Booting Linux from a USB Memory Stick

Linux on a Stick

Everyone knows you can boot Linux from a live CD, but have you thought about putting Linux on a compact and highly portable USB memory stick? BY FABRIZIO CIACCHI

A bootable "live" CD like Knoppix [1] or Kanotix [2] gives the user a fully portable operating environment. You can carry your system with you and boot it from anywhere.

Your tools, your files, and your workspace will follow you wherever you go – even to another PC with a different operating system. Live CDs are also used by system administrators for troubleshooting computers that won't boot normally.

What could be more portable than a live Linux CD? What about a live Linux USB memory stick? A tiny USB memory stick is even more portable, and often more durable, than a CD, and writing to USB memory is typically smoother and faster than the business of "burning" data to a CD.

With some tricks and a bit of work, you can configure a Linux distribution to boot from a USB memory stick. All you need is a memory stick and a suitably small Linux distribution. Of course, this trick only works if the BIOS of the PC you are booting supports USB boot.

Getting a Little Linux

USB memory sticks come in different sizes. Some hold as much as 1 GB, which would pose few limitations to the size of the on board operating system, but smaller sticks are less expensive and much more common. Part of our purpose is to create an inexpensive system, so I will base this discussion on the standard and very common 128 MB size. However, the procedure I describe in this article can also be used to put a larger Knoppix-based distribution on a larger USB memory stick.

Assuming you want room to work and store documents, it is a good idea to only use half of the available space (64 MB) for the Linux system and related tools. Obviously, it would be very difficult to include useful but expansive tools such as OpenOffice or the Gimp.

Luckily, several developers in the Linux community are already working on the problem of how to put Linux in a very small space. The following distributions are possible candidates for USB:

- **Damn Small Linux** [3]: The Damn Small Linux (DSL) distro is based on Knoppix (and Debian [11] too), but the author has reduced the size to only 50 MB by deleting some documentation and radically optimizing nearly every directory. Damn Small Linux can boot a graphical environment with a Fluxbox like Window Manager.
- **RUNT** [4]: RUNT (ResNet USB Network Tester) is a distribution based on Slackware [5] that can work on a 128 MB USB memory stick. The distribution can be booted using a boot floppy (available on the site) that works also for ZipSlack [6]. RUNT is used mainly in network environments and contains a lot of networking tools.
- **Feather Linux** [7]: The Feather Linux distribution is based on Damn Small Linux (DSL) [3] and is also suitable for a 128 MB USB stick. It's not so different from DSL, but it includes more software (about 14 MB plus), and it has already been refined and tested for USB devices.
- **Flonix** [8]: Flonix is also based on DSL, but it uses some different programs (for instance, IceWM instead of Fluxbox). The Flonix project also introduced a useful web install process. Ultimately, Flonix was so successful that it become a commercial project and is no longer available as a free version to download. But if you search on Internet, you may find an older (free) Flonix image to use for your memory stick.
- **Puppy Linux** [9]: Puppy Linux is a young project that has some useful features. First of all, it all loads in RAM so it is very fast; you need at least 128 MB of RAM. Puppy Linux is bootable from many types of devices (harddisk, CD, USB), and it contains very thin and fast programs. (The size of the complete distribution is 50 MB.) You can start an X session with FVWM-95 Window Manager.
- **SPB-Linux** [10]: SPB-Linux is a modular distribution that is very small and very powerful. It cannot use X, but it is based on directFB with the Sawfish Window Manager. It contains programs such as Firebird, Java, and Mplayer. SPB-Linux is a good project that is well documented.

For this example, I chose to install Damn Small Linux (DSL) [3] because DSL is the most flexible of the distributions I found. Flonix and Feather Linux are based on it, and its size is about 50 MB, so it would work for an even smaller 64 MB memory stick if necessary.

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Installing on a Stick

The first step is to back up all the data that is currently on the memory stick. Insert your USB stick, open a terminal, and write:

```
$ su
Password: - insert Root ⏎
password and press ENTER -
# mkdir usb_pen
# mkdir usb_backup
# mount -t vfat /dev/sda1 ⏎
usb_pen
# cp -a usb_pen/* usb_backup
# umount usb_pen
```

Now that all your data is safety stored, you need to format your memory stick to reduce your chances of encountering a problem during boot. To perform this operation, give the following command as root (when the pen is inserted but not mounted):

```
# fdisk /dev/sda
```

When fdisk starts, press *p* to see the list of all the partitions on your media (generally one), then press *d* to delete the first partition. If you have more than one partition, make a backup of all partitions (ie. sdal, sda2, etc.), then delete them all. When all the partitions are deleted, follow the instructions in fdisk to create a FAT16 primary partition and make it bootable.

The next step is to download the ISO image of Damn Small Linux [12]. The size of the image is about 50 MB, so the download might take a while depending on your Internet connection. When you have downloaded the file, open a console, use the *su* command to log in as root, and go to the directory with the *dsl-0.8.3.iso* file. Then execute the following commands:

```
# mkdir dsl_temp
# mkdir dsl_usb
# mount -o loop dsl-0.8.3.iso ⏎
dsl_temp
# cp -a dsl_temp/* dsl_usb
```

At this point you have copied the content of the iso image into a new directory so you can work on it. If you try to copy this data directly to the USB memory stick, it will not boot because we need to fix the position and the naming of files. With the console opened, enter the following commands:

```
# cd dsl_usb/
# mv boot/isolinux/* ./
# rmdir boot -r
# mv isolinux.bin syslinux.bin
# mv isolinux.cfg syslinux.cfg
# cd ..
```

The last part is very simple; mount the USB memory stick, copy all the data to it, and, after *umount*, use the syslinux program to make it bootable.

```
# mkdir usb_pen
# mount -t vfat /dev/sda1 ⏎
usb_pen
# cp -a dsl_usb/* usb_pen
# umount usb_pen
# syslinux /dev/sda
```

Now reboot your computer, leaving the memory stick inserted, modify the BIOS boot device, and let the system boot to DSL on the memory stick.

As I mentioned, this process only works if your computer can boot from a USB device. In addition, a USB device with a non-standard Master Boot Record (MBR) may have problems supporting system boot under Linux. See "Common Problems" for more information. ∎

Common Problems

The most common problems you may face when implementing this system are:

• a BIOS that does not support (or is not configured for) USB boot;

• a USB device with a non-standard boot system, so that it won't boot even if you have set up everything correctly.

First of all, you need to check in the BIOS (usually you can enter into it by pressing *del* or *F1*) if the USB-keyboard and the USB-legacy options are enabled; then, you need to insert your USB memory stick and check in the boot device sequence if there is an option for booting from USB. (*Boot from Zip USB* is sometimes a good choice.) Then select the USB device as the first boot peripheral.

A USB boot option may not be available on some computers, since support for USB boot was introduced only in recent years. You can bypass this problem if you use a boot floppy that loads the USB modules and searches for the Linux distribution on the USB media. Of course, carrying around a boot floppy with the Linux memory stick isn't as appealing as booting directly from the memory stick, but if your computer doesn't support USB boot, this alternative option may still provide

some of the portability benefits described earlier in this article. You'll find a floppy image that supports USB boot at the DSL site [13]. When you have downloaded the file, you can create a floppy, by typing this command as root:

```
# dd if=bootusb-0.8.img of=/⏎
dev/fd0 bs=1024 conv=sync ; ⏎
sync
```

Then shut down your computer, insert the USB memory stick and the floppy, turn on the computer, and select the floppy as the first boot device in the BIOS.

Another possible problem, which is independent of whether you are booting to a floppy or directly to USB, is that some USB devices may not support the booting procedure. This problem can be caused by a non-standard MBR for the USB device. For this article, I used a 128 MB Iomega Mini Drive (www.iomega.com), which worked properly with a good transfer speed, but some of the devices I tested did not support this boot process. To address this problem, SPB-Linux provides a program that implements an alternative boot sector on the USB device to support USB boot [14].

INFO

[1] Knoppix homepage: *http://www.knoppix.net*

[2] Kanotix homepage: *http://kanotix.com*

[3] Damn Small Linux: *http://www.damnsmalllinux.org*

[4] RUNT: *http://www.ncsu.edu/project/runt*

[5] Slackware: *http://www.slackware.com*

[6] ZipSlack: *http://www.slackware.com/zipslack*

[7] Feather Linux: *http://featherlinux.berlios.de*

[8] Flonix: *http://www.flonix.com*

[9] Puppy Linux: *http://www.goosee.com/puppy*

[10] SPB-Linux: *http://spblinux.sourceforge.net*

[11] Debian homepage: *http://www.debian.org*

[12] DSL ISO image: *http://ftp.belnet.be/packages/ damnsmalllinux/current/dsl-0.8.3.iso*

[13] DSL USB floppy boot image: *http://ftp.belnet.be/packages/ damnsmalllinux/current/bootusb-0.8.img*

[14] Alternative boot sector: *http://home.tele2.ch/spblinux/spbsetup/ Linux/spb2_mbr.sec*