.org)

HBase: [hadoop.apache.org/hbase](http://hadoop.apache.org/hbase)

Redis: [code.google.com/p/redis](http://code.google.com/p/redis)

Voldemort: [project-voldemort.com](http://project-voldemort.com)

MongoDB: [www.mongodb.org](http://www.mongodb.org)

Hypertable: [hypertable.org](http://hypertable.org)

Dynomite: [wiki.github.com/cliffmoon/dynomite/dynomite-framework](http://wiki.github.com/cliffmoon/dynomite/dynomite-framework)

BigTable: [labs.google.com/papers/bigtable.html](http://labs.google.com/papers/bigtable.html)

### Brewer's CAP Theorem:

Brewer's CAP Theorem by Julian Browne:  
[www.julianbrowne.com/article/viewer/brewers-cap-theorem](http://www.julianbrowne.com/article/viewer/brewers-cap-theorem)

CAP Theorem:  
[devblog.streamy.com/2009/08/24/cap-theorem](http://devblog.streamy.com/2009/08/24/cap-theorem)

Towards Robust Distributed Systems by Dr Eric A. Brewer:  
[www.cs.berkeley.edu/~brewer/cs262b-2004/PODC-keynote.pdf](http://www.cs.berkeley.edu/~brewer/cs262b-2004/PODC-keynote.pdf)

Brewer's Conjecture and the Feasibility of Consistent Available Partition-Tolerant Web Services (2002) by Seth Gilbert and Nancy Lynch: [citeseer.ist.psu.edu/544596.html](http://citeseer.ist.psu.edu/544596.html)

E. F. Codd's "A Relational Model of Data for Large Shared Data Banks":  
[www.seas.upenn.edu/~zives/03f/cis550/codd.pdf](http://www.seas.upenn.edu/~zives/03f/cis550/codd.pdf)

### Other Links:

Dennis Forbes on Software and Technology:  
[www.yafla.com/dforbes](http://www.yafla.com/dforbes)

Looking to the future with Cassandra by Ian Eure:  
[about.digg.com/blog/looking-future-cassandra](http://about.digg.com/blog/looking-future-cassandra)

NOSQL debrief by Johan Oskarsson:  
[blog.oskarsson.nu/2009/06/nosql-debrief.html](http://blog.oskarsson.nu/2009/06/nosql-debrief.html)

BASE: An Acid Alternative by Dan Pritchett:  
[queue.acm.org/detail.cfm?id=1394128](http://queue.acm.org/detail.cfm?id=1394128)

Should you go Beyond Relational Databases? by Martin Kleppmann:  
[carsonified.com/blog/dev/should-you-go-beyond-relational-databases](http://carsonified.com/blog/dev/should-you-go-beyond-relational-databases)

NoSQL Q and A: [www.dbms2.com/2009/12/11/nosql-q-and-a](http://www.dbms2.com/2009/12/11/nosql-q-and-a)

NoSQL Video by Brian Aker:  
[www.youtube.com/watch?v=LhnGarRsKnA](http://www.youtube.com/watch?v=LhnGarRsKnA)

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# Comparing Linux and Microsoft Windows for Enterprise Usage

Selling Linux in the Enterprise often is a tough job, but with the right information, you can start making the case for Linux. JERAMIAH BOWLING

For far too long, Linux has existed on the periphery of enterprise computing. Whether it is skepticism of open-source technology, a preference for paid instead of community support or the ever-forking tree of distributions, many businesses have shied away from Linux. In recent years, commercial Linux vendors have been hard at work polishing their distributions in the hope of establishing a beachhead in the enterprise. These mature distributions have rendered many past criticisms moot, and coupled with new opportunities in emerging technologies like virtualization, Linux stands poised to re-establish itself as an enterprise-caliber operating system. However, if these vendors are to be successful, they must take on the leviathan in the enterprise: Microsoft.

In this article, I discuss several areas of the enterprise that are prime candidates for Linux adoption or expansion. In each case, I look at the current Microsoft offering in that area and then highlight a legitimate Linux-based contender. In doing so, I do not intend to keep a running score card and come up with an unsurprisingly biased conclusion (this is *Linux Journal* after all). I merely want to start the conversation in order to demonstrate Linux's inherent business value and strengthen the community at large.

There are a few caveats before I proceed. For the purposes of this article, I have blurred the line between server and desktop platforms to keep the discussion at a strategic level. The topics I examine may touch upon aspects of one or both platforms. I also have limited the distributions used here to those with paid support, as they tend to be targeted at the enterprise market. With the exception of BIND and DHCP, I have avoided any technologies/packages, such as LAMP, Samba, Sendmail or any iconic Linux app I felt already has been beaten into the ground with comparisons. I want to bring something new to the table. Finally, this article does not tackle the thorny issue of application serving or application compatibility. We all know the vast majority of business apps are developed for the Microsoft platform. Wine and/or Mono are not the answers. Developing software to emulate another vendor's code always will leave Linux users behind their Microsoft counterparts. However, the rapid growth of Web-based apps, advancements in virtualization (application and desktop) and the arrival of cloud computing may change this dynamic in the near future as applications become separated from the desktop.

## Desktop Security—User Account Control/Security Configuration Wizard

User Account Control (UAC) has been an essential part of Microsoft OSes since Vista. UAC protects the OS by requiring services and programs to operate with the correct permissions via security confirmation prompts. It is meant to limit the number of programs that run with unnecessary administrative privileges, a long-criticized weakness of applications developed for the Microsoft platform. Although UAC has received praise for making strides to eliminate this weakness, many admins have found that prolonged use leads some users simply to click Yes on the elevation prompts rather than evaluate the security risk. This leads to the elevation of non-desired programs, possibly to the detriment of the system. UAC can be complemented with the use of the Security Configuration Wizard that locks down unnecessary ports and services using a form-like survey to determine your minimum necessary configuration.

Security always has been an important component of the Linux pedigree. Utilities like sudo and chroot, which limit the context of certain programs and operations, long have been part of the Linux security toolbox. In the case of Debian-based distributions, root access is prohibited except through the use of sudo. Also, most distros now utilize either AppArmor or SELinux as an additional security layer at the host level. Although SELinux and AppArmor take different tacts to



Figure 1. SELinux Administration in RHEL

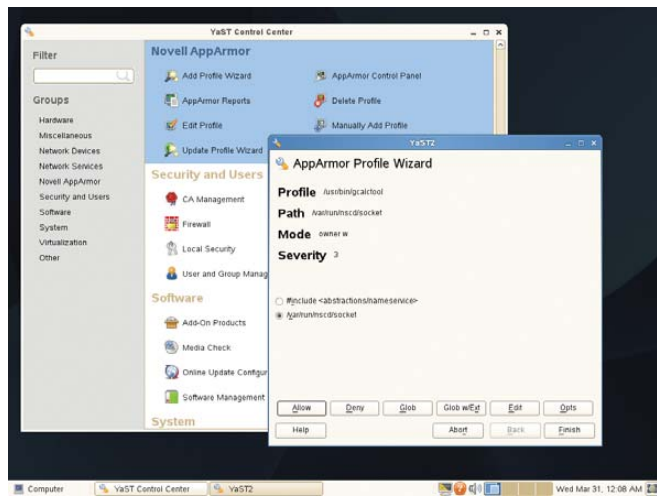


Figure 2. SUSE AppArmor Wizard

securing a system, each utilizes a least-privilege-based approach to minimizing the threat surface through the use of profiles. Although SELinux (Figure 1) has the distinction of being developed by the National Security Agency and of being extremely secure, it can be difficult to administer. By contrast, many admins believe AppArmor is just as effective and easier to configure. Novell includes a nice GUI tool for AppArmor in SUSE Enterprise Linux that includes a wizard for profiling applications that is a real time-saver (Figure 2).

### Host-Based Firewalls—Windows Firewall

The Windows firewall included in Server 2008 and Windows 7 is a great improvement over previous incarnations. It filters on packets, IP addresses and source/destination program, and its management GUI is easy to use. However, it lacks some of the advanced features found in Linux-based firewalls. In contrast,

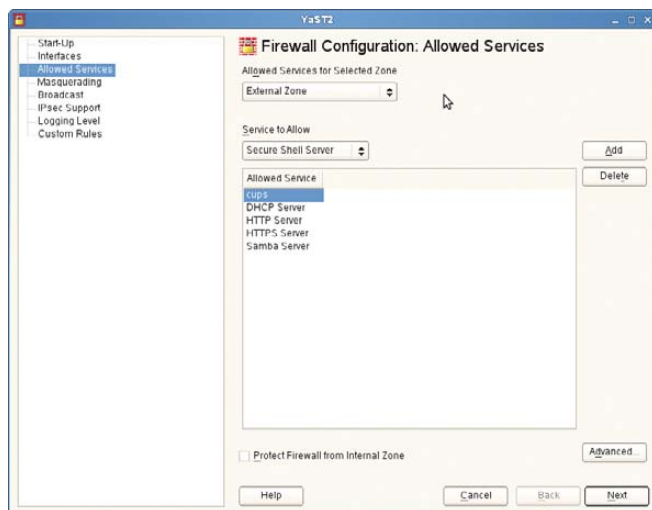


Figure 3. SUSE Firewall Configuration GUI

Linux has been wed to open-source firewall development in near lockstep since ipchains and now iptables. Although many admins still prefer the text-based administration of iptables, there are many easy-to-use GUI-based interfaces, such as the one found in SUSE through Yet another Setup Tool (YaST, Figure 3). Unfortunately, these tools often limit access to advanced features, such as port redirection, IP translation and quality of service, which can be accessed from the command line. To be fair, some of these capabilities are available in Server 2008 by adding other modules (RRAS) or products (ISA), but that adds another layer of administration and cost where Linux possesses them out of the box. Some admins may feel that firewalls are not a significant factor in enterprise security except in the perimeter. Others suggest that firewalls are more important now than ever, because technologies like the cloud and mobile computing are erasing the traditional boundaries of the perimeter. Only time will tell.

### Package Management/Updates—Automatic Updates/Windows Software Update Services

The last decade easily could have been labeled the Decade of the Patch. Because of the ever-evolving security landscape, new vulnerabilities are discovered daily. Don't get me wrong. Security researchers provide an invaluable service to the industry, but sometimes when I have to push patches en masse daily, I pine for the old days when I could just push a single service pack every so often. Patching is not solely a Microsoft phenomenon. Vulnerabilities exist in Linux as well. Most modern operating systems worth their salt include a native updating mechanism to address flaws and vulnerabilities. In Windows, it is Automatic Updates for individual systems or Windows Software Update Services (WSUS) for managing a large number of systems. Microsoft has done well with both programs and should be applauded for their maturation in the last five years. Like its name implies, Automatic Updates automates the patching of host systems through a Control Panel interface. WSUS adds reporting features and the ability to

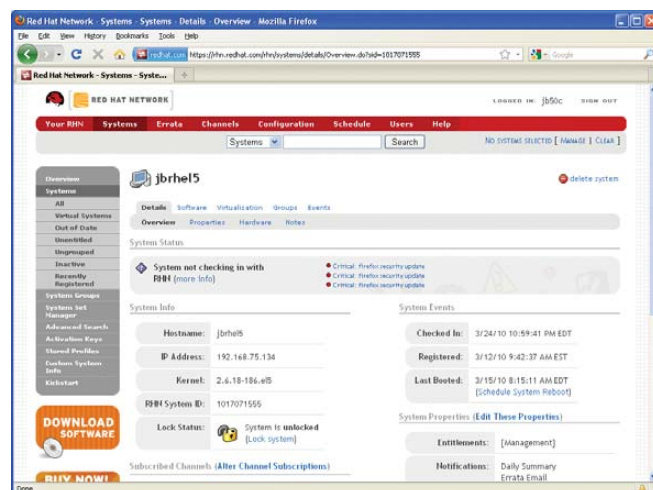


Figure 4. Managing Your System via Red Hat Network

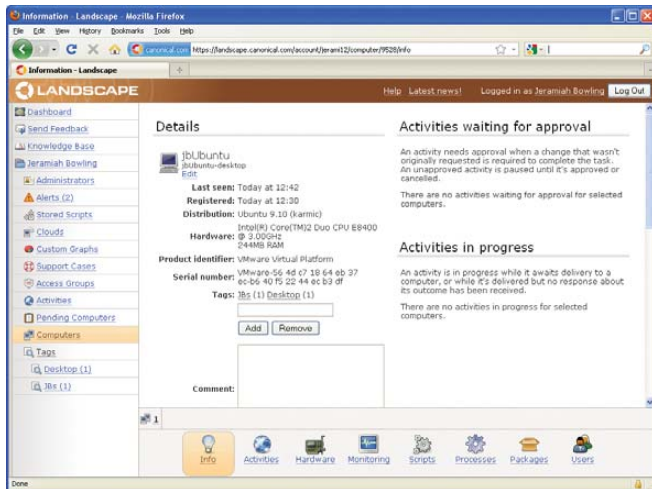


Figure 5. Canonical's Landscape Service for Ubuntu

centralize patch distribution, although the process for approving, denying and/or superseding patches can be kludgy.

Linux updating mechanisms vary by distribution, but share similar functionality with their Microsoft counterparts. Debian-based systems have apt, Red Hat-based systems have Yellowdog Updater Modified (YUM), and SUSE has YaST (which provides a graphical front end to the ZYpp package management engine). Each tool is easy to automate and includes the ability to resolve dependency issues prior to an update. They also share the ability to deploy local repositories to reduce bandwidth consumption as with WSUS, but to achieve the nicer dashboard and reporting features of WSUS requires subscription-based services, such as Red Hat Network (Figure 4) or Landscape from Canonical (Figure 5).

### Basic Network Services—Microsoft DNS/DHCP

DNS and DHCP are production network roles where many Linux servers make their entry into an enterprise. Although these services may seem boring, they form the backbone of the modern enterprise. On the Microsoft side, we have the proprietary versions of DNS and DHCP included in Server 2008. Both are configured using the Server Manager utility and then administered through their respective mmc consoles. Microsoft has integrated its versions of DNS and DHCP deeply with Active Directory (AD) and a multitude of its proprietary network services. Although on the surface this may not seem like a problem, a single misconfiguration can affect multiple parts of the Microsoft infrastructure (AD, Exchange and so on). On the Linux side, we have the Berkeley Internet Name Domain (BIND), the standards-based market leader. BIND is a dependable workhorse that has enough flexibility to support Active Directory and keep DNS administration separate from other parts of the infrastructure. You can administer BIND through the command line or GUI tools like the Red Hat BIND Configuration Tool (Figure 6).

Alongside DNS, DHCP is a critical, though overlooked

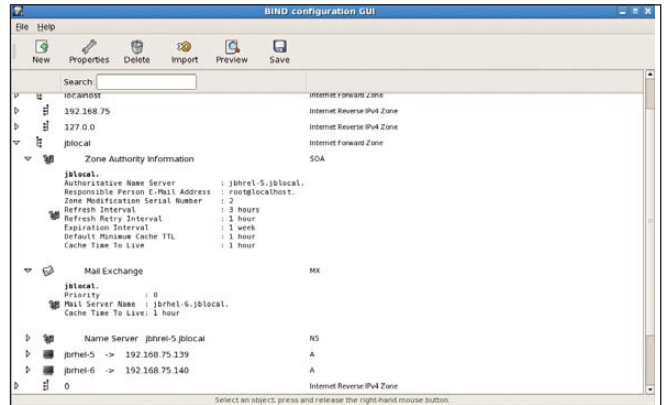


Figure 6. Red Hat's BIND Configuration Tool

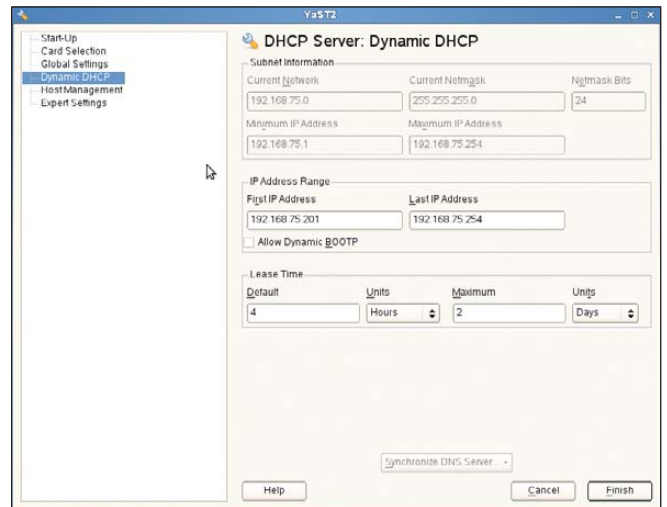


Figure 7. Managing DHCP with YaST in SUSE

network service. It also is an excellent springboard for Linux in a new environment. It is low impact and can integrate into almost any existing network with little interruption. DHCP is available in most distros, and tools like those found in YaST make administration a snap (Figure 7). DNS and DHCP usually can be combined on a single server, as is found in many Microsoft environments, but with a smaller footprint.

### Directory Services—Active Directory

Active Directory is the heart of Microsoft networking. It is a powerful tool that has a solid reputation for providing reliable directory services. Chances are, unless you are already a \*nix shop, you're probably using it right now. AD has dominated the landscape for so long that many people forget its roots. In the strictest sense, AD is an LDAP-based server that uses Kerberos for authentication and DNS for name resolution. The reason for its dominance is twofold: its flagship mail product (Exchange) requires it, and every Microsoft desktop and server OS shipped has a built-in AD client. Directory services existed



before AD, and other alternatives are available (even non-Linux ones) that provide similar services.

One of the better alternatives is eDirectory from Novell (Figure 8). eDirectory has its roots in Novell Directory Services (NDS), the highly popular directory service that dominated the enterprise in the 1990s. Although Novell has lost considerable market share to AD in the last decade, it has continually improved its directory products. eDirectory is scalable, supports multimaster replication and is OS-agnostic, which means it can easily be deployed to almost any environment (including Windows). For Linux systems, eDirectory can run on either SUSE or Red Hat Enterprise servers. eDirectory can be managed by using ConsoleOne (Figure 8) or the newer, sexier iManager Web management package (Figures 9 and 10) that uses role-based assignment of privileges. This is similar to AD; however, the level of granularity over directory permissions found in iManager is far greater. As a side note, Novell currently has a standing relationship with Microsoft that each will support the other's products. This could be a benefit when campaigning for a bigger Linux presence in a Microsoft-centric enterprise.

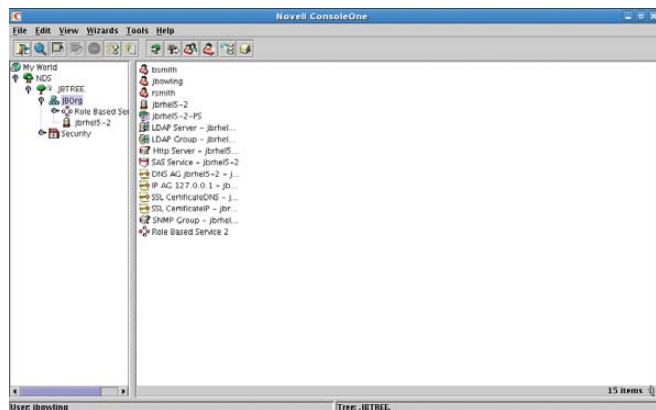


Figure 8. Novell's ConsoleOne (eDirectory)

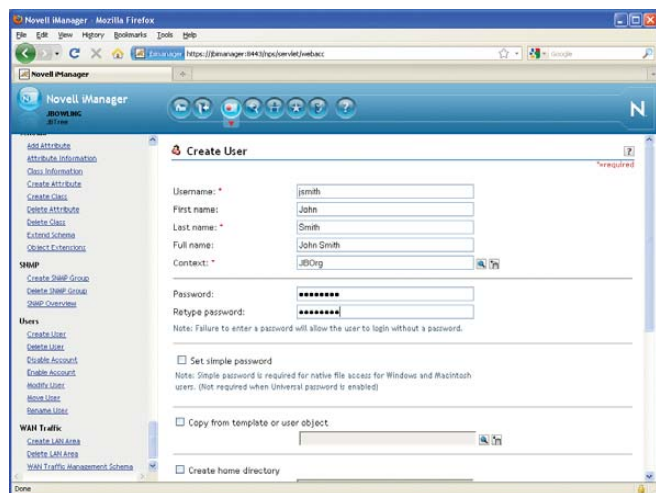


Figure 9. User Creation in iManager (eDirectory)

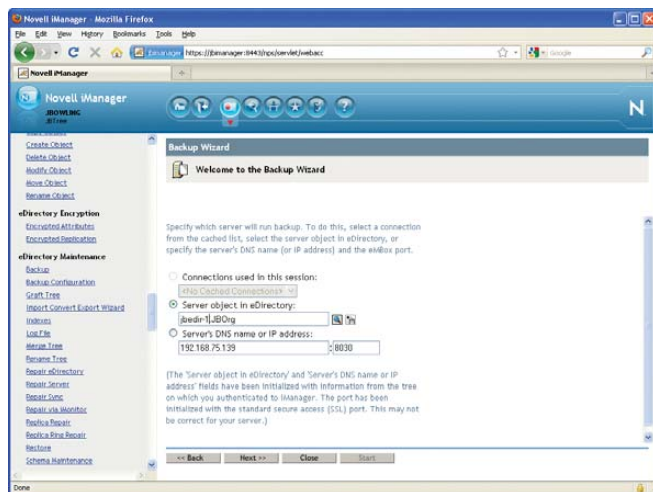


Figure 10. eDirectory Management Tasks in iManager

## Virtualization—Microsoft Hyper-V

Virtualization may be the hottest topic in the industry at the moment. It seems like “virtual” is the buzzword of every other Webinar out there. I won't spend time explaining the value of virtualization, save that server consolidation and desktop/application virtualization seem to be the biggest reasons so many people are interested in it. Microsoft made a major move into the virtualization arena with its release of Hyper-V. Unlike Microsoft's earlier product, Virtual Server, Hyper-V sports a fully virtualized hypervisor that removes the need for running a virtual server on top of a “fat host”. Hypervisors allow guests to access underlying hardware directly, and because there is very little overhead, performance is dramatically improved. Hyper-V has received a number of improvements with the release of Server 2008 R2. It now has more enterprise-grade capabilities for management and high availability, and most notably, support for live migrations. It can be managed with the Hyper-V Manager Console, an enterprise-grade tool for creating and managing Hyper-V hosts and guests.

There are Linux-based options for virtualization as well. For the longest time, Xen was the darling of the Linux virtualization movement. Following the acquisition of Xen by Citrix, many vendors have begun making the switch to using the Kernel-based Virtual Machine (KVM) module as their primary virtualization platform. KVM is a hypervisor module that can run in a kernel of 2.6.20 or higher, but it does require a compatible vm-enabled processor. Red Hat, formerly a huge supporter of Xen prior to its acquisition, has tied its wagon to KVM. In fact, Red Hat is releasing its KVM-based Red Hat Enterprise Virtualization (RHEV) product as a direct competitor to Hyper-V, VMware and Xen. RHEV is composed of a minimalist RHEL KVM-enabled installation, tweaked as a host system for virtualization. Unlike most virtualization products on the market, RHEV is rolling out a competitive subscription-based pricing model that includes both the hypervisor and manager software in the same license (often sold separately). It also touts

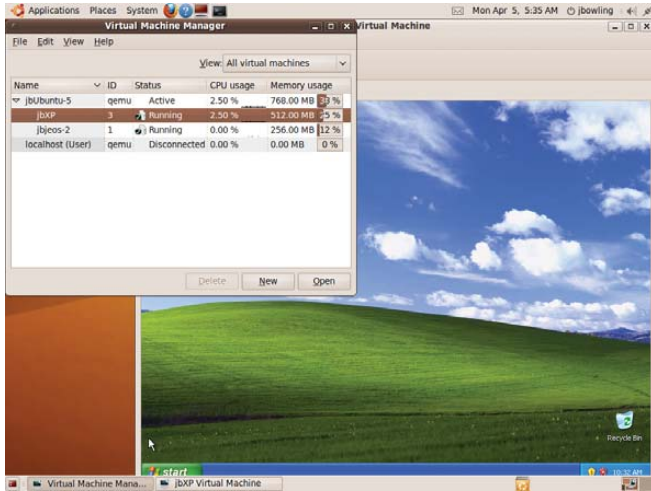


Figure 11. Managing VM's with virt-manager in Ubuntu

advanced virtualization features, such as live migration and automatic server failover. I really wanted to test-drive RHEV for this article, but I was unable to obtain a trial version of the product. Regardless, KVM runs near flawlessly in most distributions. For demonstration purposes, I deployed KVM on

Ubuntu, which provides a Just enough OS (JeOS, pronounced "juice") image configured specifically for virtual appliances. KVM hosts can be managed using the GUI-based virt-manager package (Figure 11) or other command-line tools.

### Cloud Computing—Microsoft Azure/Cloud Computing Initiative

Cloud computing is almost as buzzworthy as virtualization, which is funny considering that it is an offshoot of the virtualization movement. Cloud computing refers to a strategy of using a pool of resources (such as servers, storage, bandwidth) or a "cloud" to offer individualized servers or services to customers. Cloud services usually pertain to Web-based application services, but more and more apps are appearing "in the cloud". These newer apps include corporate e-mail hosting, file storage, user collaboration and mobile apps. Clouds are a cost-beneficial proposition for smaller customers that want the advantages of a data center (clustering, high availability/disaster recovery) without

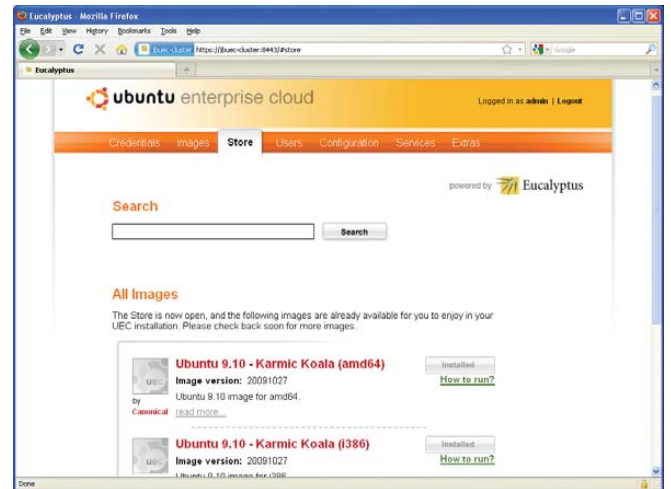



Figure 12. Ubuntu Enterprise Cloud Web Interface

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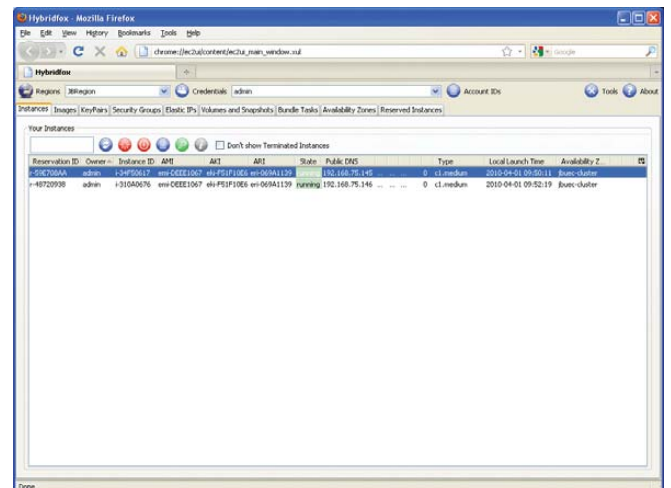


Figure 13. Managing Cloud Instances with Hybridfox

the cost of maintaining one. Amazon has been a pioneer in this area with its Elastic Compute Cloud (EC2) service where you can purchase your own cloud servers or applications that run within the Amazon cloud. Microsoft has jumped into the market and poured considerable resources and energy into the emerging technology. It has been live with its public cloud, Azure, since 2009. Microsoft's private cloud, which will be managed through System Center, is scheduled for release in the first half of 2010.

If you want to deploy a private Linux-based cloud now, you can do so with Ubuntu. The process is remarkably simple. Download Ubuntu server and launch the server install process. Upon boot, you will see an option from the main install screen to install the server as a Ubuntu Enterprise Cloud (UEC) server either as a cluster controller or as a node. You will need one of each to get started. Once up and running, you can download images from the management site (Figure 12) or begin creating your own images that match your cloud needs. The cloud you are deploying actually is a re-branded version of the open-source cloud software Eucalyptus. Management is accomplished via command-line or GUI-based tools like hybridfox (Figure 13), a Firefox add-in that runs like a modified version of Amazon's Elasticfox management utility.

Many other areas of the enterprise are ripe for Linux penetration. The ones presented here represent some of the best chances for Linux adoption in the vast majority of enterprises. I encourage you to download and test these options to see how beneficial they can be to your business. Linux's future development, its very survival, rests in its ability to stake a claim in the business computing market, and the only way to do that is by constantly challenging the status quo with viable, cost-saving alternatives. Hopefully, I've given you some of those alternatives here. ■

Jeremiah Bowling has been a systems administrator and network engineer for more than ten years. He works for a regional accounting and auditing firm in Hunt Valley, Maryland, and holds numerous industry certifications, including the CISSP. Your comments are welcome at [jb50c@yahoo.com](mailto:jb50c@yahoo.com).

## Resources

Red Hat Network: <https://rhn.redhat.com>

Canonical Landscape:  
[www.canonical.com/projects/landscape](http://www.canonical.com/projects/landscape)

BIND: [www.isc.org/software/bind](http://www.isc.org/software/bind)

Novell eDirectory: [www.novell.com/products/edirectory](http://www.novell.com/products/edirectory)

RHEV: [www.redhat.com/virtualization/rhev/server](http://www.redhat.com/virtualization/rhev/server)

KVM: [www.linux-kvm.org](http://www.linux-kvm.org)

Ubuntu Enterprise Cloud (Private):  
[www.ubuntu.com/cloud/private](http://www.ubuntu.com/cloud/private)

Hybridfox: [code.google.com/p/hybridfox](http://code.google.com/p/hybridfox)

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# Getting Started with Quickly

Quickly helps you (quickly) write applications with Python and GTK. JONO BACON

**At the heart** of what makes Linux thrive as an operating system are *applications*. Within it is a vibrant, diverse range of applications, satisfying even the most particular needs, all just a few clicks away. With such an imaginative range of applications available, a similarly vibrant developer community has formed, complete with a vast array of tools, languages and functionality. Unfortunately, although powerful, many of these tools are awkwardly complex, and many developers have let their ideas and creativity become buried under an avalanche of confusion around how those tools fit together.

Part of the cause of this problem is that many developer tools cater only to systematic developers—the kind of code-writing workaholics who hack for a living, with a fervent attention to detail backed up by unit tests and other hallmarks of the professional programmer. There are, however, developers of a different sort who are driven by writing practical code, scratching their itches and having fun writing programs and sharing them with others. These are opportunistic developers.

As part of our work in Ubuntu, we have been keen to harness opportunistic developers and enable them to do great work using Ubuntu as a platform. As part of this goal, we have developed a series of tools to make it simple for you to break down the barrier between idea and implementation, and help you to scratch your itches more quickly and easily. One such tool is Quickly ([wiki.ubuntu.com/Quickly](http://wiki.ubuntu.com/Quickly)).

## Enter Quickly

Quickly gets you up and running (quickly, of course) writing an application from scratch. Traditionally, writing desktop applications has involved a not-insignificant amount of faffing required, with build systems, source control, packaging frameworks, graphical interface tools and other things that get in the way of writing code. Quickly is a tool that simplifies how those different things fit together.

Quickly provides a framework with a series of templates for creating different types of applications. With each template, a series of opinionated decisions are made about the tools involved in creating that application. By far, the most popular template and the one that Quickly itself was created to satisfy is the Ubuntu template. This template uses a set of tools that has become hugely popular in modern desktop software development, and tools we have harnessed in Ubuntu. They are:

- Python: a simple, easy-to-learn, flexible and efficient, high-level language.
- GTK: a comprehensive and powerful graphical toolkit for creating applications and the foundation of the GNOME desktop environment.

- GNOME: the desktop environment that ships with Ubuntu, offering many integration facilities.
- Glade: an application for creating user interfaces quickly and easily, which then can be loaded right into your Python programs.
- GStreamer: a powerful but deliciously simple framework for playing back and creating audio, video and other multimedia content.
- DesktopCouch: a framework for saving content in a database that is fast and efficient, hooks neatly into Ubuntu One and is awesome for replication.
- gedit: for editing code—Quickly assumes you are going to use the text editor that ships with Ubuntu, which provides a simple and surprisingly flexible interface for writing your programs.

With this core set of tools, you can write any application you can imagine and know that it will run effortlessly on Ubuntu and other distributions. Let's make the magic happen.

## Getting Quickly

Today, Quickly primarily is used on Ubuntu and is not currently packaged for other distributions, although we hope this changes in the future and that other distributions use Quickly too. If you are running Ubuntu, getting Quickly is as simple as installing from the Ubuntu Software Center or firing up a terminal and running:

```
sudo apt-get install quickly
```

After a few minutes, you should be up and running.

## Creating a Project

With Quickly installed and ready to roll, let's start creating a simple application. Fire up a terminal with Applications→Accessories→Terminal, and enter the following command:

```
quickly create ubuntu-project myapp
```

This command uses Quickly to create a new Ubuntu Project called myapp. You will see a flurry of lines fly past your eyes as Quickly generates the new project and saves its various files inside a new directory called myapp. When Quickly finishes generating the project, it runs it automatically, and you should see a window that looks remarkably similar to Figure 1.

The generated application has a number of important

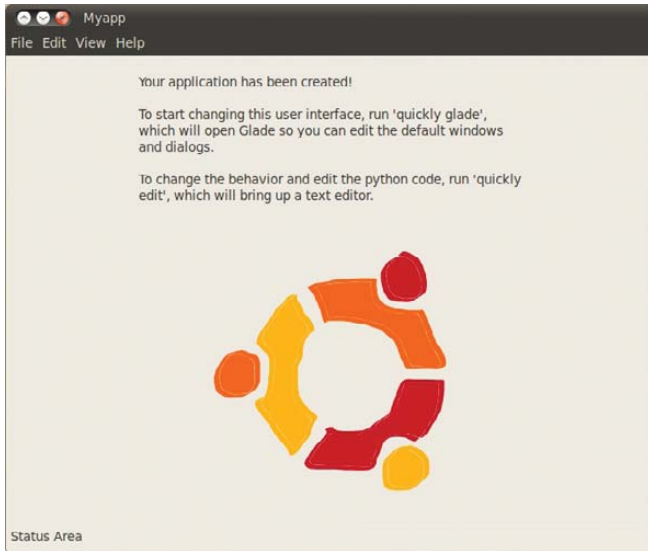


Figure 1. Myapp Main Window

elements common to many applications, such as a menu bar, menu items and status bar, and it also includes a label with

some text and a rather nice Ubuntu circle of friends image. Feel free to click through the menus and play with your new program. It won't do much yet, but from this pre-existing base, you now can turn it into any program you want. Let's start working on it. First, go into the project directory:

```
cd myapp/
```

Quickly has a series of commands that each begin with the `quickly` command. The first command you need to know is how to run your program. Simply use the `run` command:

```
quickly run
```

This runs your program and displays it on the screen. When you're finished with the program, you can close it down either by clicking the window close button or pressing `Ctrl-C` inside the terminal.

Now, let's create a really simple program that demonstrates how basic development works with Quickly and its key components: Python and the GTK widget set. To do this, the program will have a text entry box and when you type in a word, it will search for that word on Google. Although delightfully simple, it demonstrates the basics well and is a good place to start.

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## Changing Your Program's Interface

In every program, you can use buttons, scrollbars and other interactive things to click on to construct your program interfaces. These building blocks for creating interfaces are called widgets, and they are part of the GTK toolkit.

First, let's make some changes to the user interface to remove some unneeded widgets. You also will want to add a text box widget. To edit your user interface, use a program called Glade, which lets you visually construct your interface by pointing and clicking. Later, you can hook different widgets up to code that do interesting things. First, load Glade with:

```
quickly glade
```

When Glade pops up, it should look eerily similar to Figure 2. (Note: in Quickly 0.4, the command is `quickly design`.)

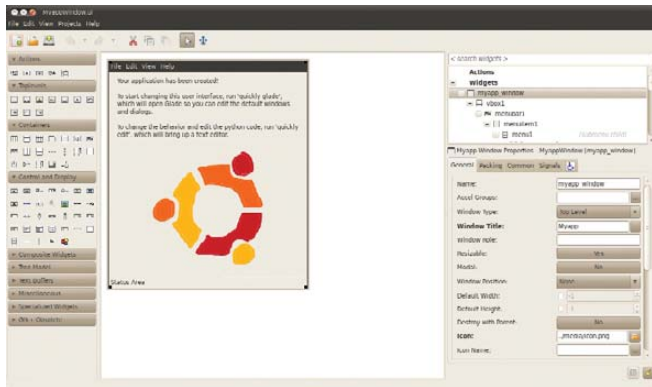


Figure 2. Glade

Glade has a few components to its interface. In the middle, you can see the current interface on which you are working. There, you can click on widgets to highlight them, move them around, delete them and more. The collection of icons on the

**Traditionally, writing desktop applications has involved a not-insignificant amount of faffing required, with build systems, source control, packaging frameworks, graphical interface tools and other things that get in the way of writing code.**

left of the main Glade interface is called the Tool Palette, and it provides a wide range of widgets you can use in your application. Simply click on a widget, and then click in your application window to add it.

To the right of the Glade interface are two main areas. At the top, you can see the widget hierarchy. This shows that widgets are part of other widgets. Many widgets act as containers for others. As an example, a button typically has a label on it with some text and the label (a `gtk.Label`) sits inside the button (a `gtk.Button`).

Below the widget hierarchy is a collection of tabs that all reflect settings for the currently selected widget. As an

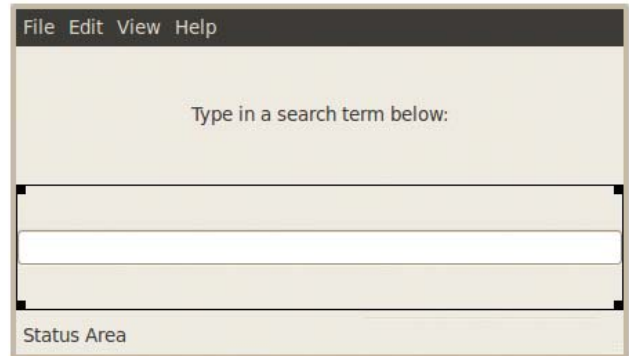


Figure 3. Text Entry

example, if you click on the image of the circle of friends (the Ubuntu logo) in your application interface in Glade, you can see the contents of the widget settings area adjust to show the available settings for a GTK image widget. If you click on the text above the image (which is called a GTK Label), you will see the settings reflect that widget too.

Now, let's adjust the interface to reflect this simple application. Having clicked on the label, change the text that is displayed by looking at the widget settings on the right of the main Glade window, and look for the label option. In there, delete the existing text, and enter the following text: "Type in a search term below:". You should see the label in your user interface change.

With the label complete, you don't really need the circle of friends image, so click it and press the delete key. When the image is deleted, you will see a gray space open up behind it. This is an empty part of your interface where you can put another widget. It's also rather convenient, because you will want to fill this space with a text entry widget where your users can type in their search terms.

To add a widget, use the tool palette area on the left side of the main Glade interface window. In the Control and Display section, hover over the icons until you find

the Text Entry item (typically, it's the third icon down on the left). Click it, and then click in the gray space that opened up when you deleted the image. You now should see the text entry appear, and your user interface should look like Figure 3.

With the widget there, you should name it. All widgets in your interface can be referenced throughout your code, and you often will use this name to reference them. To do this, go to the widget settings area on the right of the Glade interface, and in the Name option, enter "search\_box" as the name. You can call the widget whatever you like, but I usually refer to what it does (for

example, search) and then use an underscore and add the description of the widget (for example, "box" for a text box). This makes it easy to determine what the widgets do when reading your code.

### Connecting Clicks to Code

Before continuing, let's take a brief break from the tools to discuss a key aspect of how graphical programs work—a technique known as Event Driven Programming. It's a fairly simple idea. When users interact with one of the widgets in your program, it will trigger behavior that you want. For instance, in this example program, you want users to enter a search term into the text box, and when they press the Enter key, the program will search for the term in a Web browser.

When you interact with a widget in a certain way, it generates a *signal* to indicate what you did to the widget. In this case, you are interacting with a text box widget, and there are a range of signals for different ways of interacting with it, such as copying text to the clipboard, pasting text in there, moving the cursor with the arrow keys, typing in a letter and more. This example application is specifically intended to search Google when users press the Enter key (pressing Enter typically indicates they have finished typing), so it's a good time to trigger the desired behavior.

The way this works is you will use Glade to specify which handler in your program code you want to call when a particular signal is generated. In this case, the signal that is generated when you press the Enter key is called *activated*, and soon you are going to create a handler called `search_for_term` in your code to respond to the signal.

To make this connection, ensure that the text box currently is highlighted in Glade, and in the widget settings, click the Signals tab. There you will see a list of signals in the Signal column. Now, click in the space to the right of the activated signal, and in the Handler column, enter "`search_for_term`" as your handler. Now, click File→Save to save your work in Glade.

### Writing Some Code

With the user interface complete, now let's write the `search_for_term` handler that performs the search. To edit your program's code, simply use the edit command in the terminal:

```
quickly edit
```

This will fire up each of your source files in your project into the default Ubuntu text editor, gedit. A number of different source files will load, but most of the action happens in the `myapp` file. This is the main Python program that is executed when you run `quickly run`.

The code you need to write to take the term entered into the search box and search Google with it is pretty simple, and you can use the `webbrowser` Python module to help. In the `myapp` file, after the `import gtk` line add:

```
import webbrowser
```

This imports the `webbrowser` Python module, which loads URLs into the system's default Web browser.



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Now, scroll down, and after the `on_destroy` handler, add the following after the `gtk.main_quit()` line:


```
def search_for_term(self, widget, data=None):
    """Search for the term entered"""

    searchurl = "http://www.google.com/#hl=en&source=hp&q="
    searchterm = searchurl + widget.get_text()
    webbrowser.open_new_tab(searchterm)
```

Here, you add the `search_for_term` handler, and it has three arguments that are passed to it:

- `self`: all class methods are passed `self`, this is normal Python.
- `widget`: this is a reference to the widget that called the handler. You can use this to get information from the text entry widget.
- `data=None`: when you call a handler, you can pass it additional data if you like, but you can ignore this for this example.

When this handler runs, first construct the final search



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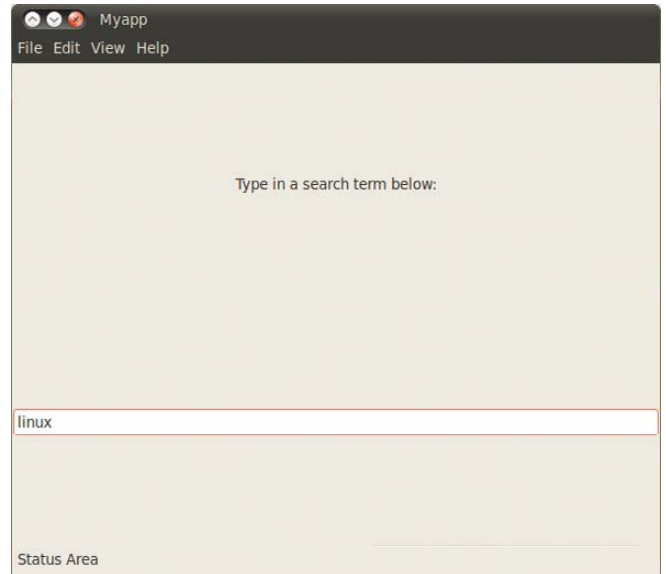


Figure 4. Myapp Main Run

term by concatenating `"http://www.google.com/#hl=en&source=hp&q="` and the content that was typed into the search box. To get this content, use the widget that was passed to the handler automatically. This is a reference to the text entry widget and can be used to run any of the methods that are part of the `gtk.Entry` text entry widget. One such method available is `get_text()`, which simply returns the text that was entered. As such, concatenate this with the Google URL, and you now have a complete URL you can pass to the Web browser. For example, if you typed in `"chickens"`, the full URL would be `"http://www.google.com/#hl=en&source=hp&q=chickens"`.

To pass the URL to the browser, use the `webbrowser` module and its `open_new_tab()` method that opens a new tab with the URL that you pass it.

With the code complete, let's run it to double-check that everything works:

`quickly run`

You now should see something similar to Figure 4 in which you can type some text, press Enter and see the results in your browser. If you see some errors in your terminal, be sure to double-check that you typed in everything correctly.

Quickly is an incredibly simple and powerful tool for generating applications, and I barely have scratched the surface of what is possible with it. You can find out more about using Quickly by visiting [wiki.ubuntu.com/Quickly](http://wiki.ubuntu.com/Quickly). ■

Jono Bacon is the Ubuntu Community Manager at Canonical, author of *The Art Of Community* published by O'Reilly, founder of the Community Leadership Summit and co-presenter on *Shot Of Jaz* and *FLOSSWeekly*.



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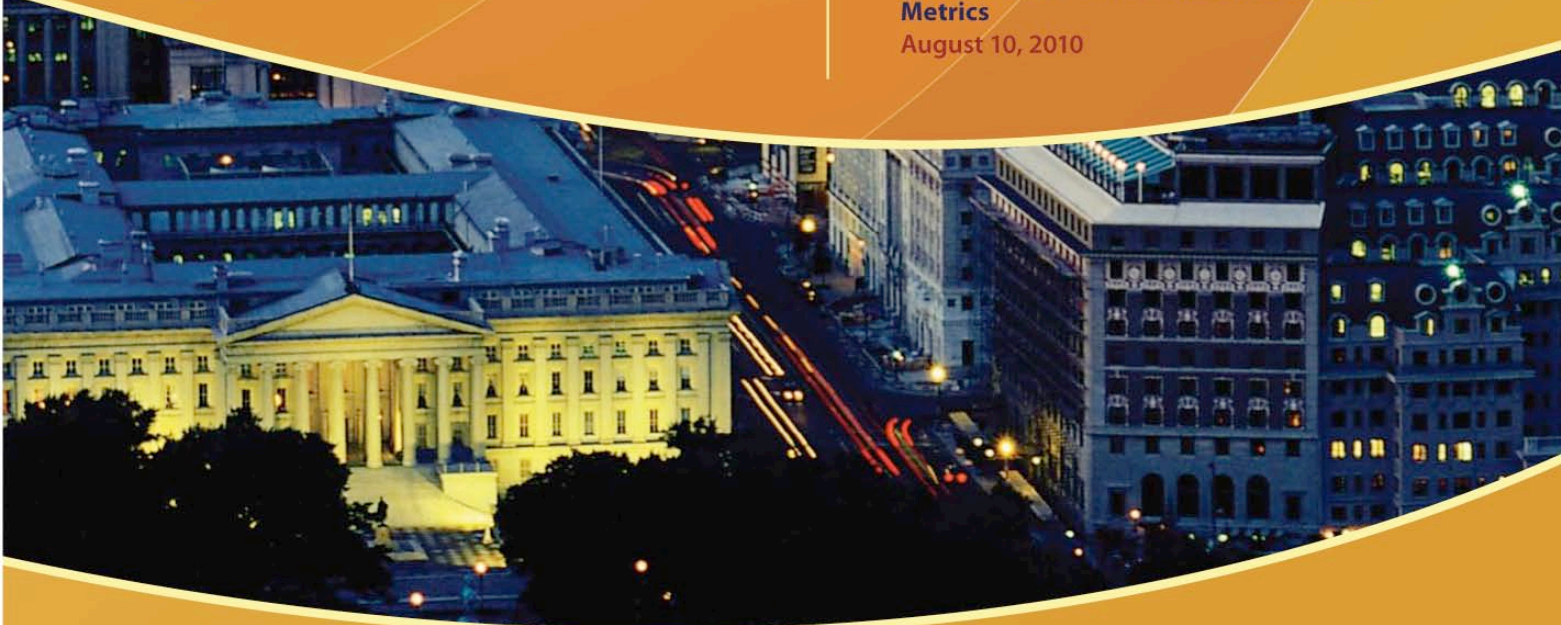
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# Server Monitoring with Zabbix

Think implementing a large monitoring service is tedious? Not so with Zabbix. Start monitoring several-dozen critical hardware and services quickly. PAUL TADER

**Zabbix** ([www.zabbix.com](http://www.zabbix.com)) is an open-source, commercially backed monitoring solution that supports UNIX, Linux, BSD, Mac OS X and Windows platforms and is built to support large installations. Zabbix is the creation of Alexei Vladishev and his company Zabbix SIA. This article is based on the latest version of Zabbix, version 1.8.1, which was released in January 2010. At the time of this writing, most Linux distributions include the previous version (1.6) in their repositories. There are significant changes when compared to 1.8, but most of this article still applies. A partial feature list includes:

- Distributed monitoring.
- Clients for Linux, BSD, Windows, Mac OS X and commercial UNIXes.
- Database back end (MySQL, Oracle, PostgreSQL or SQLite).
- Auto-discovery mode.
- Web-based interface.
- Notifications via e-mail, SMS or Jabber.
- Support for polling or trapping Zabbix client messages.
- SNMP.
- Agent-less monitoring (ping, port checks and so on).
- Graphs.

Although you can install Zabbix from your Linux distribution's repositories, I'm going to install version 1.8.1 from source using Ubuntu 9.10 for the server platform with a MySQL database back end. I also show how to configure a Linux client with the basic monitoring that comes with a default Zabbix installation.

## Prerequisite Applications

Before compiling the Zabbix sources, I need to install prerequisite packages:

```
shell> sudo apt-get install mysql-server apache2
↳ libapache2-mod-php5 php5-mysql php5-gd
↳ libmysqlclient15-dev libsnmp-dev libiksemel-dev
```

```
↳ libcurl4-gnutls-dev
```

(In Ubuntu, the package names are `mysql-server`, `apache2`, `libapache2-mod-php5`, `php5-mysql`, `php5-gd`, `libmysqlclient15-dev`, `libsnmp-dev`, `libiksemel-dev` and `libcurl4-gnutls-dev`.)

## Installation

The Zabbix sever and client will run as the user `zabbix`, so you need to create an account:

```
shell> sudo useradd -s /bin/true zabbix
```

Next, create the zabbix database:

```
shell> mysql -u<username> -p<password>
mysql> create database zabbix;
mysql> quit;
```

Download the source code from [www.zabbix.com/download.php](http://www.zabbix.com/download.php), uncompress the archive and then follow the steps below to set up the database schema and default configuration. Note that I am using the MySQL schema files to set up my database; there are different schema files for the other supported databases:

```
shell> sudo tar zxvf zabbix-1.8.1.tar.gz
shell> cd zabbix-1.8.1/create/schema
shell> cat mysql.sql | mysql -u<username> -p<password> zabbix
shell> cd ../data
shell> cat data.sql | mysql -u<username> -p<password> zabbix
shell> cat images_mysql.sql | mysql -u<username> -p<password> zabbix
```

To compile the server code, `cd` back to the root of the extracted `zabbix-1.8` source directory, and run the following command to compile the server binaries to have support for MySQL, SNMP and Jabber:

```
shell> ./configure --enable-server --with-mysql --with-net-snmp
↳ --with-jabber --with-lib-curl
shell> sudo make install
```

```
shell> ./configure --enable-agent --enable-static
shell> sudo make install
```

I recommend building static binaries for the clients. This helps when deploying the client across different (Linux)



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versions. Although the `make install` command builds and installs the server binary `zabbix_server`, it does not build the client agent binary. To compile the client binaries, `cd` into `zabbix-1.8.1/src/zabbix_agent`, and run another `make install`. The binaries then are installed into `/usr/local/sbin`—the same location for the server binary:

```
shell> ./configure --enable-agent --enable-static
shell> cd src/zabbix_agent
shell> sudo make install
```

Two `zabbix` binaries are compiled: `zabbix_agentd` and `zabbix_server`. The latter is used to run the client from a superserver, such as `inetd`, and the former runs as a `dæmon`. It's recommended to run the `zabbix_agentd`.

### Server and Client Configurations

Zabbix uses one configuration file for the server and another for the client. Sample configuration files are available in the `zabbix-1.8.1/misc/conf` directory. Make a directory called `/etc/zabbix`, change the ownership of the directory to the user `zabbix`, and copy the `zabbix_server.conf` and `zabbix_agentd.conf` files to this directory.

There isn't much to change in either of the configuration files, but they are well documented within the files themselves. Two configuration parameters in the client `zabbix_agentd.conf` file that should be changed are the lines `Server=` and `Hostname=`. The first should point to your Zabbix server and the second should be the hostname of the client.

With the exception of maybe the `DBUser` and `DBPassword` parameters in the `zabbix_server.conf` file, nothing else needs to be changed if you're running a site with less than a few hosts. Look through both configuration files and refer to the Zabbix documentation for any variables that could be helpful to your site.

### Startup Scripts

You can find several startup script examples within the `zabbix-1.8.1/misc/init.d` directory. Copy the one for your installation to `/etc/init.d`, and make any necessary changes. For Ubuntu, I used the scripts located in the `debian` directory. In both the server and agent configuration files, I needed to change the location of the binary from `/home/zabbix/bin` to `/usr/local/sbin`.

### Zabbix Web Front End

The `zabbix-1.8.1/frontend/php` directory contains the Web-based front end to Zabbix. Copy this directory structure somewhere below Apache's `DocumentRoot`, and load that URL in your Web browser. You will be greeted with the Zabbix Introduction screen (Figure 1). This wizard-like page steps

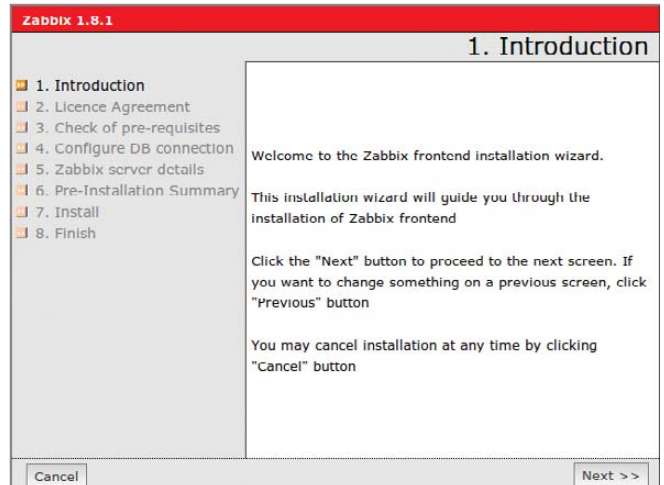


Figure 1. Zabbix Introduction Screen

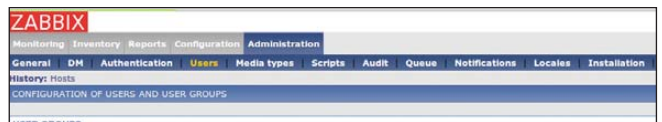


Figure 2. Front-End Options

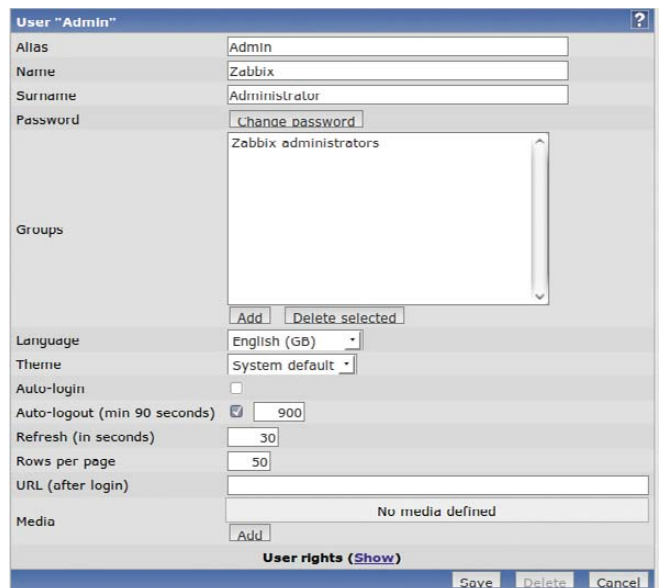


Figure 3. Admin User Configuration Page

through your configuration and presents you with a License Agreement. The next screen details any configuration changes that need to be made before continuing, such as PHP memory and execution time settings.

Once past the configuration screen, the main login screen loads. The default account is `Admin` with the password `zabbix`. Of course, once you're logged in, change the default password. The front-end layout consists of two

# Start Quick, Finish Reliably

rows of options (Figure 2). Click Administration, then Users. Make sure the pull-down menu located on the right side of the screen has Users selected instead of User Groups. Next, click on the admin user. A configuration page for the Admin user is shown (Figure 3). First, change the password. Also, add an e-mail address (click Add next to the Media line), as we're going to configure alerts to be sent via e-mail later in this article.

## Adding a Host

Three files need to be copied to a new client: the zabbix\_agentd client binary to /usr/sbin, the zabbix\_agentd.conf configuration file to /etc/zabbix and an init script. Edit the zabbix\_agentd.conf configuration file, and change the line that reads Server= to equal the Zabbix server name, and change the Hostname= line to equal the client hostname. Once completed, start up the zabbix agent with the init script.

Back on the Zabbix server Web page, click Configuration→Hosts within the Web front end. Make sure Hosts is selected in the pull-down menu on the right-hand side of your screen, and then click the Create Host button. The Hosts configuration screen appears (Figure 4). You can give your host any name you choose, but I recommend staying with the short hostname (hostname -s) instead of a fully qualified domain if you can. Add it into the Linux servers group, and populate the DNS name with the fully qualified DNS name. I could choose to monitor this host with its IP address, but I'll trust that DNS always will be up to date. The only other change to this page is to click Add under the Linked templates area. Click the radio button next to Template\_Linux and choose Select at the bottom of this pop-up window. Back at the Host screen, click Save. All the monitoring Items and Triggers included in the Template\_Linux will be added to the client.

The Zabbix monitoring structure starts with Items (checks or collects data), then Triggers (monitors data in Items) and finally, Actions (e-mail, SMS or run scripts).

## Items

Items can be considered the "data collectors". Some items are built in to the agent binary, and others will be custom scripts. After installing Zabbix, you will have a range of templates that contain these Items for common operating systems checks,

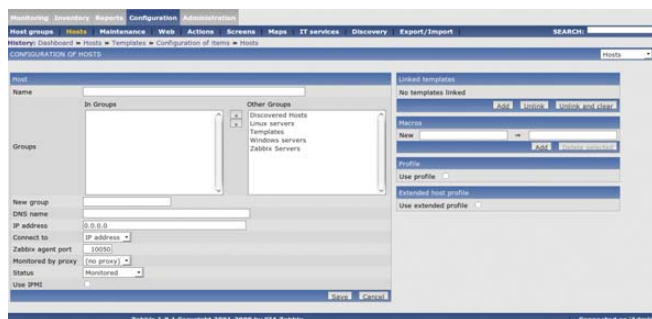
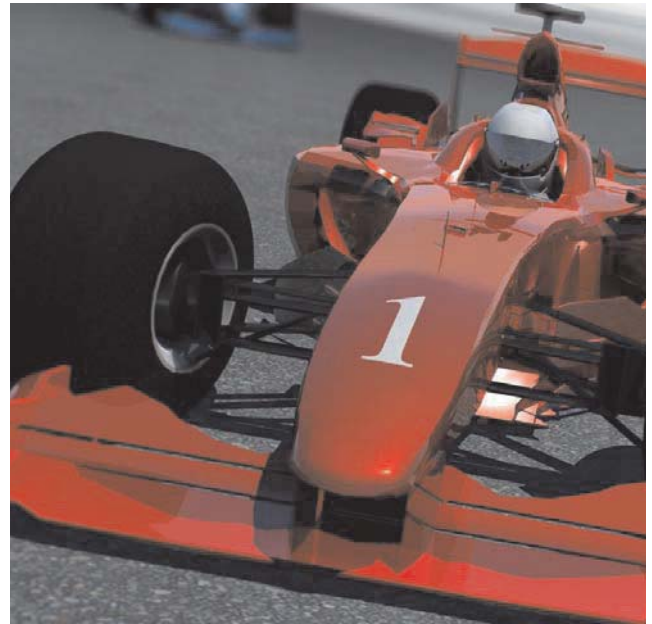


Figure 4. Host Configuration Screen



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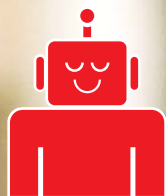
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# Lullabot- Powered

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such as Linux, Solaris, MAC OS X and Windows systems.

Let's look at the template we used with our first client. Using the Global search box at the upper right-hand side, search for "Template\_Linux". The search results should return a page that has links to the Items, Triggers or Graphs for this template (Figure 5). Select the Items link. All these Items will be monitored on any host that has the Template\_Linux template applied to it, such as the first host configured above.

Click the Item called Free disk space on /. Here are all the details for this Item (Figure 6). Most fields are self-explanatory, but here are few important ones:

- **Description:** a free form field that describes the check. Note that in the free disk space check there is a \$1. Zabbix replaces this with the first field in the key (explained later).
- **Type:** a Zabbix agent type is a check preformed by the agent running on the client at defined intervals. A Zabbix agent check is compiled in the binary, such as checking free disk space, number of free/used inodes or a custom written script. Another type is a Zabbix Trapper. A Zabbix Trapper acts like an SNMP trap. Its value is updated only when the client sends the update by running the binary zabbix\_sender. For example, say you have a cron job that takes 30 minutes to finish. Normally, the Zabbix server will time-out waiting for a response from the client running this script. A better way would be to add a line in the cron job script to update the Zabbix server when it's finished using the zabbix\_sender program. Another type of check is called Simple checks. This is used for agent-less clients—for example, pinging a host or checking a specific port (e-mail, SSH and so on) with an external host.
- **Key:** this field is the "expression" that Zabbix will check. It can be a built-in key, such as the free disk space Item (vfs.fs.size[/,free]) or a custom script that you wrote. The documentation details all the built-in keys and expressions that can be used.

You also can tell Zabbix what type of data is going to be returned: text, characters or numbers and a multiplier for that value. Also, you can specify for how long you want fine-grained graphs (history) and trends. The Applications section is where you can group similar checks. For example, if you were adding another filesystem item, you would add

it to the Filesystem application.

## Triggers

Select the Triggers link from your Global search results (Figure 5). A trigger in Zabbix monitors the data that the Items collect. If the data exceeds a configured threshold, it's assigned to one of six severity levels. Figure 7 shows the triggers that come with Template\_Linux. Displayed are the severity level, status, description and an expression that

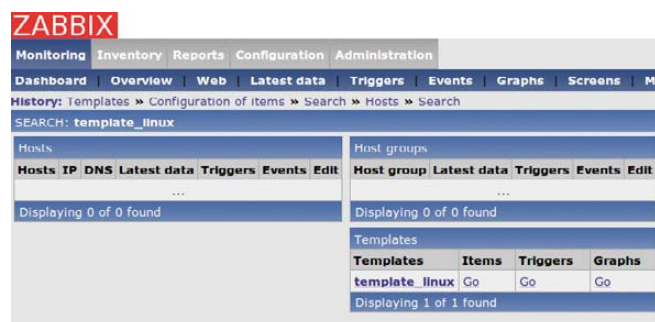


Figure 5. Template\_Linux

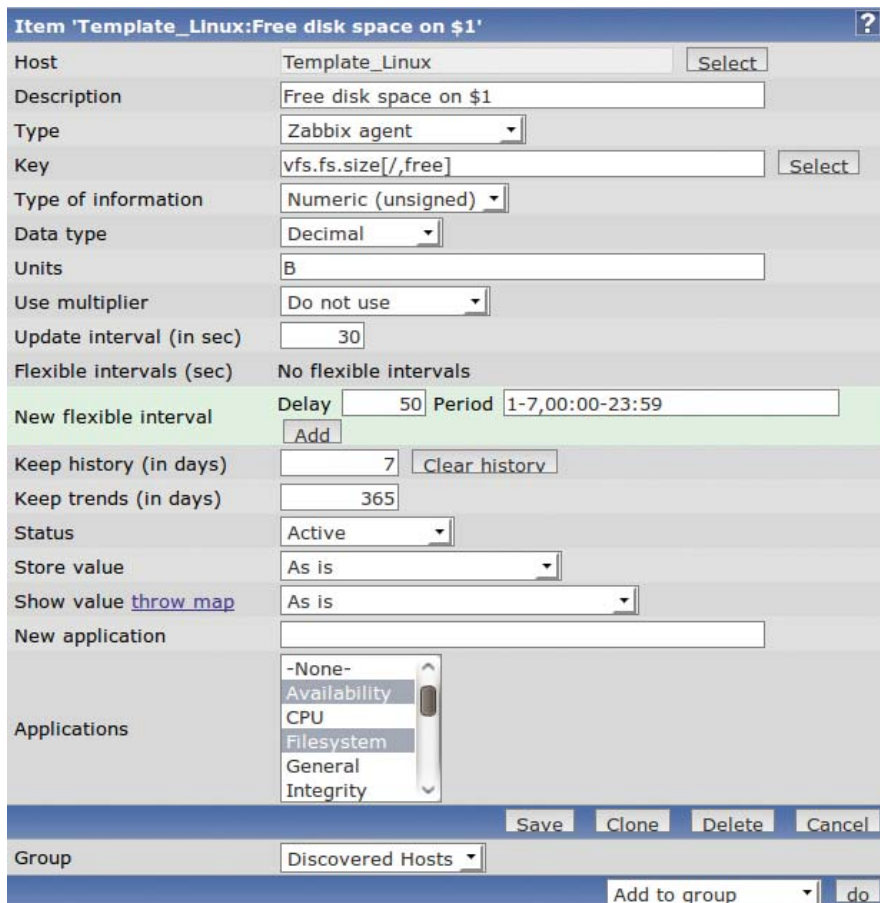


Figure 6. Free disk space on / Item

## One of the screens I find most informative is the Status of Triggers Web page.

Severity	Status	Name	Expression	Error
Warning	Enabled	localhost.conf has been changed on server.Template_Linux	{Template_Linux.vfs.fs.size[/etc/hosts.conf].diff(0)}>0	
Average	Enabled	/etc/passwd has been changed on server.Template_Linux	{Template_Linux.vfs.fs.size[/etc/passwd].diff(0)}>0	
Average	Enabled	/etc/services has been changed on server.Template_Linux	{Template_Linux.vfs.fs.size[/etc/services].diff(0)}>0	
Average	Enabled	/usr/bin/sash has been changed on server.Template_Linux	{Template_Linux.vfs.fs.size[/usr/bin/sash].diff(0)}>0	
Average	Enabled	/usr/sbin/rsyncd has been changed on server.Template_Linux	{Template_Linux.vfs.fs.size[/usr/sbin/rsyncd].diff(0)}>0	
Warning	Enabled	crontab has been changed on server.Template_Linux	{Template_Linux.vfs.fs.size[/etc/crontab].diff(0)}>0	
Average	Enabled	Apache is not running on Template_Linux	{Template_Linux.proc.net[http]}>1	

Figure 7. Template\_Linux Triggers

Trigger "Low free disk space on (HOSTNAME) volume /"

Name: Low free disk space on (HOSTNAME) volume /

Expression (Toggle input method): {Template\_Linux.vfs.fs.size[/,pfree].last(0)}<10

The trigger depends on: No dependencies defined

New dependency: Add

Event generation: Normal

Severity: High

Comments:

URL:

Disabled:

Buttons: Save, Clone, Delete, Cancel

Figure 8. Trigger Configuration Screen

makes up the trigger. Click on the trigger named Low free disk space on Template\_Linux volume /, and the trigger configuration screen should come up (Figure 8).

The first field, the Name field, should describe the problem. For instance, "IMAP port not responding on server123" is better than "E-mail down". This most likely will be the text that you're going to receive in an e-mail, page or SMS message, so a clear, descriptive name will be very helpful at 2am should that call occur.

The Expression field is what Item this Trigger is going to monitor and what its thresholds are. Our expression for this trigger is configured with {Template\_Linux.vfs.fs.size[/,pfree].last(0)}<10", which loosely reads, "Monitor the host called Template\_Linux and its key vfs.fs.size[/,pfree]. If the last value it returned is less than 10, assign it a severity level of High." Click Select. From here, you can change the expression to trigger on averages, absolute values or maximum values for a period of time. For now, I'll leave the trigger function as is, except I want to change at what value it triggers. So close the Condition pop-up window and change the expression to 5% by changing the value from 10 to 5 at the end of the line. Click Save to make the changes.

### Actions

Actions occur when a trigger is activated. They can be via e-mail, Jabber, SMS message or running a remote script. Let's configure an action to e-mail the admin if any trigger with level Disaster has been activated. Select Configuration→Actions, and then the Create Action button on the right-hand side of the screen. The Configuration of Actions screen should be visible (Figure 9). Name it something helpful, then click the New button under Action conditions. Choose Trigger severity from the Information to Disaster. Click Add when finished. Next, select the New button in the Action operations area.

ZABBIX

Monitoring Inventory Reports Configuration Administration

Host groups Hosts Maintenance Web Actions Screens Maps IT services Discover

History: Configuration of actions » Hosts » User groups » Users » Configuration of actions

CONFIGURATION OF ACTIONS

Action

Name:

Event source: Triggers

Enable escalations:

Default subject: {TRIGGER.NAME}: {STATUS}

Default message: {TRIGGER.NAME}: {STATUS}

Recovery message:

Status: Enabled

Buttons: Save, Cancel

Action conditions

Conditions: No conditions defined

Buttons: New

Action operations

Details Action

No operations defined

Buttons: New

Figure 9. Configuration of Actions Screen

Action operations

Details Action

No operations defined

Edit operation

Operation type: Send message

Send message to: Single user Admin

Send only to: Email

User medias: Email ptader@linuxscope.com 1-7,00:00-23:59; NIWAHD

Default message:

Buttons: Add, Cancel

Figure 10. Configuring the Operation

Configure the operation to send a message to a single user named admin (Figure 10). Click Add when done. Finally, click the Save button. Now, any trigger that you assign the severity level of Disaster will result in an e-mail being sent to the Admin user. You can create Actions for a single trigger from a specific host if needed, but the action above can be treated like a "site-wide" action.

### Daily Monitoring

There are several ways to monitor the clients you have configured. One of the screens I find most informative is the Status of Triggers Web page. Click Monitoring→Triggers (make sure Group and Host have "all" listed from the pull-down on the right-hand side of the screen). On this screen, Zabbix lists all the triggers that have been activated, their assigned severity level, the date of last change and short description as well as an Acknowledged and Comments column. This could be considered a sysadmin's to-do list. ■

Paul Tader is an independent consultant implementing open-source solutions in the Chicago area, where he has run every Linux and BSD flavor since the mid-1990s as well as instructing Linux certification courses at a local college. Feel free to contact Paul at ptader@linuxscope.com.



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# Markets in Three Dimensions

Moving beyond the horizontal. DOC SEARLS



Old analog televisions had controls called horizontal and vertical. One kept the picture from falling over sideways, while the other kept the picture from sliding off the top or the bottom of the screen.

I think we need similar controls in our heads when we look at the product categories we call markets.

In the world of free software and open source, we mostly care about the horizontal: creating code, standards and other means for expanding markets sideways, toward the horizons. We work to keep both developers and users free from capture in the vertical markets we call silos, so they can do more stuff in more ways. We don't often ask "Where would we be without silos?" because we know. We would be free to build and use anything we want, out in the market's wide-open spaces.

Still, innovation happens in silos too. Many of the technical graces we take for granted would not have happened outside the walls of silos built by Apple, Canon, IBM, Intel, Sony and other large companies with ample and hardened intellectual property portfolios. Linux itself was developed originally (and still primarily) for Intel's x86 CPUs. Much of what we take for granted in chips from Intel and other makers is thick with intellectual property protections we would hate to see applied to our own software work. Every large maker of original electronic products (including all the companies listed above) produces between dozens and thousands of new patents every year, adding to portfolios that muscle licensing income and deals of many other kinds. Occasionally, companies do battle in court, but most of the time the dealing is quiet. If revealed, it is only through pro forma small-print disclosures in documentation.

What matters is that these portfolios give large makers the confidence and security they feel is required to produce original and appealing goods for which there is little or no competition. This is an ideal to which Apple, for example, constantly aspires. Back in 1997, not long after Steve Jobs returned to lead Apple after a long interregnum, he killed off cloners of the company's computers. Here's what I wrote about it at the time in an e-mail to Dave Winer (which Dave later published):

To Steve, clones are the drag of the ordinary on the innovative. All that crap about cloners not sharing the cost of R&D is just rationalization. Steve puts enormous value on the engines of innovation. Killing off the cloners just eliminates a drag on his own R&D, as well as a way to reposition Apple as something closer to what he would have made the company if he had been in charge through the intervening years....

Now Steve is back, and gradually renovating his old company. He'll do it his way, and it will once again express his Art.

These things I can guarantee about whatever Apple makes from this point forward:

1. It will be original.
2. It will be innovative.
3. It will be exclusive.
4. It will be expensive.
5. Its aesthetics will be impeccable.
6. The influence of developers,

even influential developers like you, will be minimal. The influence of customers and users will be held in even higher contempt.

The iPod, iPhone and iPad each not only fulfilled all six of those requirements, but also redefined their market categories in the vertical dimension. That is, they grew the range of things that could be done with a given device, and the size of its marketplace. The iPhone in particular redefined the smartphone market and enlarged it far beyond the narrow range of possibilities allowed by combinations of mobile phone makers and mobile phone companies. New kinds of applications by the thousands burst out of the ground like a geyser. But all are contained inside Apple's silo, where they move only through the company's sphinctered approval and sales processes.

In fact, far more can be done on Linux (notably Android) and Symbian OSes than on iPhone's, just given the open nature of the former and the closed nature of the latter. But, thanks to Apple, there is much more to imagine doing outside that company's closed and private silo.

This is the point at which some suggest that open-source goods are derivative, rather than original. But that's not the case. We still happen to live in a time when investment in closed, and original stuff is greater than investment in the open and original kind. As long as that's still the case, we'll have the Apples of the world aiming for the heights while the rest of us build out the widths and the depths that characterize wide-open marketplaces. ■

---

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

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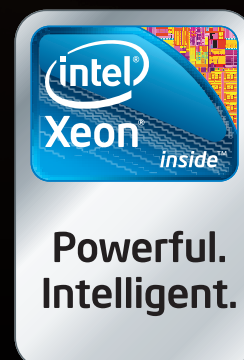
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