

Tru64 UNIX Best Practice

Recording a Data CD-ROM

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Product Version: **Tru64 UNIX Version 5.1B and later**

This Best Practice describes how to record a data CD-ROM for the Tru64 UNIX Operating System.

Contents

Recording a Data CD-ROM

Is This Best Practice Right for You?	1
Before You Begin	2
Terminology	2
Media Creation	3
Writing CD-ROMs	4
Processing time	5
ISO 9660 requirements	5
Applying the Best Practice	6
Recording a CD-ROM	6
Copying a Non-bootable CD-ROM	8
Verifying Success	9
Troubleshooting	9
Alternative Practices	10
Comments and Questions	10
Legal Notice	10

Recording a Data CD-ROM

This Best Practice illustrates an efficient method of saving up to 650 MB of information from a Tru64 UNIX file system to CD-ROM.

Use this best practice to

- Move data from one machine to another.
- Archive files.
- Move data between Tru64 UNIX operating systems and to Windows NT and Windows XP operating systems.

The software that performs the recording process is externally licensed and supports many recording scenarios and hardware. This Best Practice describes the options and procedures that most easily allow you to transfer data from the Tru64 UNIX operating system to CD-ROM. The `cdrecord` and `mkisofs` reference pages list all available options.

See the Tru64 UNIX Best Practices web page for more information about Best Practices documentation.

Is This Best Practice Right for You?

Not all Best Practices apply to all configurations, so you must be sure that it is appropriate for your system and circumstances. To use this Best Practice, you must meet the requirements described in the following table:

Requirement	Description
Operating System	Tru64 UNIX Version 5.1B or later; an earlier system running Version 4.0F or later that has <code>mkisofs</code> and <code>cdrecord</code> installed
System Configuration	A CD burner attached to your system.
System Load	Heavy system loads may affect writing a CD-ROM

This procedure is used to write a file system to disc. You cannot copy individual files one at a time to the CD-ROM as you would to a floppy. The information you write is converted to an ISO 9660 image that is then copied to the CD-ROM.

If you do not have the software to record CDs and want to download it from the source, see the CDrecord web page. The page states that OSF-1 is a supported system. For the purpose of this application, OSF-1 is equivalent to Tru64 UNIX.

Follow the appropriate copyright restrictions when copying or creating CD-ROMs.

Before You Begin

Before you apply the Best Practice for recording a data CD-R or CD-RW, you must understand some background information.

- *Terminology*
- *Media Creation*
- *Writing CD-ROMs*
- *Processing time*
- *ISO 9660 requirements*

There are CD glossaries available on the Internet that further explain compact disc concepts and terminology. The web page <http://www.cdrfaq.org> contains useful information. However, Compaq is not responsible for any content or recommendations presented in it.

You cannot use this process to burn DVD-R, DVD-RW, or any other format DVD.

Terminology

This Best Practice uses compact disc terminology as follows:

- CD burner
A unit that can read and record CDs.
- CD drive
A unit that reads CDs but cannot record them.
- CD-R

Compact Disc-Recordable. A compact disc with a surface that can be recorded only once. However, it is not necessary to write the whole disc at once (see *Writing CD-ROMs*).

- CD-ROM

Compact Disc-Read-Only-Memory. The medium on which data is stored for reading by computers. This term can apply to recordable, rewritable, or stamped CDs.

- CD-RW

Compact Disc-ReWriteable. A compact disc with a surface that can be erased entirely and rerecorded.

- Data Underflow Error

A processing error that occurs when the system cannot provide data to the CD burner as fast as it is needed.

- Disc-at-Once

A process that writes all tracks on a disc in one operation.

- ISO 9660

International Organization for Standardization (ISO) specification for formatting data on a CD-ROM. See *ISO 9660 requirements*.

- ISO image

A file system that is saved in ISO 9660 plus extensions format.

- Stamped CD

A CD-ROM that has been produced by a stamping or pressing process rather than by a writing process.

- Track-at-Once

A process that writes one track per write operation.

By convention, CD-ROMs are called discs, while hard drives and floppies are called disks.

Media Creation

The way information is physically stored on disc depends upon the type of CD-ROM:

- For mass production, CDs are pressed or stamped from a mold created from a master. Stamped or pressed CDs are often produced to distribute software.

Stamping CDs is particularly appropriate for making many copies of the same information. Stamping requires a facility set up to do the work. In general, stamped CDs are less susceptible to damage than recorded CDs.

- CD-Rs contain a dye layer that is altered by laser to produce the recording. This may make them more susceptible to physical damage than other CDs. CD-Rs are available in three types: green, silver, and gold. The more expensive are perceived to be more reliable.
- CD-RWs use a phase change to record and to erase. The material in the recording layer is transformed from crystalline to amorphous form by the laser. This produces a track of material with a different refractive index. Erasing the CD is a slow process that returns the material to its earlier form. This transformation can be done many times before the material breaks down.

Complete compatibility between all CD burners and all CDs does not exist at present. In general, CD burners operating at higher speeds (perhaps 12x or higher) require more expensive discs. Currently, the only way to determine if a particular type of CD will work on your machine is to try it.

Writing CD-ROMs

A standard CD-ROM holds 650 MB of data and can contain up to 99 tracks. The minimum track length is 600 Kb. There are CDs with 700 MB storage capacity, but they are not recommended if you need the disc to be read by an older CD reader.

The maximum number of files you can write depends on the file system you're using. In theory, for ISO-9660 (see *ISO 9660 requirements*), you can have as many files as you want. In practice, you are limited to about 65,000 files if you want broad compatibility.

There are two basic ways of writing to a CD-R or CD-RW.

- Disk-at-Once writes the CD in one pass. All information is written in a single operation. No further information can be added to the CD because the CD burner performs track-closing operations.
- Track-at-Once writes tracks individually. Table-of-contents closing operations are delayed until the last write. A gap is entered between tracks.

Compaq recommends that you use this process and write a single-track ISO image to CD-ROM. Because CDs are not costly, there is little reason to use a more complex operation or to put an existing data CD at risk of damage in another write process.

In general, it is not necessary to use rewriteable CDs. There is no time benefit and CD-Rs are relatively inexpensive. You cannot selectively erase files or tracks on a CD-RW. You must erase the whole disc.

Processing time

Burners operate at three speeds. The highest is the read speed. The lower speeds are for writing. The writing time is fixed at 150 Kb/sec. If you have a 1x drive, it takes 74 minutes to write 650 MB of data. If you write at twice the speed, it takes half the time. The speed increase is linear, so if you have a 4x drive, the writing time is 1/4 of 74 minutes. If you write less data, it takes less time.

If your system is very active, you can choose to write at a slower speed to decrease the risk of a data underflow error. This error occurs when a system can't transfer data fast enough to fill the write buffer.

ISO 9660 requirements

ISO 9660 is the "Volume and file structure of CD-ROM for information interchange" standard used for writing data to CD-ROMs. Following this standard creates a CD-ROM that is readable on many platforms. To convert from the Tru64 UNIX layout to ISO format, run the `mkisofs` command on the directory you want to write.

The ISO 9660 standard is limited. It restricts file names to upper case characters in an 8.3 format and it allows no symbolic links. However, `mkisofs` supports the Rock Ridge and Joliet extensions to ISO 9660, which allow more flexibility. Choose these options for the `mkisofs` command (see *Applying the Best Practice*) to permit the extensions when you burn the CD.

The Rock Ridge extension applies to Tru64 UNIX and allows long file names, lower case, deeply nested directories, symbolic links, device-special files, and so on.

The Joliet extension applies to Windows NT and Windows XP and allows 64 character file names and the Unicode international character set.

Note that the extensions apply to file names. They do not recognize file content. Therefore, the extensions do not handle the end-of-line differences between Tru64 UNIX and Windows nor little- and big-endian issues. These must be managed by applications reading the data.

Applying the Best Practice

Before you record or copy a CD, be sure you understand the information in *Before You Begin* and follow the appropriate copyright restrictions.

The output file that you are recording must be on the same machine. Operating across the network increases the probability of data underflow errors.

See the `mkisofs` and `cdrecord` reference pages for more information.

Recording a CD-ROM

1. Log in as root.
2. Check your hardware configuration to locate your CD burner.

```
# hwmgr v d
```

```
HWID: Device Name      Mfg      Model      Location
-----
31: /dev/disk/floppy0c  3.5in floppy  fdi0-unit-0
41: /dev/disk/dsk0c    COMPAQ    BD009735C6  bus-2-targ-0-lun-0
42: /dev/disk/cdrom1c  HP        CD-Writer+ 9600  bus-2-targ-4-lun-0
44: /dev/disk/dsk1c    COMPAQ    BD009735C6  bus-2-targ-1-lun-0
46: /dev/disk/cdrom4c  HL-DT-ST  RW/DVD GCC-4120B  bus-0-targ-0-lun-0
```

In this example the device that will be used is 0,0,0 (as shown in the bus, targ, lun output).

3. Create the ISO 9660 image.

Lay out your directory structure, files, and so on in the form that you want. If you do not want to record an existing directory, create a new directory and copy the appropriate subdirectories and files to it.

Run the `mkisofs` command with the appropriate options to generate the ISO image file that you will write to the CD-ROM. In this example, `./MyData` is the root directory for the file system to be copied. The `D` (no deep directory relocation), `R` (Rock Ridge extensions needed for UNIX) and `J` (Joliet extensions needed for Windows NT or XP) are selected. The output file for `mkisofs`, the ISO image `./test.iso`, must reside on the local system.

```
# mkisofs -D -R -J -o ./test.iso ./MyData
Using CASE000.;1 for /case (CASE)
```

```

Using _____000.;1 for /!@#$$%^&*{ }| |:
; <>?-_+= (!@#$$%^&*{ }| |)
Using LIST_000.KSH;1 for ./MyData/bin/list-data.ksh~
(list-data.ksh)
Using BURN_000.KSH;1 for ./MyData/bin/burn-cdr.ksh~
(burn-cdr.ksh)
Total translation table size: 0
Total rockridge attributes bytes: 6210
Total directory bytes: 28672
Path table size(bytes): 188
Max brk space used 20930
496 extents written (0 Mb)

```

It is a good idea to check the size of your ISO 9660 image file. It should be a few percent larger than your original data.

```

# ls -l ./test.iso
-rw-r--r-- 1 root system 1015808 Nov 2 14:08 ./test.iso

```

4. Place a CD-R or CD-RW in your CD burner and run the `cdrecord` command to burn the image file on to the CD.

Set recording parameters. Suggested parameters are `-v` (increment the level of verbosity), `-data` (data CD), `padsize=307200` (for compatibility with certain mass duplication programs), `speed=0` (desired copying speed), and `dev=0,0,0` (device to record on).

```

# cdrecord -v -data padsize=307200 speed=0 \
dev=0,0,0 ./test.iso
Cdrecord 1.10 (alphaev56-dec-osf5.1)
Copyright (C) 1995-2001 JM-vrg Schilling TOC Type:1 = CD-ROM
scsidev: '0,0,0'
scsibus: 0 target: 0 lun: 0
Using libscg version 'schily-0.5'
atapi: 0
Device type      : Removable CD-ROM
Version          : 2
Response Format   : 2
Capabilities     :
Vendor_info      : 'HL-DT-ST'
Identifikation   : 'RW/DVD GCC-4120B'
Revision        : '2.00'
Device seems to be: Generic mmc CD-RW.
Using generic SCSI-3/mmc CD-R driver (mmc_cdr).
Driver flags     : SWABAUDIO
Drive buf size   : 1605632 = 1568 KB
FIFO size        : 4194304 = 4096 KB

```

```

Track 01: data      0 MB          padsize: 300 KB
Total size:      1 MB (00:08.64) = 648 sectors
Lout start:      1 MB (00:10/48) = 648 sectors
Current Secsize: 2048
ATIP info from disk:
  Indicated writing power: 5
  Is not unrestricted
  Is not erasable
  Disk sub type: Medium Type A, high Beta category (A+) (3)
  ATIP start of lead in:  -12513 (97:15/12)
  ATIP start of lead out: 359849 (79:59/74)
Disk type:      Long strategy type (Cyanine, AZO or similar)
Manuf. index:  22
Manufacturer:   Ritek Co.
Blocks total:   359849
Blocks current: 359849
Blocks remaining: 359201
Starting to write CD/DVD at speed 4
  in write mode for single session.
Last chance to quit, starting real write in 9 seconds...
Operation starts.
  Waiting for reader process to fill input buffer...
input buffer ready. Performing OPC...
Starting new track at sector: 0
Track 01:      0 of      0 MB written.
Track 01: writing 300 KB of pad data.
Track 01: Total bytes read/written:
  1015808/1323008 (646 sectors).
Writing time:   5.843s
Fixating...
Fixating time:  65.235s
cdrecord: fifo had 16 puts and 16 gets.
cdrecord: fifo was 0 times empty and 0 times full,
  min fill was 100%.

```

The line detailing how often the fifo was empty and full is useful for resolving problems with data underruns. If the min fill percent is low, run `cdrecord` when your system load is light.

Copying a Non-bootable CD-ROM

1. Log in as root.
2. Mount the CD-ROM you want to copy. You must have enough room on your system for the ISO image of this CD.

3. Run the `mkisofs` command to create the ISO image, specifying an output file on your local system. The command generates output that is an image of the CD-ROM.
4. Continue from step 4 in *Recording a CD-ROM*.

Verifying Success

After you apply the Best Practice for Recording a Data CD-ROM, you can verify whether it was successful.

To check for accuracy, mount the CD and run the `diff` command recursively on the mount point of the CD and the ISO 9660 file you have saved on disk. For example,

```
# mount -r /dev/disk/cdrom4c mnt
# diff -r ./MyData mnt
```

If the Best Practice was not successful, see *Troubleshooting* for information about identifying and solving problems.

Troubleshooting

If you determine that the Best Practice was not successful, as described in *Verifying Success*, use the following table to identify and solve problems:

Problem	Possible Solutions
Data incomplete	Check if the file you are writing is larger than disk size; if so, divide data and record again.
Power failed when writing disc	Start over.
Cannot read new CD-ROM	Try a different reader; read-only drives more than five years old may not be able to read burned CDs.
Can't write to CD	Must have root permission to burn CDs; must have CD burner, not just a reader
Data underrun error	Write at a slower speed; burn CD at time of lower system load

Alternative Practices

There is no alternative method of recording a CD-ROM. If you need to save or transfer data on your system and cannot use a CD-ROM, write it to either a floppy disk or to tape.

Comments and Questions

We value your comments and questions on the information in this document. Please mail your comments to us at this address:

`best_practices@zk3.dec.com`

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