PARTITIONING

BEGINNERS

GNU-Parted PATCH VOORK MIRKO DÖLLE AND KARSTEN GÜNTHER

Partitioning hard disks under Linux is still regarded as the hardest task for beginners and tedious for advanced users. Reason enough to get to grips with the relatively new partition editor, parted.

When we talk about partitions, this usually means individually administered parts of a hard disk. Every partition as such is independent of other parts of the hard disk. So it is especially interesting when you want to use several operating systems – each system is based on its own partition and does not as a rule bother the others. It is as if you had installed several hard disks. There are some limitations on the number of partitions and their arrangement. So any hard disk can have a maximum of four partitions. If you need more, you will have to use one of the four partitions as an extended partition. You can split this into logical partitions. The four actual partitions are also referred to as "primary partitions" and differ from the logical ones in that it is possible to boot from them. Logical partitions can only exist within an extended partition. All in all, you can only use a single extended partition per hard disk. This can contain a maximum of 59 logical partitions - which, together with the four primaries, makes a total of 63 partitions per hard disk. Linux simply numbers the partitions in sequence, by appending the so-called "Minor Device Number" onto the name of the hard disk. The four primary partitions on the first hard disk at the first IDE controller (thus /dev/hda) are given fixed names with /dev/hda1 to /dev/hda4. The logical partitions from /dev/hda5 on, are always moved up. If you have assigned the logical partitions /dev/hda5, hda6 and hda7 and now delete hda5, hda6 and hda7 will now move up one, so there is no gap. If on the other hand you have assigned the primary partitions hda1 to hda3 and now delete hda2, the numbering of the other partitions remains unchanged. In

practice, 63 partitions are rarely needed. In the standard system only the minor device numbers 1 to 15 are available, though you can assign others if necessary.

You don't normally format your hard disk (though that's all right in principle). Usually, only individual partitions (which can of course for their part encompass the whole of the hard disk) are formatted. When this happens, a file system is written on the partition to allow the data to be administered. All current distributions offer during installation to divide up the hard disk at the discretion of the manufacturer or by hand ("partitioning") and then to put in the desired file system - with Linux this is usually ext2 ("Second Extended File System") for the data and swap as the swap partition. It is not practical, after every change to the partitioning of the hard disk, for you to have to reformat the partitions concerned and thus lose all the data inside. Until now, the thing to do was to select hard disk partitioning so that it can be kept forever. But beginners can scarcely be expected to know what the optimal partitioning for their home PC is. Even more advanced users have to wrestle now and again with the decision which was taken on first installation. This is where the partition editor Parted, from Andrew Clausen, comes in. It offers extensive options for installing the three commonest types of partitions, Linux-native, Linuxswap and FAT/VFAT from new, to test them, delete them, copy file systems between different partitions and a few other things, too.

At present Parted has no graphical interface. But don't worry, there's no need to remember fiddly



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Table 1: Features of Parted in overview						
	Linux-native (ext2 only)	Linux-swap	FAT/VFAT			
install partitions	yes	yes	yes			
delete partitions	yes	yes	yes			
test partitions	yes, but better to use e2fsck	yes	yes			
copy partitions	only into partitions of same size or larger	yes	yes			
move partition	limits only upper limit	yes	educed as required,			
			increased to a limited extent			
hide/show partition	no	no	yes			

Large and small numbers

A great mystery, especially for beginners, are the Major and Minor Device Numbers, which you may come across for example in the /dev directory, but also in the file /etc/conf.modules.

Under Linux many names are fairly meaningless, especially those of the device files such as /dev/hda or again, /dev/audio. If you ever enter Is -I /dev/audio, you get the following line:

crw-rw-rw- 1 root root 14, 4 Jul 26 1998 /dev/audio

What is unusual about this representation is that Is states, in the file size field, "14, 4". The "14" here stands for the Major Device Number, the "4" is the Minor Device Number of the device file /dev/audio. The first letter on the left, the file type, also differs from those of other inputs, as can be seen in the Table "filetypes", /dev/audio is a "Character Special File". The Major Device Number tells the kernel which device driver is responsible when a character file with this number is accessed. At this point the automatic module loader of the kernel and the file /etc/conf.modules come into play. Make a search using the command grep "char-major-14" /etc/conf.modules for all definitions for the Character Major Device Number 14. Here are four examples:

alias char-major-14 off alias char-major-14 soundcore alias char-major-14 es1371 alias char-major-14 sb

The lines mean that when a device file is accessed with char-major-14 the kernel module behind it must be loaded automatically, so it is not already in the memory. The "off" statement from the first example means that no module is being loaded – the driver is either contained in the kernel or is loaded manually. Take note that the type of a device file is dictates which driver is used – a "Block Special File" has a Block Major Device Number and is used by a different driver as a "Character Special File" with the same Character Major Device Number. If the Major Device Number states the driver to be used, then the driver, on the basis of the Minor Device Number can recognise which device is intended, if a special type of treatment is desired. So the Block Major Device Number 3 is used for /dev/hda and /dev/hdb. From the Minor Device Number the associated IDE-driver can tell that 0 means /dev/hda, and 1 to 15 stands for the partitions hda1 to hda15. The number 64 addresses /dev/hdb, and 65 to 79 stand for hdb1 to hdb15. Another example is /dev/st0 with "9, 0" and /dev/nst0 with "9, 128". Behind both of these is the first SCSI streamer, with the difference that in the case of minor-128 the tape is not rewound after every access. The fact that the device names as such have no special meaning for Linux is shown by the following example, which you can try out. As root user, put a second audio device into the /tmp directory:

mknod /tmp/myaudio c 14 4

Now you can use cat /etc/conf.modules > /tmp/myaudio to make a bit of a racket: if you happen to have an au-file to hand, you can listen to this. With rm /tmp/myaudio you then delete the newly set up device file again.

Table. The types				
Abbreviation	Designation	Use	Example	
-	regular	Normal file	track1.wav, /etc/passwd, /bin/bash	
d	directory	directory	letc, lusr, ltmp	
L	ymbolic link	Symbolic Link	/dev/cdrom, /usr/X11R6/bin/X	
S	socket	communication tunnel, often used by	/dev/log	
		programs in order to understand each other		
c	character special	device file which can be read or described as characters	/dev/ttyS0, /dev/nst0, /dev/audio	
b	block special	device file which can be read or described	/dev/hda, /dev/fd0, /dev/sda	
		in blocks of a specified length		
р	pipe special	device file from which the data can be read	/dev/initct	
		in exactly the sequence they were written in		

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parameters, the developers have built in an interactive text interface à la *fdisk*.

Installation of Parted

Most distributions unfortunately come without Parted, so we must install the partition editor ourselves. To do this, you can either use the RPM (included on the CD) or compile the sources from the CD yourself. You can find installation instructions in the box. You can find the latest version of Parted on the Internet at *http://www.gnu.org/software/parted/* and *ftp://ftp.gnu.org/gnu/parted.*

If you start *parted* without additional parameters, the program tries to find the standard hard disk, and reports this, for example with *Use /dev/hda*.

When starting Parted it is best to specify at the same time the hard disk to be treated, as it is too easy to overlook what Parted is using as standard and it's possible to treat the wrong drive. The following example uses the second hard disk on the first IDE controller:

parted /dev/hdb

Careful, never put the name of a partition such as */dev/hdb1*. Parted assumes that */dev/hdb1* refers to an entire hard disk and will try to provide the partition with partitions again – a pointless undertaking.

You will be asked to check the hard disk's geometry in the BIOS every time a program is started. The is because Parted is falling back on the data recognised by the kernel and makes all changes on the basis of these figures. Another system which uses the BIOS data (but also bootloaders such as LiLo or GRUB) can fall into false geometry and later deny you service. So it pays to copy the hard disk data from the BIOS start screen, or to look directly into BIOS. The numbers within Parted correspond to the Minor Device Numbers of the respective hard disk, giving "1" for *hda1* or *hdb1*. You absolutely must ensure that the

Installation

The RPM archive parted-1.2.9-0.i386.rpm is installed using

rpm -i parted-1.2.9-0.i386.rpm

This should work with all RPM-based distributions, we tested SuSE 7.0, RedHat 6.2 and Mandrake 7.1.

If you would like to reduce your Windows partitions to install Linux, but your distribution does not provide this option, we have enclosed an extract from a boot diskette with parted. You can write the extract file under Linux with

dd if=partboot.img of=/dev/fd0

This will copy the necessary files onto a diskette in the first drive. If you only have access to Windows or DOS, use the program enclosed in the sub directory rawrite, by simply retrieving it and specifying the extract file and the disk drive to be used. If you want to convert the sources, first unpack the file parted-1.2.9.tar.gz from the CD and

If you want to convert the sources, first unpack the file parted-1.2.9.tar.gz from the CD and change to the directory:

tar xvzf parted-1.2.9.tar.gz
cd parted-1.2.9

In addition you will need the libraries libreadline.so and libuuid.so, which are usually in the directory *llib*. The next steps are preparing for conversion, compilation and then installation.

./configure --prefix=/usr
make
make all-recursive
make install

The parameter --prefix=/user ensures that Parted is classed as a normal system program and does not end up in /user/local as intended by the programmers. For installation you should be logged in as root. Error messages during configure are problematic and indicate missing packets or a directory structure not expected by parted. The most frequent error is that the library libuuid which is responsible for file system accesses, is missing. The file is in the development packet for ext2fs, often named as ext2fs_d or ext2fs-devel. After installation is complete you can delete the directory from parted.

Partitioning table after

Fig. 1:

set up

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Konsole Sessions Options Help File ash-2.04# parted GNU Parted 1.2.9 Copyright (C) 1999-2000 Andrew Clausen, Lennert Buytenhek and Red Hat Inc. Translations are Copyright (C) 1999-2000 Free Software Foundation, Inc This program is free software, covered by the GNU General Public License. This program is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU General Public License for more details. Using /dev/hda Warning: The operating system thinks the geometry on /dev/hda is 778/255/63. You should check that this matches the BIOS geometry before using this program. (parted) p Disk geometry for /dev/hda: 0-6105.6 megabytes Start 133.4 End 1129.6 Туре Minor Filesystem Flags extended 33.4 996.2 logical (parted)

partitions to be handled are not being used in any way (i.e. not mounted). You can get a list of the partitions being used with *mount*. Unlike *fdisk* Parted takes all actions immediately and not only when quitting. There is almost no way back once you have deleted a partition.

Show and test partitions

First take a look at your current partitioning with *p*. The start and end of the individual partitions are not specified in the form of cylinders (as with *fdisk*) but in megabytes. Parted rounds up whole cylinders internally, as the partition table of the hard disk requires. The result of this is that the sizes entered often differ from the figures entered. Parted has a test function for ext2, swap and FAT/VFAT at its disposal. In the case of ext2 it is advisable to use the noticeably more powerful *e2fsck*. This comes with every distribution. Parted makes no bones about it if errors are found when checking the second partition with "check 2" for instance. It refers directly to e2fsck as a means of assistance. Even if things run through without a hitch, it points out that this is just a superficial test and *e2fsck* is the better alternative. If you have found a faulty ext2 partition, it is advisable to make a repair using e2fsck You must close down Parted first or change to a different console in order to do this. In the simplest case you can leave it to *e2fsck* to take all the steps, as here on the first logical partition:

e2fsck -c -p -v -y /dev/hda5

The sample retrieval makes for an automatic correction of any errors found. If the partition is still mounted, *e2fsck* will ask whether you really want to start the test – in this case you should always answer "No". Otherwise the threat of a system crash and/or loss of data is presented.

For FAT- and VFAT-partitions you can use the program *dosfsck* as an alternative to the Parted-

Check. The following call up (again, in the system and not from Parted) automatically tests and corrects a FAT or VFAT partition:

dosfsck -a -t -v /dev/hdb3

Depending on the distribution *dosfsck* may not be part of the standard installation and will have to be installed later.

Set up partitions

Parted has three commands for setting up partitions. You set up a new partition with *mkpart*. The following lines first set up an extended partition and then a logical ext2 partition:

mkpart extended 130 1128 mkpart logical ext2 130 1000

The extended partition begins at 130 MB and goes up to 1128 MB, where the details relate to the total size of the hard disk. The logical partition is made within the extended one and goes from 130 to 1000 MB. Since the logical partitions are automatically numbered in sequence, no partition numbers need be stated – the next onefree is used. In principle the logical partitions must lie within the extended ones. This means there is as much room available for all logicals as you have reserved for the extended partition. Optional partition types for *mkpart* are *primary*, *extended* and *logical*. As file system *ext2*, *linux-swap* or *fat* can be stated.

A look at the new partition table in Figure 1 shows that Parted has done some rounding off.

Parted often asks whether the boot-loader GRUB is to be installed. As GRUB is still at an early phase of development, it's better if you use Lilo. GRUB will play a big role in future, as it allows selection menus. You can find out more about this at *http://www.gnu.org/software/grub*. Next, install the desired file system on the new partition:

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mkfs 5 ext2

The command *mkpartfs* is called up exactly like *mkpart* and combines both steps:

mkpartfs logical ext2 60 90

Deleting and copying

To delete a partition all you need to know is its partition number:

rm 5

You thereby rid yourself of the first logical partition. But take care! As described above, Parted makes changes immediately. There's no going back. Plus, the logical partitions behind are all moved up. This can cause problems when the system is restarted if you do not adapt the file */etc/fstab* and move up the partition numbers there by hand.

One special feature of Parted is the option of copying the content of whole partitions into another partition or onto another hard disk. In the following example, the content of the first logical partition is copied into the second logical. The content of the second logical is copied onto the first logical partition /dev/hdb:

cp 5 6 cp 6 /dev/hdb 5

Warning, the target partitions must be already set up, *cp* does not make a new one itself. They must also be large enough for the content to fit into them completely. You can also only copy ext2 partitions into ext2 partitions of the same size or larger, regardless of how much of the original partition is used.

All change

Certainly the most used function in Parted is enlarging and reducing partitions. This allows space to be created on a hard disk fully taken up with Windows for Linux. *resize* allows the borders of a partition to be changed. To do this, we must first set up a large Windows partition:

mkpartfs primary vfat 1 1200

We can move the end of the Windows partition (the first primary partition here) further forward, in order to create space for a Linux partition. Or, as in the example, the start can be moved further back so that Linux stands in front of Windows.

resize 1 600 1200

It is not, by the way, necessary to defragment a Windows partition which has been used before reducing. Parted cannot work miracles yet, you can only reduce the Windows partition as far as space is available. Parted may warn you if necessary. Once reduction is complete, you now have room for the Linux partition: mkpartfs primary ext2 1 599

Parted is still having problems with processing ext2 partitions. Using these you can alter the upper limit but not the lower, at present.

Bootable partitions

A partition must be marked as bootable to be able to boot from it at all. So you need such a partition on the hard disk from which you normally start. Under Parted you can mark this as bootable with *boot* and the corresponding partition number. This can (as described earlier) only be one of the four primary partitions. With the following command, make the first primary partition startable, in our case this is Windows:

boot 1

Fresh hard disks

If you have a new hard disk or have formatted your hard disk, you can put in a new, completely empty partition table with *mklabel*. Take care, as this command used on a full hard disk irrevocably overwrites the old partition table. You can never get your data back. It may be advisable to print out your partition data and store it somewhere safe in the can hope that an expert might be able to help you. The following example prints out the partition data of the first hard disk on the standard printer:

fdisk -l /dev/hda | lpr

Hide and seek

Finally, there are two more, previously unmentioned features to be pointed out. (V)FAT partitions can be hidden under Windows, so that when starting they are not assigned a drive letter. Parted supports this feature by the commands *hide* and *unhide*. For Linux, however, this game of hide and seek is meaningless.

Conclusion

For those migrating from Windows to Linux, Parted is useful in order to be able to retain Windows. Unfortunately, most distributions are still using their own programs or the timehonoured *fdisk*, with which Windows partitions can usually only be deleted, but not reduced. And yet, Parted is not a universal panacea, because it is precisely in connection with Partition-Magic that SuSE is reporting problems. This is one more reason to back up your data, before you go to work with Parted. There is still hope that in future versions, Parted will become more stable and flexible and get an easy-to-use interface. Perhaps then it will win through as the standard tool for almost all distributions.



parted 1.2.9 LinuxUser/parted/ rawrite LinuxUser/parted/rawrite/

Info

GNU-Parted Homepage: http://www.gnu.org/software/ parted/ FTP-Download: ftp://ftp.gnu.org/gnu/parted/

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