Burn-proof technology
FIREBREAK

CHRISTIAN REISER

Even in these days of gigahertz CPUs, CD burning often means burnout. But you can blank out memories of meltdown with BURN-Proof technology.

Most burn interruptions are due to buffer underruns. A buffer underrun occurs when the computer fails to transport data fast enough to the CD burner. This means that the internal buffer memory of the CD burner is empty, thereby rendering the CD-ROM incomplete and unusable.

The reason for this is that the data has to be written onto the CD at a constant rate. It is therefore crucial that both the speed of CD rotation and the laser path across the surface of the disc are kept at a regular rate. The inner tracks are shorter, the outer ones longer. In order to run at the required constant rate, the CD-ROM must run faster when reading the inner tracks than it does when reading the outer ones. Consequently, CLV (Constant Linear Velocity) ensures that the laser always covers the same distance per unit of time.

In the case of single-speed devices, the data rate is 2352 x 75, giving a speed of 176,400 bytes per second. A burner with 12x acceleration consequently writes at 12 x 176,400 bytes per second — a speed of just over 2MB per second. This quantity of data has to be supplied constantly by the computer. Until now, incremental burning was not an option.

Buffer solution

Several procedures have been developed to circumvent this well-known problem. The first solution developed was to incorporate the buffer into the burner itself. The newer burners hold buffer capacities of up to 4MB, meaning that a maximum burn rate lasts for about 1.5 to 2 seconds. The burner software forms a buffer in the memory, meaning that, in burner software such as *cdrecord*, buffer allocation is up to you. The standard size is 4MB.

The latest method for avoiding buffer underrun, BURN-Proof, stands for **B**uffer **U**nder **R**u**N** and comes from Sanyo *(http://www.sannet.ne.jp/ BURN-Proof/)*. BURN-Proof takes the innovative approach of attempting to prevent not the underruns themselves, but their consequences.

A small microcontroller inside the CD burner constantly clocks the fill level of the built-in buffer. If it detects a risk of buffer underrun (where the buffer is less than 10% full), it initiates the ending of the burn procedure. If the data has been written onto the CD-R, the chip remembers its location. As soon as the buffer is full again, the CD burning software restarts the burn procedure. This means that this software must also support BURN-Proof. The microcontroller recommences burning at the point at which the last data was burned.

Similar software from Ricoh and Yamaha are called JustLink and Waste-Proof Strategy respectively. So far however, only BURN-Proof has made it onto the market. Linux supports this technology with cdrecord and cdrdao from version 1.1.5 onwards.

Using BURN-Proof

You can determine whether a drive supports BURN-Proof by using the command

```
# cdrecord -checkdrive dev=0,X,0 driveopts=help
Cdrecord 1.10a16 (i586-pc-linux-gnu)
Copyright (C) 1995-2001 Jörg Schilling
[...]
Driver options:
burnproof        Prepare writer to use Sanyo BURN-Proof technology
noburnproof      Disable using Sanyo BURN-Proof technology
```

The **X** can be defined via *cdrecord -scanbus*. An example can be found in the *IDE/ATAPI burner*

How we tested

Tests were performed on an AMD K6-2 at 350 MHz and with kernel 2.4.2. In the CD-R tests a 691 MB ISO-9660-Image was burnt onto the CD-R. In the CD-RW tests we settled for 137MB. The read tests always went via the inner tracks — the first 100MB and the first 10 minutes of the test CD.

CD burners with buffer-underrun protection						
Manufacturer	Lite-On	Plextor	Plextor	Plextor	Ricoh	Teac
Website	www.liteonit.com.tw	www.plextor.be	www.plextor.be	www.plextor.be	www.ricoh.de	www.teac.de
Model	LTR-12101B	PX-W1210A	PX-W1210S	PX-W1610A	MP9120A-DP	W512E
Shop price	£115	£150	£225	£170	£175	£120
Speed (Write/Rewrite/Read)	12/10/32	12/10/32	12/10/32	16/10/40	12/10/32(/8 DVD)	12/10/32
Connection	ATAPI	ATAPI	SCSI	ATAPI	ATAPI	ATAPI
Buffer-underrun protection BURN-Proof	BURN-Proof	BURN-Proof	BURN-Proof	JustLink	BURN-Proof	
Speed test:						
Burn CDR [kB/s]	1750	1736	1747	2265	1761	1739
Fix CDR [s]	25.3	24.2	24.6	18.9	22.9	27.9
Burn CDRW [kB/s]	1212	1278	1272	1107	1406	1302
Fix CDRW [s]	28.0	33.8	34.1	33.7	35.4	34.4
Read CD-ROM [kB/s]	2145	2479	2512	3094	2483	2414
Read audio (playing time/read time)	2.27	5.45	6.06	5.22	1.86	3.05

under Linux box. BURN-Proof is activated with the addition of the parameter *driveropts=burn-proof* to the normal *cdrecord* command.

But does it work?

Now to reality: We had five drives using BURN-Proof and one drive using JustLink in our test. Although employing the same approach to buffer underrun as BURN-Proof, JustLink has to be started up differently; cdrecord cannot do it. We did not experience this problem with either SCSI or with ATAPI. But it was considerably harder than expected to test the CD burners on BURN-Proof. Since cdrecord uses the POSIX real-time expansion, it has a higher priority than all other tasks; only the kernel takes precedence. This is no place to start. There is no point in blocking the IDE bus in order to slow the progress of data to the burner, since no modern IDE device is capable of overtaxing the IDE bus permanently. The only remaining option is to slow down the data to be burnt before it gets to cdrecord. We created the data on the fly (without dumping it on the hard disk) with mkisofs and brought this task to a stop by lowering its priority and starting other tasks. In the end we managed to fabricate a buffer underrun on all the drives and BURN-Proof always caught them, although cdrecord does not issue a message when this happens.

Conclusion

All burners with BURN-Proof function perfectly, the interruption of the flow of data has no effect on the legibility of the CDs. But Sanyo states that CDs produced using BURN-Proof should preferably be read with a 4x CD-ROM or a CD-player built after 1995. Every interruption in the write process results in a small gap, which could in some circumstances cause older drives to get out of step. Only the Ricoh drive produced illegible blanks in the test. *JustLink* is not currently supported by any Linux burn program. If you are buying one, check whether *cdrecord* or *cdrdao* can cope with the respective burner.

Considering today's high-performance computers however, a question naturally presents itself: Do we really need a device with this technology? Burnt CDs are something of a rarity — at least under Linux.

hdX: *Under Linux, all IDE devices are addressed as /dev/hdX. hdX in this case stands for: hda: first controller, master hdb: first controller, slave hdc: second controller, master hdd: second controller, slave.*

IDE/ATAPI burner under Linux

cdrecord directly supports SCSI burners, assuming correct installation of the SCSI-Host adapter. ATAPI devices must first be converted from IDE to SCSI-API. This is conducted via the kernel module ide-scsi: This module provides a SCSI emulation for every IDE drive which is not yet occupied by another driver, so that it appears to programs as a genuine SCSI drive. The real problem now is to keep the CD burner free for the IDE-SCSI module. Here the methods differ depending on whether the IDE CD-ROM is permanently supported in the kernel, or if it is loaded as a module (IDE-CD). The simplest way to find this out is by mounting a data CD into the file system and then using lsmod to check if the IDE-CD module has been loaded. If the IDE-CD support is firmly anchored in the kernel, this means you have to tell the kernel by boot parameter that it should keep the burner free for the SCSI emulation. This is done using the parameter ***hdX****=ide-scsi. From now on, /dev/hdX is no longer available and the burner can be addressed via /dev/scd0. The boot parameter should be permanently entered in the bootloader; in the case of LILO, the append entry in the /etc/lilo.conf is extended to do this:*

```
append = "hdX=ide-scsi"
```

If parameters already exist under append, hdX=ide-scsi is placed before them and separated from the rest by a comma. If ide-cd is not fixed in the kernel, then the ide-cd parameters must be adapted first so that this module no longer accesses the burner. Secondly, the ide-scsi parameter must be altered so that other devices are not occupied, even when their driver has not yet been loaded. Both settings are defined in the file /etc/modules.conf. For the ide-cd-module, just the line

```
options ide-cd ignore=hdX
```

needs to be inserted. Making sure that ide-scsi only occupies the burner is unfortunately not that simple — there are no options for modules. For this reason, you need to make sure that all drivers for any other possible devices are already loaded before the ide-scsi module is initialised. This is effected by the following entry:

```
pre-install ide-scsi modprobe -k ide-cd;modprobe -k ide-tape;modprobe -k ide-floppy
```

The parameter -k ensures that the drivers are unloaded automatically when they are not needed. Last of all, in both cases the ide-scsi emulation must be entered as SCSI controller:

```
alias scsi_hostadapter ide-scsi
```

Whether everything has worked is shown by

```
# cdrecord -scanbus
Linux sg driver version: 3.1.17
Cdrecord 1.10a16 (i586-pc-linux-gnu) Copyright (C) 1995-2001 Jörg Schilling
Using libscg version 'schily-0.4'
scsibus0:     0,0,0     0) 'TEAC    ' 'CD-W512EB      ' '2.0B' Removable CD-ROM
              0,1,0     1) *
              0,2,0     2) *
              0,3,0     3) *
              0,4,0     4) *
              0,5,0     5) *
              0,6,0     6) *
              0,7,0     7) *
```