Expert techniques for getting more from Knoppix

KNOPPIX TRICKS

Knoppix creator Klaus Knopper shares some tips for using Knoppix in the real world. **BY KLAUS KNOPPER**

Knoppix is a full Linux system on a removable disk. You can plug your Knoppix disk into almost any Intel-compatible computer and boot Knoppix – regardless of what system is on the hard drive. But unlike many bootable Linux distros, Knoppix is not intended simply as a demo system or recovery disk. Knoppix is a *real* Linux distribution capable of many of the everyday chores you would commonly expect of a hard-disk Linux.

Of course, most people think of a live distro as a tool for troubleshooting and data recovery, and Knoppix is certainly used for these tasks, but Knoppix is also capable of some equally essential but less exotic assignments.

Slip your Knoppix disk into the CD or DVD drive, and start your computer. The system boots much the same as any other Linux system. (See the box titled “Booting Knoppix.”) Once you have started the system, Knoppix looks pretty much like a “normal” and preconfigured Debian installation, apart from some automatic scripts that create Desktop icons for newly plugged-in USB devices and the automounter taking care of CD-ROMs. But is it the same?

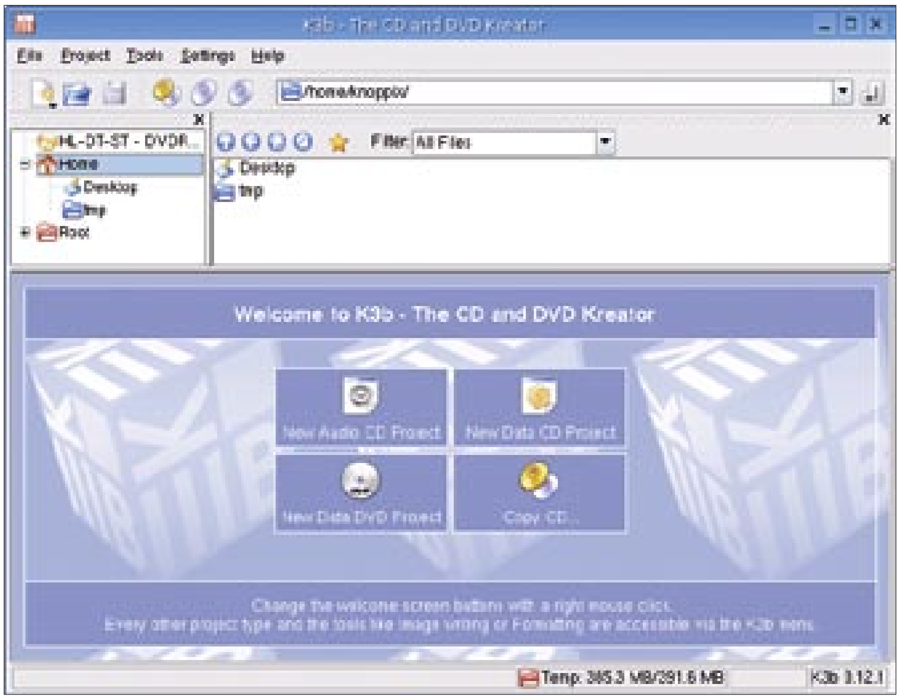
The fact that the operating system is running from a read-only medium makes some tasks more difficult – but not as difficult as you might think. In this article, I’ll describe how to use Knoppix for practical tasks such as:

- installing a new program
- burning CDs
- writing to NTFS partitions

These techniques give Knoppix a power and versatility you may not expect from a live distro, and once you master some of these tasks, you may find yourself discovering new ways to make Knoppix part of your everyday life with Linux.

Installing New Programs

With Knoppix 3.8, a new feature was introduced that made remastering Knoppix easier and added capabilities you would probably not expect in a system designed to run from a read-only medium: unionfs.



Change the welcome screen buttons with a right mouse click.
Every other project type and the tools like image writing or Formatting are accessible via the K3b menu.

Figure 1: If you don't like working from the command line, you can burn a CD with k3b.

Basically, what unionfs does is to "simply" merge directories. Example: You can merge a read-only directory (like a mounted CD-ROM) at */KNOPPIX* and a read-write but empty, writable ramdisk directory at */ramdisk*, to create a read-write and pre-populated */UNIONFS* directory that's fully writable.

In previous versions of Knoppix, there was a strict separation between read-only data and writable data, and symlinks were used to put files where they were expected in the individual directories. This system worked well, though it was complicated to maintain since, for every program added to Knoppix, you had to figure out which files were supposed to be written to and copy them to the ramdisk with a symlink on the read-only area.

Since unionfs now takes care of copying changed data to the ramdisk directory and also (seemingly) allow you to delete files on a read-only CD or DVD, you can just add your own stuff to the live system as if it were installed on a regular hard disk.

So, in theory, to install a new Debian package from the Debian mirrors listed in */etc/apt/sources.list*, we would only need to run (as root)

```
apt-get update
apt-get install pingus
```

In fact, this should work on many Knoppix versions without major problems. However, unionfs is at an early stage of development, and while the basic file operations like create, copy, rename, delete on a joined file system work fine, there are some known bugs and issues when overwriting or locking files, which is unfortunately done A LOT by programs like *update-menus* that run automatically after a program is installed. So, should you see a unionfs-related Kernel "Oops" in the output of the *dmesg* command after installing new software or updating configuration files, this is probably caused by a bug in unionfs.

A workaround for the *update-menus* case could be just removing that command using the unionfs "delete a file from an originally read-only CD" feature by just doing a

```
sudo rm -f ⮐
/usr/bin/update-menus
```

which will have the (in this case desirable) side effect of no longer automatically updating the KDE menus.

Also, minor bugs (like missing execute permissions for cdrecord in Knoppix 4.0.1) can be fixed on-the-fly without burning a new DVD by just modifying the unified live system with

```
sudo chmod 755 ⮐
/usr/bin/cdrecord*
```

It almost makes you forget that you are working without a writable harddisk when running from a CD.

For large and lengthy program downloads and installations, the "persistent Knoppix image" feature comes in handy. The persistent image feature does the

cdrecord Permissions

Remember the problem with wrong *cdrecord* permissions in Knoppix 4.0.1 that I mentioned above? To avoid unpleasant surprises, you should double-check that all */usr/bin/cdrecord** instances are executable by the Knoppix user (well, just run "cdrecord" in the shell), and fix the programs permissions in case they are wrong, using

```
sudo chmod a+x ⮐
/usr/bin/cdrecord* ⮐
/usr/bin/growisofs
```

Now we should be able to burn with all programs that use cdrecord (for CDs) or growisofs (for DVDs), such as k3b, which is integrated in the KDE menus.

Copying a Data CD or DVD for Burning

Just copying a data CD or DVD into an ISO file for later burning is easy:

```
cp /dev/cdrom ⮐
/mnt/hda2/copy-of-cd.iso
```

To obtain a copy of a non copy-protected audio CD, you would do the following. Of course, you alone must decide if this is consistent with applicable copyright laws of the nation where you reside:

```
cd /mnt/hda2
cdrdao read-cd --device ⮐
/dev/hdc --driver ⮐
generic-mmc-raw --eject ⮐
my-cd.toc
```

You can burn the CD later with:

```
cdrdao write --device ⮐
/dev/hdc --driver ⮐
generic-mmc-raw --eject ⮐
my-cd.toc
```

Of course, fans of the graphical environment could just as well use k3b for this purpose (which will call cdrecord/growisofs anyway). You just have to find the right buttons and switches.

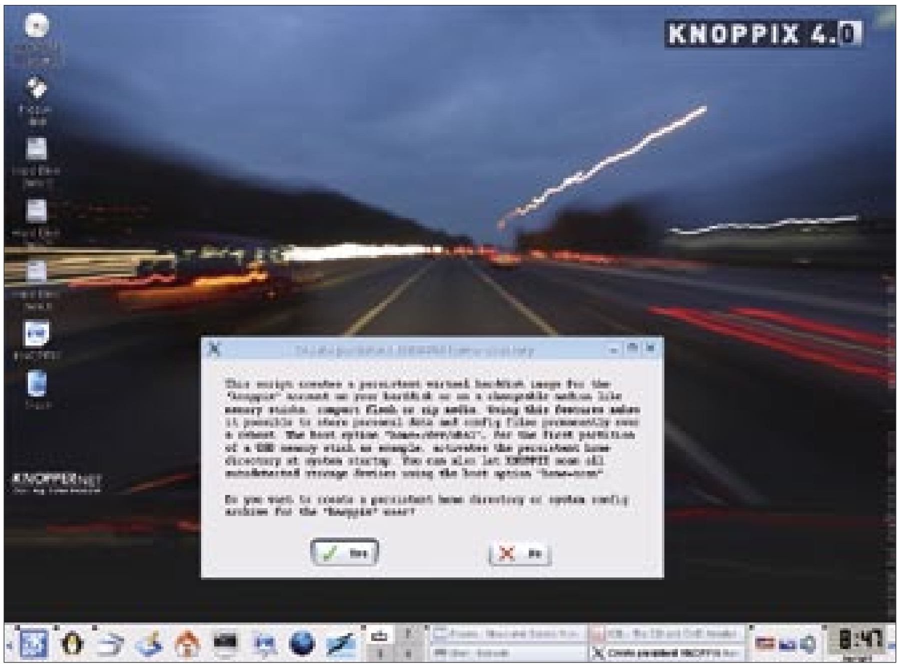
same thing the overlaid ramdisk does, just using an ext2 image on the hard disk instead of a ramdisk, and thus creating a persistent snapshot of the changes done to the CD or DVD system.

You can create this persistent image, containing all changes to the system, by calling *mkimage-knoppix* from the Knoppix menu under *Create persistent Knoppix image*. For the case of an NTFS partition, since we cannot directly write to NTFS with the Linux kernel driver, a small Windows program called *mkimage.exe* is provided inside the *KNOPPIX* directory on the uncompressed part of the CD or DVD.

Once the persistent image has been created, it has a constant size (like a virtual harddisk.) You should not make the image too small. The ideal size for the image depends on how much you intend to install or save to the writable part of the image. If you configure a printer, install one or two small programs, and execute OpenOffice once, you will already have used up 100MB or more.

Once you have created a persistent image on hard disk (or USB memory stick), the image is overlaid with the read-only DVD or CD on the next reboot, if you accept the boot option for using the image. Everything you change or save is automatically kept inside the reset-proof image.

One very important thing you need to remember about this procedure is that the image should be cleanly unmounted. In other words, a regular shutdown is required to make sure that the data from Linux's ramcache really is written. In case of emergency, a *sync* command would possibly work in this situation as well, if you need a really quick reboot using the computer's power or reset but-


This script creates a persistent virtual harddisk image for the "knoppix" account on your harddisk or on a changeable medium like memory sticks, compact flash or zip media. Using this features makes it possible to store personal data and config files permanently over a reboot. The boot option "home=/dev/sda1", for the first partition of a USB memory stick as example, activates the persistent home directory at system startup. You can also let KNOPPIX scan all autodetected storage devices using the boot option "home=scan".

Do you want to create a persistent home directory or system config archive for the "knoppix" user?

Figure 2: Knoppix 4 lets the user create a persistent disk image.

Booting Knoppix

When you boot Knoppix, the following events take place:

1. Your computer BIOS loads the *isolinux* boot loader from CD/DVD, which displays some background graphics and allows you to get help (with F2-F3) or enter kernel options.
2. isolinux loads the Linux kernel and a file called *minirt.gz*, which contains a tiny ramdisk with all drivers needed to make hard disks and (most SCSI, USB and Firewire) CD-ROMs/DVDs accessible in order to access the main Knoppix compressed file system.
3. The kernel starts all builtin drivers (i.e., IDE, SATA), decompresses the initial ramdisk, and starts the */linuxrc* script, which loads even more drivers for SCSI, USB and firewire.
4. *linuxrc* mounts the CD/DVD and loads the cloop transparent decompression block device module with */cdrom/KNOPPIX/KNOPPIX* as the input file (possibly also more cloop files containing add-ons).
5. *linuxrc* merges the read-only file system layer with a read-write dynamic ramdisk, so now we can change every file in the live session.
6. linuxrc ends, init starts and runs some scripts to investigate and make all linux-supported hardware components usable to the system (*/etc/init.d/knoppix-autoconfig*).
7. The *libkudzu*-based *hwsetup* utility loads all drivers corresponding to any hardware found and generates a hardware info file that is used by mkxf86config to create the setup file for the X server.
8. KDE starts.

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ton. But this alternative solution should be an exception.

Burning CDs or DVDs using Knoppix

Burning a CD can be difficult if you have only One CD- or DVD-writer that is already used by Knoppix. However, you can try to free the device by copying the contents of the Knoppix-CD or DVD to the hard disk, and just loading the kernel and *initrd* from the DVD drive, while running the rest from the copy on the hard drive. As of this writing, NTFS partitions are not supported for this way of booting. However, using a FAT32 or ext2 partition, you can do this by typing (for the second partition on the first hard disk on your IDE controller):

```
knoppix tohd=/dev/hda2 dma
```

at the boot prompt. This command tells Knoppix to copy all the required files to the hard disk partition and run from there. In the next session, use:

```
knoppix fromhd=/dev/hda2 dma
```

to just reuse the previously copied Knoppix instead of copying everything again. The *dma* option speeds up hard disk access by about a factor of five for most boards. If you have a board that does not support DMA, however, you should not use this option, since it can corrupt data.

Troubleshooting the Knoppix Boot Process

Now, we all know that hardware is evil, incompatible, and badly designed – nothing works as it should. RAM either misbehaves or is overclocked, interrupts run amok, and the I/O address scheme from the computer stone age is still alive and kicking in the 21st century. What can we do if the Linux kernel encounters broken hardware or badly configured firmware? For example, what if the system comes across a BIOS version that is simply non-functional unless you add a proprietary "system board" driver that exists only for proprietary operating systems?

Luckily, the Linux kernel already contains many automatic workarounds for BIOS software and broken hardware (remember the first Pentium CPUs that returned wrong results for certain arithmetic operations?), so in most cases, Linux will just print a warning message about activating a workaround and continue. This is not possible in all cases – sometimes everything seems to be detected, but, for example, the network card is not working, or USB devices are not recognized, or even worse, if PCMCIA devices freeze the entire system when initialized.

The following boot command line works with most broken BIOSes:

```
knoppix nosmp acpi=off ➘
noapic pnpbios=off pci=bios
```

The command line options have the following effects:

- *nosmp* – switch off multiprocessor and hyperthreading support for the board (some boards don't actually have a second processor, but they are kind of schizophrenic and throw errors, thinking they have).
- *acpi=off* – switch off the automatic configuration and power management function of newer boards. Some of the boards simply have a broken BIOS implementation of ACPI or need special configurations in order to work correctly. Some other boards, on the other hand, require *acpi=force* because they have a broken "fallback" if ACPI isn't activated.
- *noapic* – If some hardware components are correctly detected but just don't respond to anything, try this. It switches off the "let it look like we have more interrupts than we actually have to avoid hardware conflicts in proprietary operating systems" chip on some boards. Actually, this feature is not actually as bad or nonsensical as I have just described, but it's simply broken on many boards. If you mostly have PCI cards that can use interrupt sharing, you won't need APIC. Don't confuse APIC with ACPI. It's not the same. Both can be broken, independently of one another. If you are in doubt, switch both off. Like with *acpi=off* before, there are boards that, for an unknown reason, won't work with *noapic*.
- *pnpbios=off* – switch off automatic ISA "Plug and Play." Well, sometimes this helps if your board thinks it is a good idea to reserve a lot of interrupts for non-existing devices or to claim interrupts that should stay with onboard (PCI-bus) components.
- *pci=bios* – let the BIOS use the user-defined settings (like interrupts) for each device; don't try to read the interrupt configuration directly from the specific device. This works better for older computers; it just uses what the BIOS knows best about your hardware configuration.

There are more options for the boot command line: some are direct switches for the Linux kernel, and some are just used within the Knoppix hardware detection scripts. For example, if a graphics card incorrectly identifies itself as a SCSI controller (yes, I have seen this…), thus causing a system freeze when the "matching" SCSI driver is loaded by Knoppix, and you are confident that there is really no SCSI controller in your computer that you would need, try booting with

```
knoppix noscsi
```

Also, you may have to change the screen resolution if your display (as it is the case for most notebooks) does not support DDC autodetection of the "favorite" resolution modes. The following command should work for a 75Hz 1280x1024 TFT display:

```
knoppix screen=1280x1024 ➘
vsync=75 hsync=90
```

Note that the "text" resolution is always set to 1024x768 by Knoppix, unless you add the *vga=normal* option or just the *vga=<mode number>* options from the table shown in */usr/src/linux/Documentation/fb/vesafb.txt*.

If you are going to use a video projector for a presentation, and (did I mention that hardware was evil?) the video port on your laptop isn't working, try the *framebuffer-only* mode of Knoppix:

```
fb1024x768
```

Note that this boot command line is typed WITHOUT the prefix *knoppix* that you have seen in the example before, mostly because it REPLACES options from the default line. For some notebooks, you still have to manually activate the video port with some function key combination, but if you are in *framebuffer* mode, once you get *textmode* to display on the video projector, X/KDE will work as well.

If you are in the mood to investigate more of the options that were put into the Knoppix autoconfiguration when they were needed for a special case, see the *KNOPPIX/knoppix-cheatcodes.txt* file on your Knoppix CD.

(The possibility of data corruption is the reason this option is not the default in Knoppix, even though very few boards have this problem.)

You can also boot a completely diskless Knoppix over the network. Just launch the *knoppix terminalserver* on one computer on your LAN, and boot another system via PXE or a network boot disk that you can fetch from *www.rom-o-matic.net* for your specific network card. For Knoppix 4.0.1, you will need to fix the *knoppix-terminalserver* scripts, though, with a hotfix patch available on the DVD mirrors.

Now that the DVD or CD writer is free for burning CDs or DVDs, you can start to burn stuff right away. (See the box titled "cderecord Permissions.")

You can just burn any directory that appears in Konqueror by hitting the right mouse button over the directory icon and selecting *burn data CD with k3b*. Professional users who prefer the command line may want to issue the following command in order to create a bootable Knoppix DVD from a modified copy on hard disk:

```
growisofs -dvd-compat -Z ➘
/dev/hdc -no-emul-boot ➘
-boot-load-size 4 ➘
-boot-info-table -b ➘
boot/isolinux/isolinux.bin -c ➘
boot/isolinux/boot.cat -l -r ➘
-J /mnt/hda2/copy-of-➘
knoppix-dvd-content
```

The preceding command assumes you have a writable partition */mnt/hda2* containing a copy of the Knoppix DVD (the files, not the ISO) in the "copy-of-knoppix-dvd-content" directory.

Writing to NTFS Partitions

As you may have read, support for NTFS partitions is more-or-less limited to read operations, due to patents, licensing issues, and last but not least, the lack of usable vendor specifications. The existing open source NTFS read support in the kernel, created by a lot of work-intensive reverse engineering, works pretty well and is good for rescue tasks, such as copying data from a non-booting system to a safe place.

The only write operation the kernel ntfs driver supports at this point is overwriting files without changing their length. (This option is used by Knoppix for the persistent Knoppix image, as described earlier in this article.)

But recently, the Open Source *linux-ntfs* library (not the kernel-driver, which is derived from it) has advanced to allow limited write operations on an NTFS partition. Using the current CVS snapshot of *libntfs*, you can now:

- delete files and directories
- create up to 9 new files or subdirectories within a directory

These options are sufficient for many things that were not possible before.

Since it would be complicated to recompile every program to use *libntfs* for write operations (remember, the kernel module is about half a year behind libntfs), we can use the FUSE kernel module and an utility called *ntfsmount* to actually mount an NTFS partition.

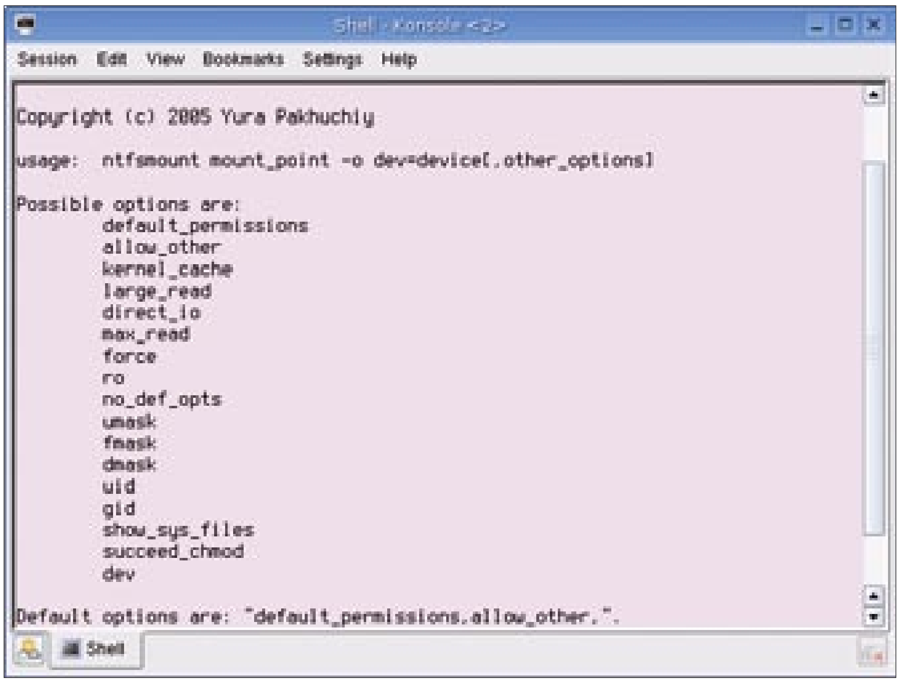
Following is a small HOWTO from the current Knoppix DVD, which explains how to use FUSE and *libntfs* for mounting an NTFS partition read/write, so you can delete or add files with the limitations mentioned above. Check out *KNOPPIX/linux-ntfs/FOR-DEVELOPERS.txt* on your Knoppix CD or DVD for this. Please keep in mind that this is still an experimental feature, so make sure you have a backup of all your important data before attempting this:

1. Load the "Filesystem in Userspace" module: *sudo modprobe fuse*
2. Make the NTFS partition accessible for unprivileged users (in the case of our example, partition 1 on the slave hard disk attached to IDE controller 2 */dev/hdd1*): *sudo chmod 666 /dev/hdd1*
3. Create a mountpoint in your user home directory: *mkdir $HOME/ntfs*
4. Mount the partition read/write into *$HOME/ntfs ntfsmount $HOME/ntfs -o dev=/dev/hdd1,force,umask=000*
   You should now be able to access the contents of the NTFS partition at *$HOME/ntfs*, but don't forget the next step.
5. As a normal "umount" is likely to not succeed with FUSE, use the following command when you are finished experimenting: *fusermount -u $HOME/ntfs*

After Step 4, you should also be able to access and browse the NTFS partition from KDE with *konqueror $HOME/ntfs/* Be very careful not to mount the same partition twice, once with the kernel module and again with ntfsmount; otherwise your kernel may get confused.

Conclusion

In this article, I described how to install a program, free the CD-ROM drive, and write to NTFS partitions in Knoppix. I hope these techniques bring you a world of new possibilities for using Knoppix in practical situations. ■



```
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usage:  ntfsmount mount_point -o dev=device[,other_options]

Possible options are:
        default_permissions
        allow_other
        kernel_cache
        large_read
        direct_io
        max_read
        force
        ro
        no_def_opts
        umask
        fmask
        dmask
        uid
        gid
        show_sys_files
        succeed_chmod
        dev
Default options are: "default_permissions,allow_other,".
```

Figure 3: Use the ntfsmount utility to mount an NTFS partition in Knoppix.