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Quick Start Guide to FFmpeg

Learn to Use the Open Source Multimedia-Processing Tool like a Pro

V. Subhash

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Chennai, Tamil Nadu, India
ISBN 978-1-4842-8700-2 e-ISBN 978-1-4842-8701-9
https://doi.org/10.1007/978-1-4842-8701-9

This Apress imprint is published by the registered company APress Media, LLC, part of Springer Nature.

The registered company address is: 1 New York Plaza, New York, NY 10004, U.S.A.

Dedicated to the creators and supporters of free and open source software

Introduction

FFmpeg is a *free and open source program* for editing audio and video files from the command line. You may have already known FFmpeg as a nifty program that can do simple conversions such as:

```
ffmpeg -i some-video.mov same-video.mp4
ffmpeg -i song-video.mp4 song-audio.mp3
```

FFmpeg is much more capable than this, but it is this intuitive interface and support for a wide variety of formats that has won it millions of users.

The FFmpeg project was originally started by a French programmer named Fabrice Bellard in the year 2000. It is now being developed by a large team of open source software developers spread around the world.

This book can serve as an easy FFmpeg tutorial, hack collection, and a ready reference. However, it is not possible for one book to cover everything that FFmpeg can do. FFmpeg has a very huge online documentation with which you may have to craft your commands. While this book may seem more than enough for most users, the documentation will open up vastly more possibilities. DO NOT avoid going through the documentation.

Before you go further into the book, you should be aware that the FFmpeg project creates two types of software:

1. `libav` **libraries**: These are FFmpeg programming software or "libraries" that are used by programmers to create audio/video processing software such as media players, browser plug-ins, and audio/video editors. The `libav` libraries have been used to build some parts of popular software such as VLC, xine, Blender, and Kodi.
2. `ffmpeg` **command-line program**: This is the FFmpeg end-user software that most people can use. The `ffmpeg` *command-line program* internally uses the `libav` *libraries*.

In this book, we will ignore the `libav` *libraries* and instead focus on the `ffmpeg` *command-line program*.

Extra Resources for This Book

- All code snippets used in this book are available in a plain-text file, complete with chapter and section titles and comments. It is actually a MarkDown/CommonMark file. You can easily convert it to an HTML, ODT, DOCX, or PDF file. Conversion instructions are in the text file.

- Videos of several code examples used in the book are available in an online video playlist.

Links to these resources can be found at

- www.apress.com/9781484287002 (domain + ISBN)
- www.vsubhash.in/ffmpeg-book.html

Any source code or other supplementary material referenced by the author in this book is available to readers on GitHub (https://github.com/Apress). For more detailed information, please visit http://www.apress.com/source-code.

Acknowledgments

The author would like to thank:

- The publisher Apress who insisted on not using any third-party video in the screenshots, as the author did in the original self-published book (*FFmpeg Quick Hacks*). Most screenshots in this Apress book were taken from the author's own videos. The rest used videos and images that were in the public domain (Archive.org, Pixabay.com, and Unsplash.com). This led to a rewrite of most of the content, and in the process, several mistakes were eliminated.
- The technical reviewer Gyan Doshi for pointing out several other mistakes and making valuable suggestions.
- Creators and supporters of *free and open source* projects.
- The author's family, friends, enemies and governments without whose help and encouragement this book would have been completed much ahead of its deadline.

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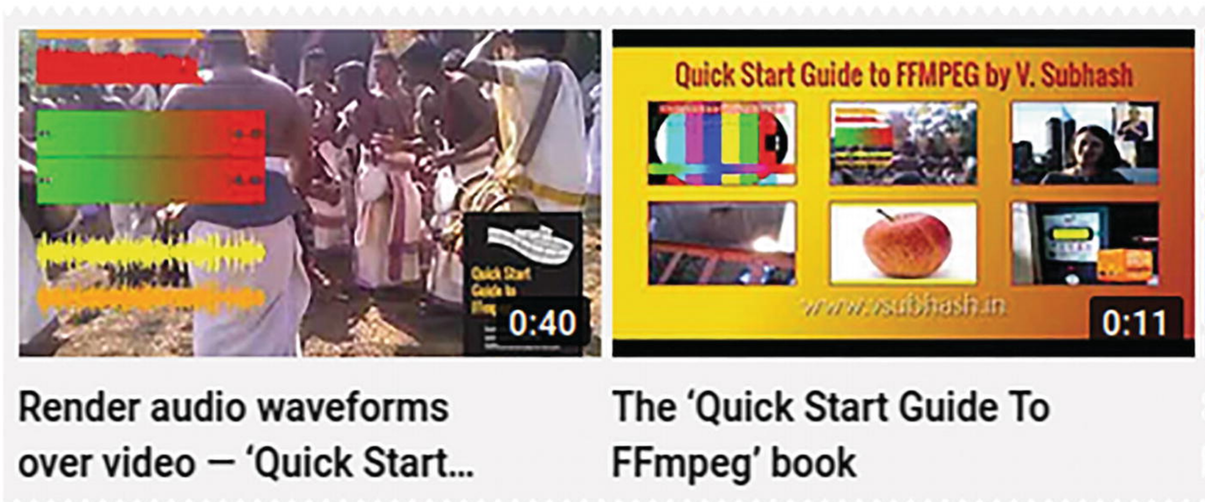
About the Author

V. Subhash



is an invisible Indian writer, programmer, and illustrator. In 2020, he wrote one of the biggest jokebooks of all time and then ended up with over two dozen mostly nonfiction books including *Linux Command-Line Tips & Tricks*, *CommonMark Ready Reference*, *PC Hardware Explained*, *Cool Electronic Projects*, and *How To Install Solar*. He wrote, illustrated, designed, and produced all of his books using only open source software. Subhash has programmed in more than a dozen languages (as varied as assembly and Java); published software for desktop (*NetCheck*), mobile (*Subhash Browser & RSS Reader*), and the Web (*TweetsToRSS*); and designed several websites. As of 2022, he is working on a portable JavaScript-free CMS using plain-jane PHP and SQLite. Subhash also occasionally writes for the *Open Source For You* magazine and CodeProject.com.

About the Technical Reviewer

Gyan Doshi

has been with the FFmpeg project as a developer and maintainer since 2018. During this time, he has focused on FFmpeg filters, formats, and command-line tools. From his experience in video postproduction stages such as editing and motion graphics, Gyan has learned how FFmpeg can be used in multimedia workflows as a valuable addition or as a substitute for expensive tools. Aside from being engaged as a multimedia/FFmpeg consultant, Gyan also troubleshoots FFmpeg issues on online forums such as Stack Exchange and Reddit.

Gyan builds the official Windows binary packages of FFmpeg (`ffmpeg`, `ffprobe`, and `ffplay`) and other tools (`ffescape`, `ffeval`, `graph2dot`, etc.) and offers them for download from his website at www.gyan.dev.

V. Subhash, *Quick Start Guide to FFmpeg*

https://doi.org/10.1007/978-1-4842-8701-9_1

1. Installing FFmpeg

V. Subhash[1]

(1) Chennai, Tamil Nadu, India

In the Introduction, I mentioned that FFmpeg was an "end-user program." It is actually three command-line end-user programs, or **executables**:

1. `ffprobe`
2. `ffplay`
3. `ffmpeg`

The executables for these programs are available for Linux, Mac, Windows, and other operating systems (OSs). When you go to the FFmpeg website (`www.ffmpeg.org`), you will have two download options:

- Either download **pre-built FFmpeg executables** to your computer
- Or download **FFmpeg source code** to your computer and build your own customized FFmpeg executables

If you are unfamiliar with building executables from source code (as are most people), you should choose the first option.

FFmpeg for Microsoft Windows Users

The download options on the FFmpeg site for *pre-built FFmpeg executables* change frequently, so this book will not be specific with instructions. Just go to this page and navigate to one of the download sites.

- https://ffmpeg.org/download.html

On the selected download site, you may be presented with a dizzying array of downloads. Spend some time reading the information given there, and pick the most appropriate download for you.

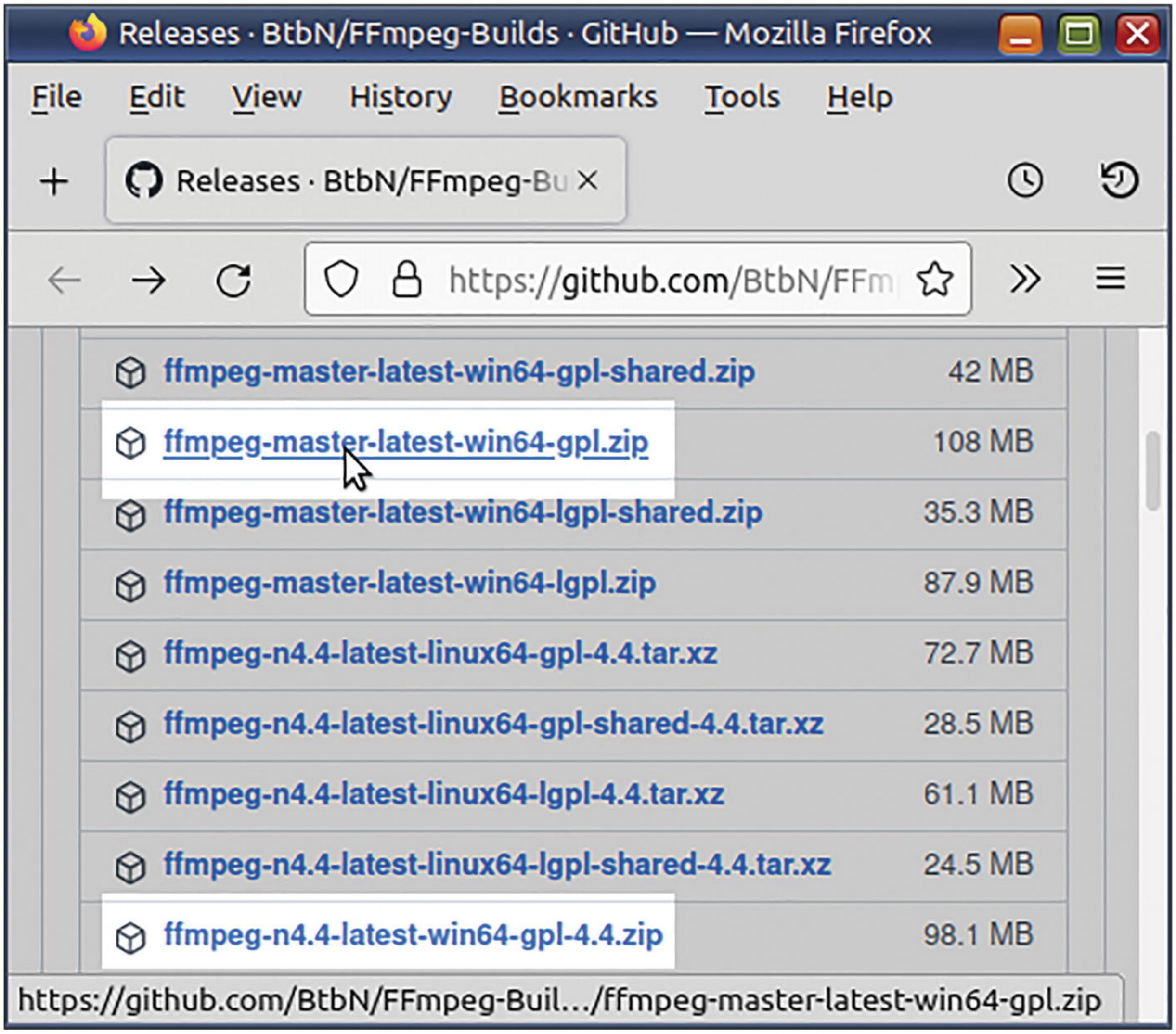


Figure 1-1 This download page lists several download options for FFmpeg executables. Strangely, for FFmpeg, the latest master download is supposed to be more stable than the numbered release version

Sometimes, there may be an *essentials* build and a *full* build. The *essentials* build may be enough for most people. If you want to use certain unusual features such as *frei0r* filters, you should choose the latter. As you never know what you might need in the future, I suggest that you choose the *full* build.

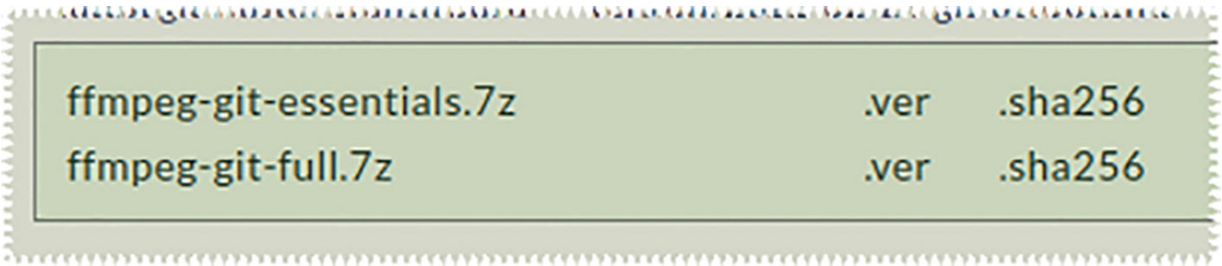


Figure 1-2 There may be more than one “build” option for the downloads

In the downloaded archives (zip or 7z files), you will find the executables: `ffprobe.exe`, `ffmpeg.exe`, and `ffplay.exe`.

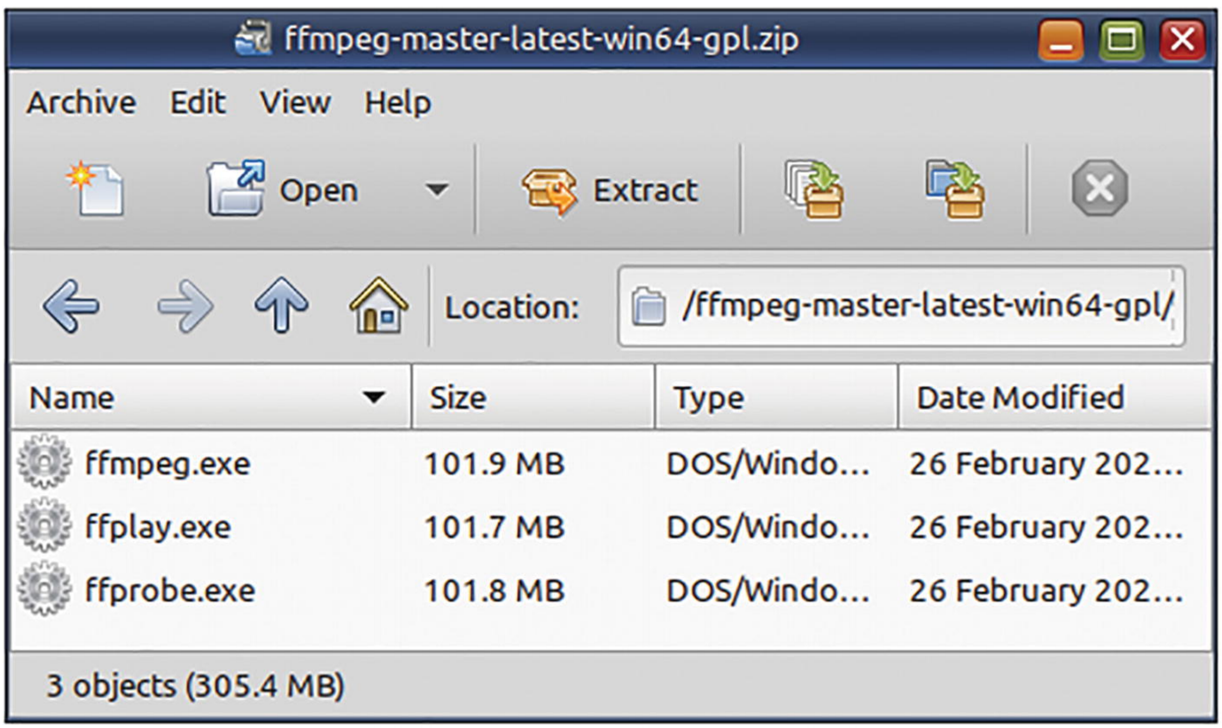


Figure 1-3 The downloaded archive file contains three EXE files. Copy them to a folder specified in your PATH environment variable

Copy the EXE files to some folder that is already included in your operating system’s PATH environment variable. If you copy them to a new folder, then add the folder’s full location to the PATH variable.

If you do not do the above, you will need to type the full path of the executable in your commands in the *Command Prompt* window.

Before modifying the PATH environment variable, take a backup of its value. Open the **Command Prompt** window and type this command.

```
echo %PATH% > PATH-BAK.TXT
```

Let us assume that you have extracted the EXE files to the folder `C:\MyInstalls\ffmpeg\bin`. Launch the **Command Prompt** window with Administrator privileges. Then, permanently suffix this folder’s location to the PATH environment variable with this command.

```
SETX /M PATH "%PATH%;C:\MyInstalls\ffmpeg\bin"
```

Then, you should check whether the FFmpeg installation is accessible from the command-line without the full path. (Do this in a **Command Prompt** window with normal-user privileges.)

```
ffmpeg -version
```

If you do not modify the environment variable, then you will have to type the full path whenever you want to use the program.

```
C:\MyInstalls\ffmpeg\bin\ffmpeg -version
```

FFmpeg is case-sensitive so do not type `FFMPEG –VERSION` and hope to get a correct response. FFmpeg may have become platform-independent, but in its heart, it still beats like a Linux program. This means that FFmpeg will not support certain functionalities expected of native Windows/DOS programs. For example, you cannot type command switches (arguments) in uppercase (even if the command name can be typed in uppercase).

```
@ Causes error
FFMPEG -VERSION
@ Causes no error
FFMPEG -version
ffmpeg -version
```

Almost all command-line examples in this book assume a Linux environment. One-line commands will not require any change in Windows.

The Windows/DOS counterpart for the Linux null device (`/dev/null`) is `NUL`. This means that you should replace all instances of `2> /dev/null` in this book with `2> NUL`. This construct is used to prevent the commands from displaying text messages on the screen. `ffmpeg` outputs all its messages to *standard error*, which happens to be the screen. In case it outputs something to *standard output*, which also happens to be screen, and has to be blocked, the Linux remedy is to use `> /dev/null`. To do the same on your Windows computer, you will have to use `> NUL` instead.

In multiline commands, you will find a “\” (backslash) at the end of each line (except the last one), as is the practice in Linux.

```
# For 'nix users
ffmpeg -f lavfi \
       -i "testsrc=size=320x260[out0];
           anoisesrc=amplitude=0.06:color=white[out1]
       -t 0:0:30 -pix_fmt yuv420p \
       test.mp4
```

As a Windows user, you should use a caret (^) instead of the backslash (\ ).

```
@ For Windows users
ffmpeg -f lavfi ^
       -i "testsrc=size=320x260[out0]; ^

           anoisesrc=amplitude=0.06:color=white[out1]
       -t 0:0:30 -pix_fmt yuv420p ^
       test.mp4
```

You should avoid writing anything after the backslash or the caret. Invisible trailing space(s) can also make a command to fail. (This happens often with copy-pasted commands.)

In a Linux `bash` terminal, the backslash is not required after a double-quotation mark has been opened, and you can continue on like that for more lines until the quotation is closed. In a Windows `cmd` terminal, all wrapping lines will have to end with a caret.

FFmpeg for Linux Users

If your Linux distribution has not installed FFmpeg by default, then use its default *software manager* or *package manager* to do so. Beware that the FFmpeg installed from software repositories used by Linux distributions are usually out of date.

The download sites linked by FFmpeg.org provide the latest builds with maximum support for external libraries. However, some Linux users like to build their executables from source. If you have a fast machine or a few hours to spare, start with the instructions on the *FFmpeg Wiki* site. Check their *source code compilation steps* specific to the Linux distribution that you use.

- https://trac.ffmpeg.org/wiki/CompilationGuide

You can customize your FFmpeg build by enabling/disabling several build options. Instead of just blindly following the wiki, spend some time studying the `configure` script or its help output.

```
configure --help
```

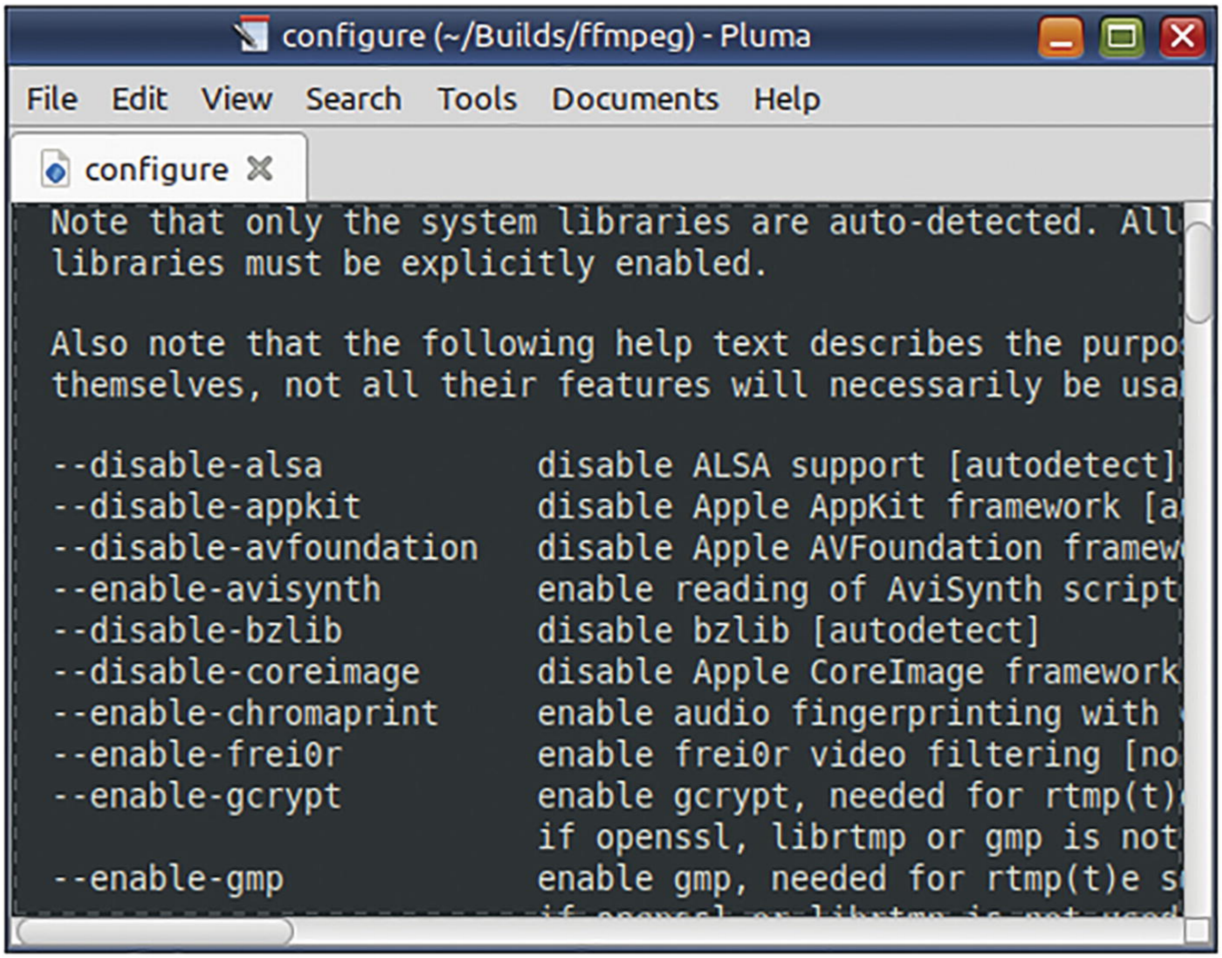


Figure 1-4 The `configure` script, by default, will try to autodetect external libraries. You may have to manually enable those that are not autodetected

In your Linux package manager app, try to search and install (*dev*-suffixed) developmental packages with similar names as the external libraries. You may not be able to install developmental packages for all of the libraries. But, for whatever libraries that you can install or have them already installed, add relevant `–enable` options to the `configure` compilation step. Here are a few:

```
...
--enable-chromaprint --enable-frei0r \
--enable-libbluray --enable-libbs2b --enable-libcdio
--enable-libflite --enable-libfontconfig \
--enable-libfreetype --enable-libfribidi \
--enable-libmp3lame --enable-libsmbclient \
--enable-libv4l2 --enable-libvidstab \
...
```

Run the FFmpeg build statement with these changes, and eventually all three binary executable files will be created in your `$HOME/bin` directory. Then, secure the copy of the documentation from the `ffmpeg_build` directory so that you can read it whenever it is required.

> ☞ When I built FFmpeg version 5.1, I encountered some errors with the official wiki guide. The guide uses one long stringified command to install the FFmpeg binary executable files. This command is a combination of several commands that downloads the source and then configures, compiles, builds, and installs the

executable files. If the configuration and compilation commands encounter any errors and you fix it, the command will restart the whole drama beginning with downloading the source. You do not have to endure that. Just continue with the `configure` step.

If you have an old OS where the latest FFmpeg executable does not run or cannot be compiled, go to https://johnvansickle.com/ffmpeg/ and download pre-built statically linked executables (not including `ffplay`). On my old Ubuntu 10 *Fiendish Frankenstein* installation, I could not run the latest FFmpeg pre-built executable nor build the source, but these statically linked executables worked. (Even the C library is statically linked.) That is how I was able to finish the 2020 version of this book in the old OS.

FFmpeg for Apple Mac Users

With Apple moving from Intel x86 to ARM architecture, any specific instructions will be outdated when you read it. It is best that you consult the FFmpeg Wiki for the specific kind of Apple hardware that you are using.

- https://trac.ffmpeg.org/wiki/CompilationGuide/macOS

Summary

Although originally designed as a Linux program, FFmpeg is also available for Windows and Mac operating systems. In this chapter, you learned how to obtain pre-built FFmpeg executables specific to your OS from the official FFmpeg site. You also learned how to build your own customized FFmpeg executables from source.

In the next chapter, you will learn how to start using the executables.

V. Subhash, *Quick Start Guide to FFmpeg*
https://doi.org/10.1007/978-1-4842-8701-9_2

2. Starting with FFmpeg

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(1) Chennai, Tamil Nadu, India

The FFmpeg project provides several end-user programs. This book will focus on three command-line programs – `ffprobe`, `ffplay`, and `ffmpeg`. You will be using `ffmpeg` most of the time, but `ffprobe` and `ffplay` can help you as well. In this chapter, you will gain an introduction to all three.

All three have an annoying “feature” – they display a build-information banner that is as big as the state of Texas. If you create the following aliases in your `$HOME/.bashrc` file, then you do not have to suffer the annoyance.

```
alias ffmpeg='ffmpeg -hide_banner '
alias ffplay='ffplay -hide_banner -autoexit '
alias ffprobe='ffprobe -hide_banner  '
```

☞ The `-autoexit` option for the `ffplay` command ensures that it makes a clean exit after playing a file instead of sticking around like it has crashed.

Some command examples in this book will have the suffixes `2> /dev/null` or `> /dev/null`. Such recourses were necessary to prevent information clutter.

ffprobe

If you want to find out useful information about an audio or video file, you need to use `ffmpeg` with the `-i` option. With `ffprobe`, you do not need the option.

```
ffmpeg -i tada.wav
ffprobe tada.wav
```

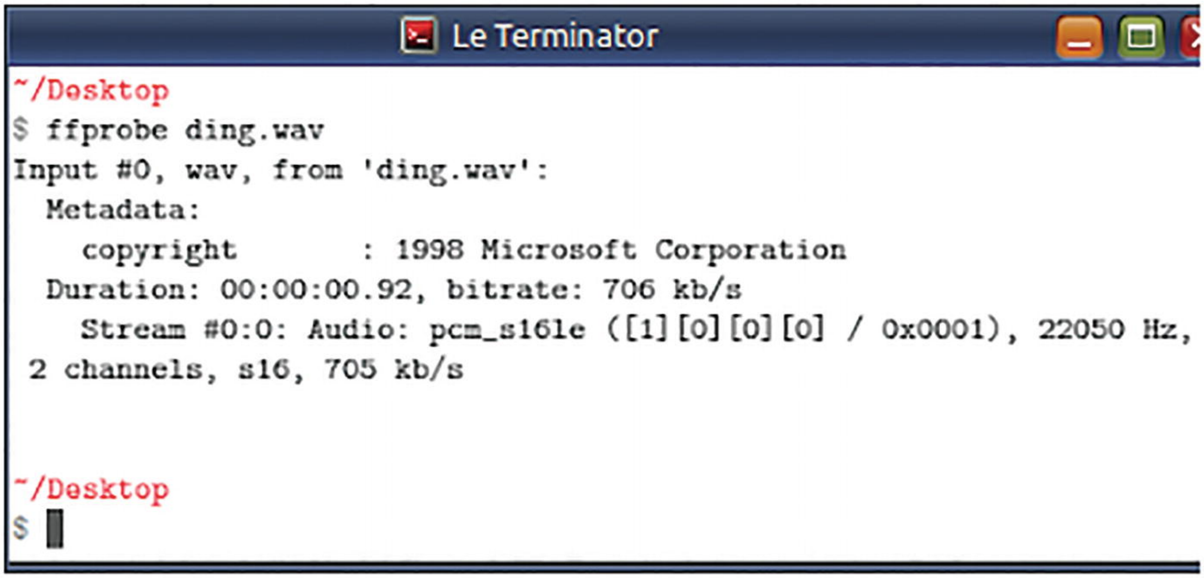

Figure 2-1 `ffprobe` can be used to display information about what is contained in a multimedia file

`ffprobe` can reveal much more information than this if you use the `-show_streams` option. You can filter the output of this command for use in your shell scripts. In a later chapter, you will find a sample output of this command.

```
ffprobe -show_streams somefile.mp4
```

`ffplay`

If you want to play a video file directly from the command line, just type `ffplay` and the file name. `ffplay` is a tiny media player. It does not have a context menu system or other interface. It responds to some keys and mouse clicks but does nothing more.

```
ffplay solar.mp4
```

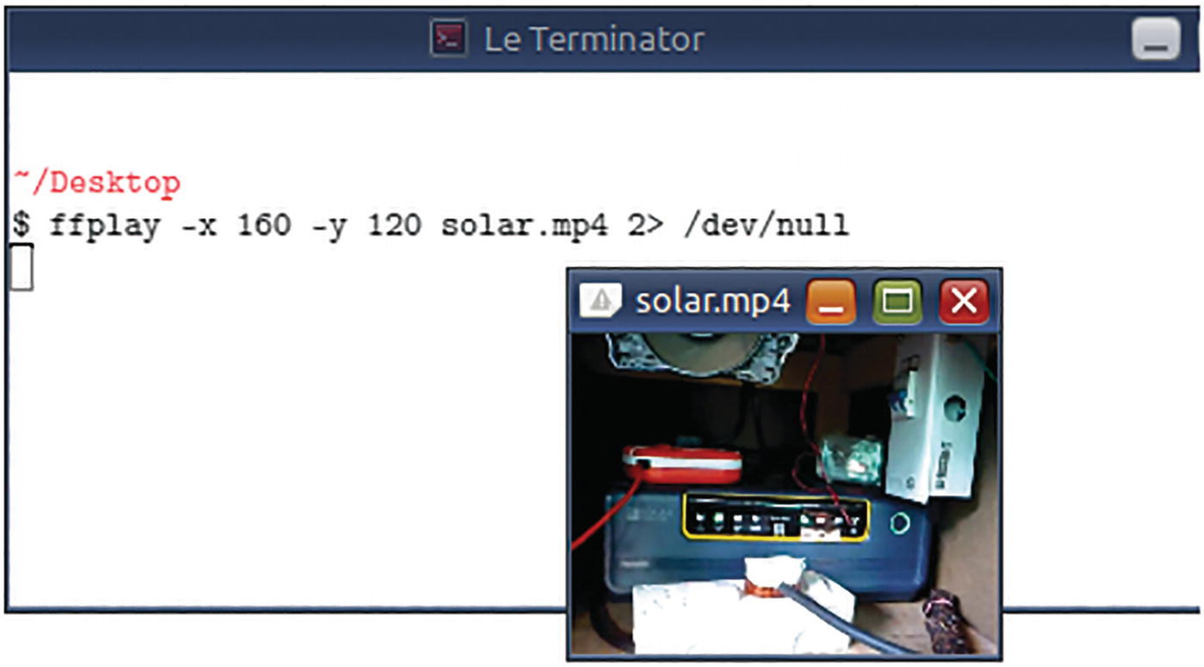

Figure 2-2 `ffplay` can be used to play audio and video files

To play an audio file without the (windowed) interface, say, as an audio notification in a shell script, you can use `ffplay` like this:

```
ffplay -autoexit -nodisp ding.wav
```

ffmpeg

The executables `ffprobe`, `ffplay`, and `ffmpeg` have several common command-line options (arguments, switches, or parameters). You can list most of them with the `-h` option.

```
ffmpeg -h
ffmpeg -h long
ffmpeg -h full > ffmpeg-help-full.txt
```

If you want to review some of the features supported by your installation of FFmpeg, try these:

```
ffmpeg -formats
ffmpeg -encoders
ffmpeg -decoders
ffmpeg -codecs
ffmpeg -filters
```

The output of these commands will give you a good overview of what FFmpeg can do. Sample output of these commands is available as annexures in this book.

You can dig out more specific help information with commands such as these:

```
ffmpeg -h demuxer=mp3
ffmpeg -h encoder=libmp3lame
ffmpeg -h filter=drawtext
```

Other FFmpeg End-User Programs

The FFmpeg project provides a few other command-line tools in addition to the three introduced in this chapter. Their purpose and usage are beyond the scope of this book. If you wish to do your own R&D, then you can find their files at `www.gyan.dev/ffmpeg/builds/#tools`.

Summary

In this chapter, you gained an introduction to the three FFmpeg executables. Before venturing into what FFmpeg can do for you, you need to learn a few things about multimedia formats and codecs. The next chapter will help you with that.

V. Subhash, *Quick Start Guide to FFmpeg*

https://doi.org/10.1007/978-1-4842-8701-9_3

3. Formats and Codecs

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(1) Chennai, Tamil Nadu, India

An MP3 audio file can be identified by its ".mp3" file extension. Similarly, an MP4 video file can be identified by the ".mp4" extension. The file extensions of multimedia files do not provide any kind of surety about the format. Even the format name is merely a notion. If you need to process audio and video content, you need to go beyond file extensions. You need to be familiar with multimedia concepts such as containers, codecs, encoders, and decoders. In this chapter, you will gain some basic information about all that and more.

Containers

Multimedia files such as MP4s or MP3s are just *containers* – containers for some audio and/or video content. An MP4 file is a container for some video content written using the *H.264 codec* and some audio content written using the *AAC codec*. It need not be like that for all MP4 files. Some MP4 files may have their video content written using the *Xvid codec* and the audio content written using the *MP3 codec*. Similarly, AVI, MOV WMV, and 3GP are popular containers for audio/video content. Codecs can differ from file to file even if their extensions are the same. A multimedia file may have the wrong extension because of some human error. You can expect all sorts of combinations in the wild.

When the codecs are not what is usually expected in a container, you may encounter annoying format errors in playback devices. Sometimes, you may be able to fix the error by simply renaming the file with the correct extension. At other times, you will have to re-encode the file using *codecs* supported by the device. So, what does it mean when a device says it only supports certain "codecs"?

Codecs, Encoders, and Decoders

When audio and video recordings transitioned from analog to digital, equipment manufacturers developed algorithms to store audio waveforms and video frames in a scheme retrievable by computer software. Initially, these storage schemes were proprietary, and their documentation was not publicly available. With the rise in the popularity of digital media devices, interoperability and open standards became necessary.

When multimedia (audio or video) content is written or stored in a computer file, it is written in a specific retrievable format developed by the manufacturer of the multimedia equipment. The algorithm used to read or write multimedia content in a specific format became known as a **codec** (coder-decoder). The software used for writing the content using the codec became known as an **encoder**. The software used to read the written content became known as a **decoder**. A camera uses an *encoder* chip to store captured video. A TV uses a *decoder* chip to play the video from a USB drive. On a personal computer, the logic of encoder and decoder chips is installed as a *software codec*.

Raw audio or video requires a lot of space when stored on a computer file. The multimedia industry, led by camera manufacturers and computer companies, has developed several compression techniques to squeeze multimedia content on to as few bytes of storage as possible. The efficiency of the compression techniques varies. When the compression discards some content (assuming that the human ear or the eye would not miss it) for a dramatic decrease in the size of the file, the technique would be known as *lossy compression*. When no content was discarded, the technique was known as *lossless compression*. Lossless compression techniques are not used everywhere because of the high file-space requirement.

To suit real-world requirements, most codecs provide options to their algorithm so that a balance between file size reduction and detail loss can be specified on a preset or *ad hoc* basis. You will do the same when you use FFmpeg. For example, in the following command, to convert an uncompressed audio from a microphone recording to a lossy compressed audio format, several settings such as bitrate, number of channels, and sampling frequency are specified.

```
ffmpeg -i uncompressed-stereo.wav \
       -c:a libmp3lame -b:a 128k -ac 2 -ar 44100 \
       compressed.mp3
```

> ☞ You will learn more about these settings in later chapters, but for now just be aware that they are often required.

Demuxers and Muxers

I have been using FFmpeg for years without knowing what demuxers and muxers were. Even now, I cannot care less. Well… maybe a little. A *demuxer* is a software component that can read a multimedia input file so that a decoder can work on it. Similarly, a *muxer* writes data to a multimedia output file after it has been processed by an *encoder*. Between a decoder and encoder, some processing work may be done, or it may even pass directly to the other end. Here is all that you need to know:

- To write to a particular container format, the format's muxer is required.
- To read from a particular container format, a demuxer is required.

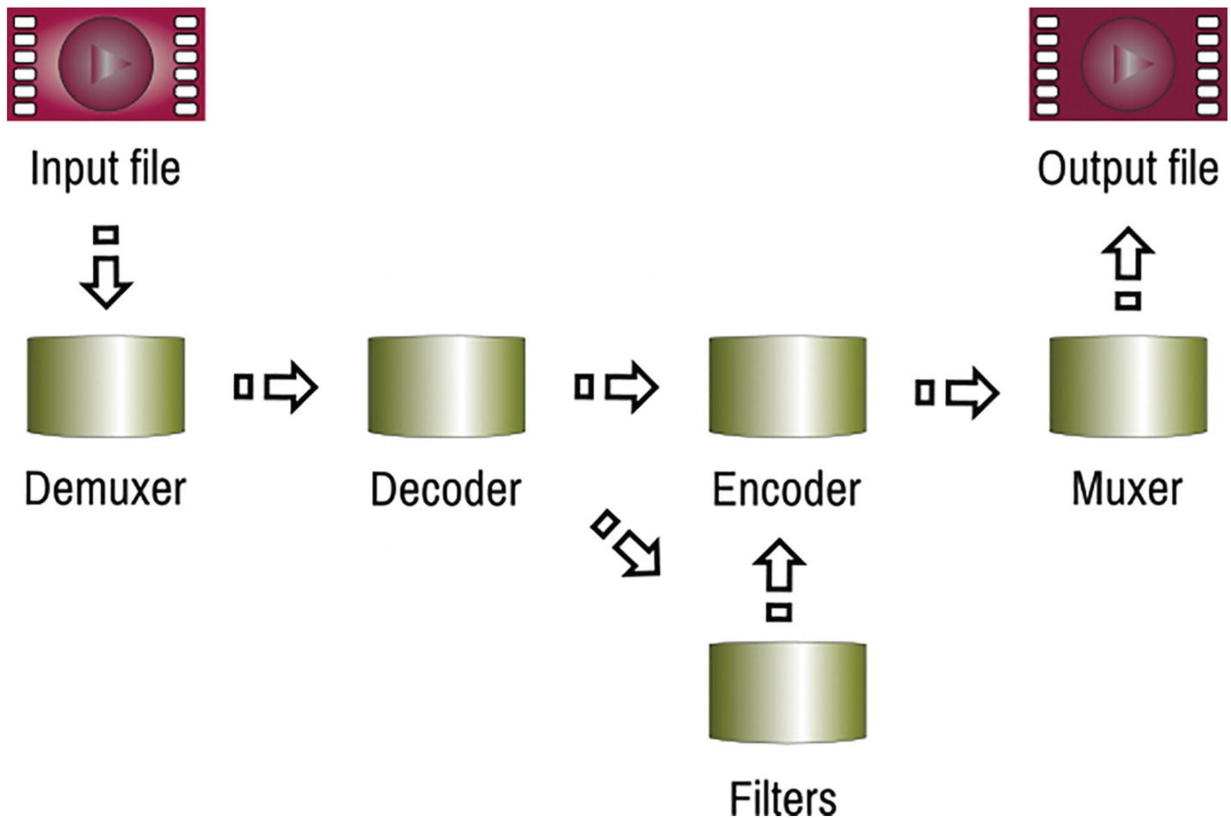

Figure 3-1 This schematic shows how different components in FFmpeg work together to give the output you want

For example, to read and write to the MP4 format, an MP4 demuxer and an MP4 muxer are required. FFmpeg automatically takes care of muxers and demuxers so that you do not have to bother with them. However, there may come situations when you do have to explicitly address them.

```
~/Desktop
$ ffmpeg -h demuxer=gif
Demuxer gif [CompuServe Graphics Interchange Format (GIF)]:
GIF demuxer AVOptions:
  -min_delay         <int>        .D....... minimum valid delay between
  -max_gif_delay     <int>        .D....... maximum valid delay between
  -default_delay     <int>        .D....... default delay between frame:
  -ignore_loop       <boolean>    .D....... ignore loop setting (netscap
```

Figure 3-2 This demuxer help output provides a clue as to how to create endlessly looping GIF animations

Summary

In this chapter, you learned some theoretical concepts about multimedia formats, containers, and codecs. In the next chapter, we will delve deeper into the container and learn how to refer to its constituents from the command line using index numbers.

V. Subhash, *Quick Start Guide to FFmpeg*

https://doi.org/10.1007/978-1-4842-8701-9_4

4. Media Containers and FFmpeg Numbering

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In the previous chapter, you learned that a multimedia file is actually a container. On the inside, it encloses multimedia *streams* and *metadata*. In this chapter, you will learn what streams and metadata are and how you can access them from the command line. The sections in this chapter are arranged for easy access and completeness. It may not be possible for you to understand all of it on your first read. Return to this chapter a few times to get a full understanding.

Containers

A container can have several streams. A stream could be audio, video, subtitles, or a file attachment.

In an MP4 video file or container, you will usually find a *video stream* and an *audio stream*. In an MP3 file, you will find an audio stream and maybe some IDv3 tags (such as title, album, and artist) as metadata.

If you have one of those rare multi-angle DVDs, then each camera angle will be represented by a separate *video stream*. Multi-language videos will have an *audio stream* for each language. DVD subtitles for multiple languages are represented as individual *subtitle streams*. MKV files may have custom font files for displaying the subtitles. These font files will be represented as *file-attachment streams*.

In an audio stream, there can be several channels. A mono audio stream has only one channel. A stereo stream has two channels - left and right. A DVD movie's 7.1 surround sound stream has eight channels - front left, front right, center left, center right, rear left, rear right, and one LFE (low frequency effects).

FFmpeg identifies these streams, channels, and metadata **using index numbers** so that you can refer to them from the command line.

Container Internals

Logically, the internals of a multimedia file look like this. A container needs to have at least one stream. Everything else is optional. It is all right for a video file to not have album art, subtitles, custom fonts, or tags (global metadata), but one video stream and one audio stream are usually expected.

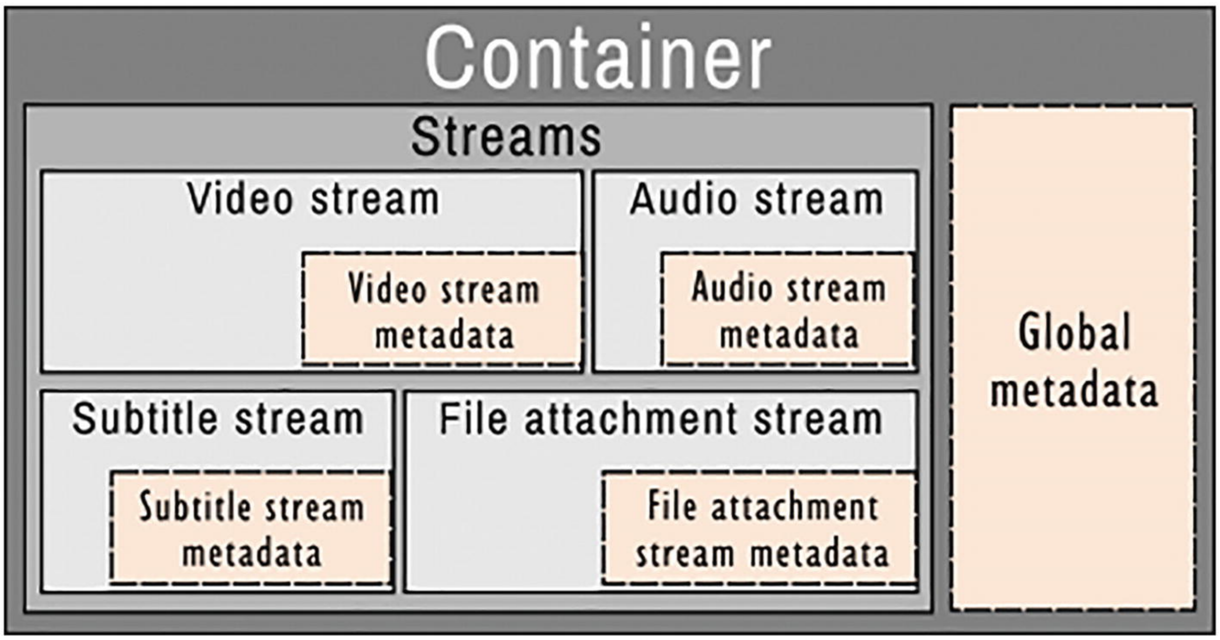

Figure 4-1 Internals of a multimedia file container

From this logical representation, you will note that a multimedia file container may have some global metadata and that each stream in the container can have stream-specific metadata too.

You can use `ffprobe` to display these details for any multimedia file.

```
~/Desktop/FasDrive
$ ffprobe "Flyte1 - Manic Monday (Album).mp3"
Input #0, mp3, from 'Flyte1 - Manic Monday (Album).mp3':
  Metadata:
    title           : Manic Monday (Album)
    album           : Greatest Hits
    artist          : The Bangles
    genre           : Pop
    date            : 1990
    comment         : Purchased by V. Subhash from Flipkart - Flyte
  Duration: 00:03:03.72, start: 0.025056, bitrate: 320 kb/s
    Stream #0:0: Audio: mp3, 44100 Hz, stereo, fltp, 320 kb/s
    Metadata:
      encoder         : LAME3.98r
    Stream #0:1: Video: mjpeg (Baseline), yuvj420p(pc, bt470bg/unkno
    Metadata:
      comment         : Cover (front)
```

Figure 4-2 This is a sample `ffprobe` output for an audio file

In this `ffprobe` output, the global metadata for the MP3 file shows ID3 tags such as title, album, and artist. It also includes a “comment” metadata that I added after I bought the music. The metadata for the audio stream shows that it was encoded using the LAME encoder by the music vendor. The album art is shown as a video stream but it has only one frame. More importantly, you should note that FFmpeg refers to the input files and streams using **index numbers starting from 0 (zero)**, instead of 1 (one).

Here is another example; this one is for a video file.

```
~/Desktop
$ ffprobe lucas.mkv
Input #0, matroska,webm, from 'lucas.mkv':
  Metadata:
    encoder         : libebml v1.0.0 + libmatroska v1.0.0
    creation_time   : 2020-02-19T20:30:08.000000Z
  Duration: 00:00:20.13, start: 0.000000, bitrate: 507 kb/s
    Stream #0:0: Video: h264 (High), yuv420p(progressive), 320x180 [SAR 1:1 DAR 16:9], 24 fps, 24 tbr, 1k tbn, 48 tbc (default)
    Stream #0:1: Audio: mp3, 44100 Hz, stereo, fltp, 128 kb/s (default)
    Stream #0:2: Subtitle: ass (default)
    Stream #0:3: Attachment: ttf
    Metadata:
      filename        : Florentia.ttf
      mimetype        : application/x-truetype-font
```

Figure 4-3 This is a sample `ffprobe` output for a video file

What does this output say?

- The MKV file is identified as the first input file `(#0)`.
- It has **global metadata** for creation time but none for title, copyright, comments, etc.
- The first stream `(#0:0)` is a **video stream** and requires a H.264 decoder.
- The second stream `(#0:1)` is an **audio stream** and requires an MP3 decoder. The audio is in stereo, that is, it has two channels.
- The third stream `(#0:2)` is a **subtitle stream** and requires a decoder for the Substation Alpha (SSA) format.
- The fourth stream `(#0:3)` is a custom font for displaying the subtitles. It is stored as a **file-attachment stream**.

- The fourth stream also has some **stream-specific metadata** identifying the font file's name and mimetype. This is important because the SSA subtitles may refer to the font by this name.

> ☞ *Mimetype* is a more rigorous file-type definition (than file extensions) and is usually used by websites to identify downloads to web browsers.

Input and Output Files

An `ffmpeg` command can have multiple input and output files. The following command has two input files and one output file. (For now, ignore the line with the filter. Filters are explained in Chapter 7.)

```
ffmpeg -i solar.mp4 -i overlay.png \
       -filter_complex "overlay=370:260:" \
       watermarked-solar.mp4
```

> ☞ When specifying multiple input files, place options specific to one input file on the left side of `-i` option. Whatever specified after the file name applies to the next input file (`-i`) or (in its absence) the next output file.

> ☞ ffmpeg can also read from streams and write to them. The streams can be piped from/to another command and also

transported over a network protocol. For more information, read the official documentation on *protocols*.

A video of my solar inverter and the cover image of one of my books are the input files. The command renders the image at 370 pixels from the left edge and 260 pixels from the top edge of the video.

Figure 4-4 The output video is the input video with the overlaid input image

The two **input files were specified using the `-i` option**. An MP4 video file is input file `#0` and a PNG image file is input file `#1`. **The output file, as is always, has been specified last**.

```
~/Desktop
$ ffmpeg -i solar.mp4 -i overlay.png \
>        -filter_complex "overlay=370:260:" \
>        watermarked-solar.mp4
Input #0, mov,mp4,m4a,3gp,3g2,mj2, from 'solar.mp4':
  Metadata:
    comment         : MOV00127
  Duration: 00:01:36.93, start: 0.000000, bitrate: 390 kb/s
    Stream #0:0(und): Video: h264 (High) (avc1 / 0x31637661)
SAR 1:1 DAR 4:3], 351 kb/s, 24 fps, 24 tbr, 12288 tbn, 48 tb
    Metadata:
      handler_name    : VideoHandler
    Stream #0:1(und): Audio: aac (LC) (mp4a / 0x6134706D), 8
40 kb/s (default)
    Metadata:
      handler_name    : SoundHandler
Input #1, png_pipe, from 'overlay.png':
  Duration: N/A, bitrate: N/A
    Stream #1:0: Video: png, rgba(pc), 245x200 [SAR 11811:11
br, 25 tbn, 25 tbc
Stream mapping:
  Stream #0:0 (h264) -> overlay:main (graph 0)
  Stream #1:0 (png) -> overlay:overlay (graph 0)
  overlay (graph 0) -> Stream #0:0 (libx264)
  Stream #0:1 -> #0:1 (aac (native) -> aac (native))
Press [q] to stop, [?] for help
```

Figure 4-5 The output of the command shows the index numbers used for the input files and streams

The output of the command shows that the first stream in the first input file is a video stream and is numbered `#0:0`. The second stream in that file is an audio stream and is numbered `#0:1`. The first stream in the second input file (the PNG image file) is considered as a video stream even though it has only one (image) frame and is identified as `#1:0`.

You can refer to streams by their type. In the previous command, the streams were as follows:

- `0:v:0` (first file's first video stream) or `0:0` (first file's first stream)
- `0:a:0` (first file's first audio stream) or `0:1` (first file's second stream)
- `1:v:0` (second file's first video stream) or `1:0` (second file's first stream)

For this to become clear, spend some time studying the screenshot in Figure 4-5.

Suppose that a multi-language DVD video file had one video stream and two audio language streams. The streams can be referred as follows:

- `0:v:0` (first video stream) or `0:0` (first stream)
- `0:a:0` (first audio stream) or `0:1` (second stream)
- `0:a:1` (second audio stream) or `0:2` (third stream)

☞ In the output of `ffmpeg` commands, you will encounter index numbers ignoring the stream type. To make your FFmpeg commands somewhat fail-safe, I recommend that you refer to streams by their type instead.

As you may have guessed, the stream-type identifier for video is `v` and `a` for audio. There are others as given in Table 4-1.

Table 4-1 Stream-type identifiers

Stream type	Identifier
Audio	a
Video	v
Video (not images)	V
Subtitles	s
File attachments	t
Data	d

After displaying the information about the input files and streams, `ffmpeg` will list how the input streams will be processed and mapped to intermediate and final streams. Then, it will list the final output files and their streams. In a `bash` terminal, you can press the key combination Ctrl+S if you wish to pause and study this information. Otherwise, all of this information will quickly flash past your terminal as `ffmpeg` will then post a huge log of informational, warning, and error messages as it performs the actual processing of the input data.

Maps

With multiple input files, FFmpeg will use an internal logic to choose which input streams will end up in the output file. To override that, you can use the `-map` option. Maps enable you to specify your own selection and order of streams for the output file. You can specify stream mapping in several ways:

- `-map InputFileIndex`

  all streams in file with specified index
- For example, `-map 1` means

  all streams in second (1) input file.
- `-map InputFileIndex:StreamIndex`

  the stream with specified index in file with specified index
- For example, `-map 0:2` means

  third (2) stream in first (0) input file.
- `-map InputFileIndex:StreamTypeIdentifier`

  all streams of specified type in file with specified index
- For example, `-map 1:s` means

all subtitle (s) streams in second (1) input file.

- `-map InputFileIndex:StreamTypeIdentifier:StreamIndex` among streams of specified type in file with specified index, the stream with specified index
- For example, `-map 2:s:1` means second (1) subtitle (s) stream in third (2) input file.

Information overload? Let me explain with an example. When I created this stop-motion video a few years ago, I used a gramophone recording as the background music. Typical of old record music, it had a lot of sound artifacts. At that time, I did not know much about FFmpeg. So, I used FFmpeg to extract the audio as an MP3 file but used the free *Audacity* program to apply a *low-pass filter*. Then, I used FFmpeg again to swap the original audio with the MP3 fixed by Audacity.

Figure 4-6 The audio of this video had gramophone sound artifacts

```
# Extract the audio
ffmpeg -i Stopmotion-hot-wheels.mp4 \
       -map 0:1 \
       Stopmotion-hot-wheels.mp3
# Apply low-pass filter to Stopmotion-hot-wheels.mp3
# using Audacity and export to Stopmotion-hot-wheels-
# Swap the existing audio track with the mp3 fixed by
ffmpeg -i Stopmotion-hot-wheels.mp4 \
       -i Stopmotion-hot-wheels-fixed.mp3 \
       -map 0:0 -map 1:0 \
       -codec copy \
       Stopmotion-hot-wheels-fixed.mp4
```

☞ `-codec copy` or `-c copy` copies the streams as they are, instead of unnecessarily re-encoding or converting them again. It saves a lot of time.

In the first command, I included a map for the second stream `(0:1)` in the MP4 file and saved it as an MP3 file. (I assumed that the second stream was an audio stream. It need not be.) I then corrected errors in the MP3 file using Audacity. In the second command, the first input file (the MP4 file) had two streams – `(0:0)` and `(0:1)` – same as in the first command. (More assumptions.) The second input file (the "fixed" MP3) had one stream `(1:0)`. In the second command, I used the first file's first stream `(0:0)` and the second file's first and only stream `(1:0)`. Alternatively, I could have typed the command by mapping to the first file's first video stream `(0:v:0)` and the second file's first audio stream `(1:a:0)`.

```
ffmpeg -i Stopmotion-hot-wheels.mp4 \
       -i Stopmotion-hot-wheels-fixed.mp3 \
       -map 0:v:0 -map 1:a:0 \
       -codec copy \
       Stopmotion-hot-wheels-fixed.mp4
```

☞ This alternative *fail-early* approach is safer, as it can protect you from typing mistakes.

The audio stream in the original MP4 `(0:1)` or `(0:a:0)` gets discarded because it was not included in any of the maps. If I wanted to retain the original audio stream, I can add another map for it as a second audio stream. The fixed audio track will be played by default by media players. I can manually select the second audio track with the remote or a menu option to hear the unfixed original audio.

```
ffmpeg -i Stopmotion-hot-wheels.mp4 \
       -i Stopmotion-hot-wheels-fixed.mp3 \
       -map 0:v:0 -map 1:a:0 -map 0:a:0 \
       -codec copy \
       Stopmotion-hot-wheels-fixed-n-restored.mp4
```

You can use maps when generating multiple output files with one command.

```
ffmpeg -i solar.mp4 \
  -map 0:1 -c:a libmp3lame -b:a 128k solar-high.mp3
  -map 0:1 -c:a libmp3lame -b:a 64k solar-low.mp3
```

The `-map` options provide a new set of streams available for options specified after them. Options such as `-codec` or `-ac` will only affect streams specified by the `-map` options before them, not the streams available in the input files.

Metadata

Metadata means data about data. When using FFmpeg, metadata is read by the demuxer and/or written by the muxer. The data is usually specified as **key-value pairs**. For a media file, the metadata can be global (for the entire file) or specific to a stream in the file. Each container format specifies a limited set of metadata keys. The MP3 format, for example, supports metadata keys such as title, artist, album, and copyright. You can specify metadata for individual streams as follows:

- `-metadata:s:StreamIndex` or
- `-metadata:s:StreamTypeIdentifier:StreamIndex`

This command sets metadata at the global/file/container level.

```
ffmpeg -i solar.mp4 -codec copy \
       -metadata title="Me Solar Inverter" \
       solarm.mp4
```

Figure 4-7 The background video has no metadata, and the video player just displays the file name on the window title. In the foreground video, title metadata is available, and the video player displays that text instead of just the file name

The `ffprobe` output in Figure 4-8 shows potentially incriminating information about a moonshiner MP3.

```
~/Desktop
$ ffprobe raisa.mp3
Input #0, mp3, from 'raisa.mp3':
  Metadata:
    major_brand     : mp42
    minor_version   : 0
    compatible_brands: isommp42
    title           : Musiki - Мужики
    encoder         :
    artist          : Raisa Prikolnaya - Раиса Прикольная
  Duration: 00:02:50.71, start: 0.000000, bitrate: 136 kb/s
    Stream #0:0: Audio: mp3, 44100 Hz, stereo, s16p, 128 kb/s
    Stream #0:1: Video: png, rgb24, 640x360, 90k tbr, 90k tbn, 90k tbc
    Metadata:
      title           : Screenshot-HD-2015-YouTube-mp4-1.png
      comment         : Other
```

Figure 4-8 This `ffprobe` output shows that this inveterate pirate had downloaded a music video from Youtube and ripped the audio!

```
ffmpeg -y -i raisa.mp3 \
       -map 0 -c copy \
       -metadata:s:v:0 title='raisa.png' \
       raisa2.mp3         # Smooth!
```

This command makes no changes to the MP3 except for the value of the incriminating `title` metadata of the album art.

```
    Stream #0:1: Video: png, rgb24, 640x360 [SAR 3780:3780 DAR 16:9],
90k tbr, 90k tbn, 90k tbc
    Metadata:
      title           : raisa.png
      comment         : Other
```

Figure 4-9 This updated `ffprobe` output shows that the pirate has smoothly changed the metadata. Maybe he was doing researchez academique! Non? Nhyet?

Remember my stopmotion video with multitrack audio? I can use the `-metadata` option to give its audio streams an informative language name.

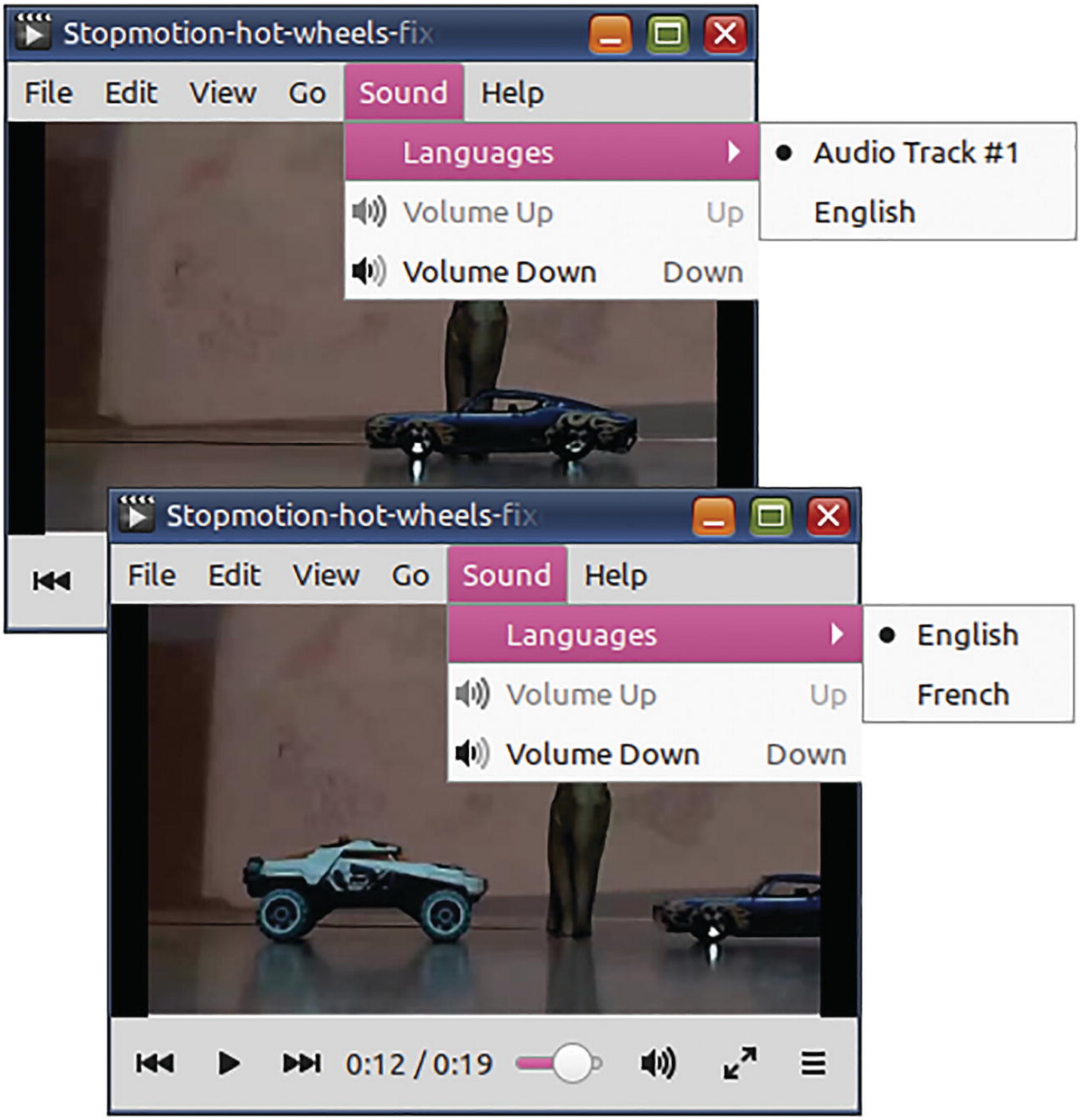

Figure 4-10 If you do not specify a language name for an audio track, media players may make wrong assumptions

```
ffmpeg -i Stopmotion-hot-wheels.mp4 \
       -i Stopmotion-hot-wheels-fixed.mp3 \
       -map 0:v:0 -map 1:a:0 -map 0:a:0 \
```

```
        -codec copy \
        -metadata:s:a:0 language="eng" \
        -metadata:s:a:1 language="fre" \
        Stopmotion-hot-wheels-fixed-n-restored.mp4
```

Remember that to set the language names for subtitle streams, the `–metadata` option should refer to subtitle streams, not audio streams.

```
  -metadata:s:s:0 language="eng" \
  -metadata:s:s:1 language="fre" \
```

The `StreamIndex` refers to the index of the stream IN THE OUTPUT FILE. The `s` after `–metadata:` identifies itself as metadata for a stream. Do not mistake it for subtitles. Also, remember that metadata is all about the output file. Do not use any numbering from the input file(s).

☞ Apart from streams (`–metadata:s`), metadata can be specified for DVD chapters (`–metadata:c`) and DVD programs (`–metadata:p`). They are not covered by this book.

☞ You can learn more about metadata in Chapter 10.

Metadata Maps

Have you noticed that when you convert MP3 files, the album art or the meta tags get lost? This is because of improper or no metadata mapping. Metadata can get lost when you convert files or create new files from multiple input files. The `–map_metadata` option helps you correctly route metadata from input files to output files. Its value is specified in a rather twisted manner. The **left is the destination** and the **right is the source**.

- `-map_metadata InputFileIndex:MetadataSpecifier` or `-map_metadata:g InputFileIndex:MetadataSpecifier` or `-map_metadata:MetadataSpecifier InputFileIndex:⏎ MetadataSpecifier`
- Where
- `MetadataSpecifier` is either `g` or `s:StreamType` (all streams) or `s:StreamType:StreamIndex` (some stream)

Yeah, it made my head spin too! Take your time. Nobody does metadata mapping on their first excursion into FFmpeg. Take the slow lane.

The following example copies global metadata from the second input file (`–map 1`) as the global metadata for the output file. This ensures that the MP3 tags are copied as the video’s metadata.

```
ffmpeg -y -i raisa.png -i raisa.mp3  \
```

```
        -c:a copy -c:v mjpeg \
        -map 0 -map 1 \
        -map_metadata 1 \
        raisa.mp4
```

The next example copies global metadata from the second input file both globally (`:g`) and to the audio stream (`:s:a`). The global metadata from the second input file can be specified either as `1:g` or simply as `1`. Global output metadata can be typed as –`map_metadata:g` (as below) or simply as –`map_metadata` (as above).

```
ffmpeg -y -i raisa.png -i raisa.mp3  \
        -c:a copy -c:v mjpeg \
        -map 0 -map 1 \
        -map_metadata:g 1:g -map_metadata:s:a 1 \
        raisa.mkv    #Does not work with MP4
```

What is the advantage of this command? If someone decides to extract just the audio stream from the MKV, the metadata does not get omitted. The stream and the MKV (global) both have a copy of the metadata from the MP3 file. The original metadata will survive even in the extracted audio stream.

```
Input #0, matroska,webm, from 'raisa2.mkv':
  Metadata:
    title           : Musiki - Мужики
    MAJOR_BRAND     : mp42
    MINOR_VERSION   : 0
    COMPATIBLE_BRANDS: isommp42
    ARTIST          : Raisa Prikolnaya - Раиса Прикольная
  Duration: 00:02:50.74, start: 0.000000, bitrate: 131 kb/s
    Stream #0:0: Video: mjpeg, yuvj444p, 640x360 [SAR 1:1 DAR 16:9], 25
fps, 25 tbr, 1k tbn, 1k tbc (default)
    Stream #0:1: Audio: mp3, 44100 Hz, stereo, s16p, 128 kb/s (default)
    Metadata:
      title           : Musiki - Мужики
      MAJOR_BRAND     : mp42
      MINOR_VERSION   : 0
      COMPATIBLE_BRANDS: isommp42
      ARTIST          : Raisa Prikolnaya - Раиса Прикольная
```

Figure 4-11 The global metadata has been duplicated to the audio stream metadata as well

☞ The `-metadata` option overrides `-map_metadata` mapping.

Channel Maps

Audio streams can have one or more channels. Monaural audio has only one channel. Stereo music has two channels - left and right. DVD movies can have two or six or eight channels for playback on both stereo and surround speaker systems.

To pin down the channels exactly as you want in the output file, you need to use the `-map_channel` option. It can be specified as follows:

- –map_channelInputFileIndex.StreamIndex.ChannelIndex
- or as
- `-map_channel -1`

  if you want the channel muted.

The `–map_channel` options specify the input audio channels and the order in which they are placed in the output file.

Imagine that the audio channels in an MP4 file are mixed up. When you wear headphones, in either ear, the voices are heard for people on the opposite side in the video. You can fix it by the following:

```
ffmpeg -i wrong-channels.mp4 \
       -c:v copy \
       -map_channel 0.1.1 -map_channel 0.1.0 \
       fine-channels.mp4
```

In a stereo audio stream, the channel order is `0.1.0` (left) followed by `0.1.1` (right). When you use a channel map of `0.1.1` followed by `0.1.0`, the channels get switched.

For the next example, imagine that you are using headphones in a work environment. You want to have one ear for music and one ear for surroundings. You could mute one of the channels.

```
ffmpeg -i moosic.mp3 \
       -map_channel 0.0.0 -map_channel -1 \
       moosic4lefty.mp3
```

☞ No, you should not make it mono. Mono audio will be heard on both sides.

In some videos, the left and right audio channels are independent tracks. What these content creators do is place the original audio on one channel and the most annoying royalty-free music on the other. Instead of deleting the offending channel, you could move each channel to a separate audio stream while preserving the original stereo stream in a third stream.

```
ffmpeg -y -i zombie.mp4 \
       -map 0:0 -map 0:1 -map 0:1 -map 0:1 \
       -map_channel 0.1.0:0.1 -map_channel 0.1.1:0.2
       -c:v copy \
       zombie-tracks.mp4
```

The first stream in the output file will be the original video `(0.0)`. The left channel `(0.1.0)` will be the second stream `(0.1)`. The right channel `(0.1.1)` will be the third stream `(0.2)`. The original stereo audio will become the fourth stream. (Yes, the second and third streams will be mono audio.)

What about the numbers after the colon? That is explained by the full definition for channel maps:

- `-map_channel InputFileIndex.InputFileStreamIndex.⏎ ChannelIndex:OutputFileIndex.OutputFileStreamIndex`

How do you like them apples? The second part beginning with the colon is optional. It is for placing the mapped input audio channel on a specified output stream.

> ☞ Channel mapping numbers use dots, not colons. The colon is used only when you begin to specify the output stream.

> ☞ Channel mapping cannot be used to mix channels from multiple input files.

> ☞ When you make changes to the channels, the audio will be converted again and this takes time. It will not be done quickly like with `-c:a copy`.

Do Not Use the `-map_channel` Option

The `-map_channel` option, with its difficulties, is on its way out. The FFmpeg version 5.1 (released in July 2022) shows this warning.

```
The -map_channel option is deprecated and will be rem
```

With newer `ffmpeg` versions, the previous commands can be rewritten using filters, which you will learn in a later chapter.

```
# Switch right and left channels of stereo audio
ffmpeg -i wrong-channels.mp4 \
       -c:v copy \
       -filter_complex "channelmap=map=FR-FL|FL-FR" \
       fine-channels.mp4
# Silence right channel
ffmpeg -i moosic.mp3  \
       -c:v copy \
       -filter_complex "pan=stereo|FL=FL|FR=0" \
       moosic4lefty.mp3
# Split channels to separate audio streams
# and also preserve existing audio stream
ffmpeg -y -ss 0:0:20 -t 0:0:20 -i zombie.mp4 \
       -c:v copy \
       -filter_complex "channelsplit[L][R]" \

       -map 0:v:0 -map '[L]' -map '[R]' -map 0:a:0 \
       -codec:a:0 aac -ac:a:0 1 \
       -codec:a:1 aac -ac:a:1 1 \
```

```
         -codec:a:2 copy \
         zombie-tracks.mp4
```

☞ The `-codec` and `-ac` options are limited to streams specified by the `-map` options specified before them.

Summary

In this chapter, you learned about how to access streams and metadata. You also learned how to pick and choose what streams and metadata you would like to have in the output file(s).

As mentioned in the beginning of this chapter, it is not necessary that you grasp every detail in this chapter on the first go. As you read forthcoming chapters, certain things mentioned in this chapter will become clearer. If not, you can always return to this chapter.

V. Subhash, *Quick Start Guide to FFmpeg*
https://doi.org/10.1007/978-1-4842-8701-9_5

5. Format Conversion

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The main reason that so many people use `ffmpeg` is its amazing ability to convert files from one format to another. `ffmpeg` supports so many formats that I doubt there is any competition even from paid software. In this chapter, you will learn how to perform these conversions and customize them to extract the best quality from the source files.

No-Brainer Conversions

The default output format in many Linux multimedia programs is OGV and OGG files. Sadly, very few consumer electronic devices support these two formats. I use `gtk-recordMyDesktop` to screen capture my computer demos, and it creates OGV video files. Before I can play the files on my TV, I need to convert them to MP4 format.

```
ffmpeg -i video1.ogv video1.mp4
```

An Ogg ringtone will play fine on an Android phone but not on a feature phone, which usually only supports MP3 and MIDI ringtones. Converting Ogg to MP3 is easy with FFmpeg.

```
ffmpeg -i alarm.ogg alarm.mp3
```

FFmpeg can guess the output format based on the file extension you have used for the output file. It will automatically apply some good preset conversion settings (defaults). You can specify custom conversion settings too.

Conversion Options

Table 5-1 lists a few FFmpeg options that are useful when converting files. You will learn how to use them in the rest of this chapter.

Table 5-1 Some FFmpeg conversion options

Option	For
-y	Prevent prompting before overwriting any existing output file
-b:a	Set audio bitrate
-c:a	Specify audio encoder or decoder

Option	For
-ar	Set audio sampling rate
-ac	Set number of audio channels
-b:v	Set video bitrate
-c:v	Specify video encoder or decoder
-r	Set video frame rate
-pass	Specify number of the encoding pass
-passlogfile	Specify prefix for multi-pass encoding log files
-f	Force specified format (or oss, alsa, rawvideo, concat, image2, null…)
-shortest	Stop all processing when any one output stream is completely processed

Option	For
-vn	Do not process video
-an	Do not process audio
-sn	Do not process subtitles

Obsolete/Incorrect Options

FFmpeg is fault-tolerant to an extent but do not be sloppy in typing the options. You should avoid using `-r:a` instead of `-ar` (audio sampling rate). Instead of conventions such as `-acodec` and `-vcodec`, you should be using `-c:a` or `-c:v` instead. Support for such old practices may be removed in future.

Codec Option

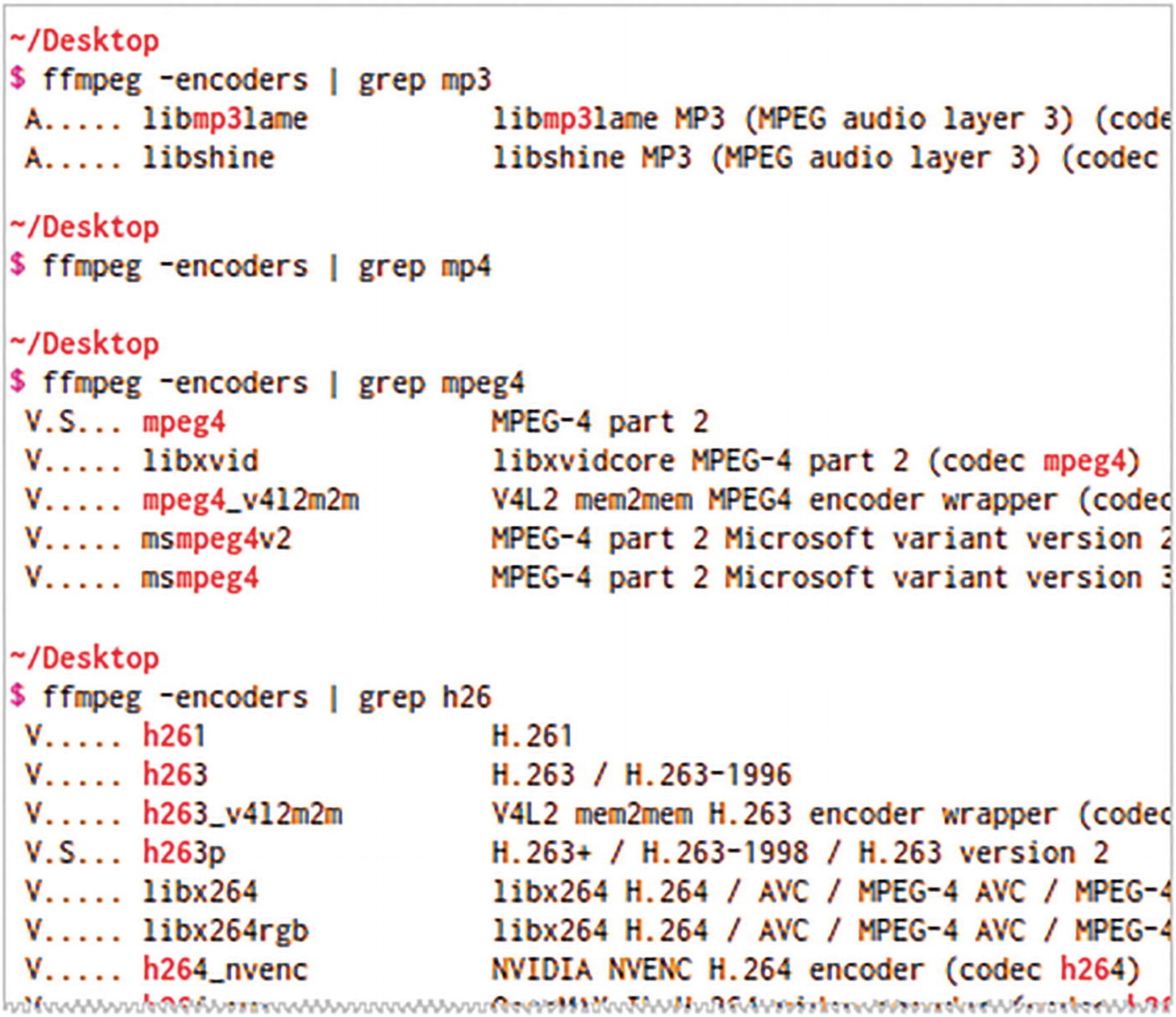
The `-codec` option is used to specify an encoder (when used before an output file). When used before an input file, it refers to the decoder. (`ffmpeg` may have more than one decoder and encoder for a particular codec.) Choose the correct name from the output of the command `ffmpeg -encoders` or `ffmpeg -decoders`, and not from that of `ffmpeg -codecs`.

The `-codec` option can also be specified for all streams for a particular type, such as `-codec:a` for all audio streams or `-codec:s` for all subtitle streams or for a particular stream using its index. For each stream, only the last applicable `-codec` option will be considered. If you use the value `copy` for the encoder, `ffmpeg` will copy applicable streams as is without using an encoder.

How do you know which codec (encoder name) you need to use for a particular format? For an MP3 file, you could try the following:

```
ffmpeg -encoders | grep mp3
```

It may not be so straightforward with other formats. Browse through the full output of the command `ffmpeg -encoders` to become familiar with codec names. Sample output of this command is available in Annexure 3. Then, you will learn that H.264 and MPEG-4 codecs have something to do with MP4 files. You could also use `ffprobe` on existing file samples and find prospective codec names.



```
~/Desktop
$ ffmpeg -encoders | grep mp3
 A..... libmp3lame           libmp3lame MP3 (MPEG audio layer 3) (code
 A..... libshine             libshine MP3 (MPEG audio layer 3) (codec

~/Desktop
$ ffmpeg -encoders | grep mp4

~/Desktop
$ ffmpeg -encoders | grep mpeg4
 V.S... mpeg4                MPEG-4 part 2
 V..... libxvid              libxvidcore MPEG-4 part 2 (codec mpeg4)
 V..... mpeg4_v4l2m2m        V4L2 mem2mem MPEG4 encoder wrapper (codec
 V..... msmpeg4v2            MPEG-4 part 2 Microsoft variant version 2
 V..... msmpeg4              MPEG-4 part 2 Microsoft variant version 3

~/Desktop
$ ffmpeg -encoders | grep h26
 V..... h261                 H.261
 V..... h263                 H.263 / H.263-1996
 V..... h263_v4l2m2m         V4L2 mem2mem H.263 encoder wrapper (codec
 V.S... h263p                H.263+ / H.263-1998 / H.263 version 2
 V..... libx264              libx264 H.264 / AVC / MPEG-4 AVC / MPEG-4
 V..... libx264rgb           libx264 H.264 / AVC / MPEG-4 AVC / MPEG-4
 V..... h264_nvenc           NVIDIA NVENC H.264 encoder (codec h264)
```

Figure 5-1 `ffmpeg` lists a lots of encoders, several pages full. You may miss some important ones if you make assumptions and filter the output. Use the command `ffmpeg -encoders | more` to conveniently browse the full output

Sample Conversion with Custom Settings

If I wanted to convert a HD video downloaded from the Internet for playing on my old portable media player, I would use these settings.

```
ffmpeg -i net-video.mp4 \
       -s 320x240 \
       -c:v mpeg4 -b:v 200K -r 24 \
       -c:a libmp3lame -b:a 96K -ac 2  \
       portable-video.mp4
```

The output video stream uses MPEG4 codec with qvga (320x240) dimensions, 200K bitrate, and a 24 frames-per-second rate. The output audio stream uses MP3 codec (Lame encoder) with two-channel audio (stereo) and 96K bitrate.

> ☞ You will know what values to use for each setting only if you make it a habit to use `ffprobe` on new types of files that you encounter.

> ☞ The bitrate is how densely the audio or video content is stored in the container. The greater the compression, the lesser is the bitrate and file size, and so is the quality. You need to find a balance between quality loss and file size reduction.

Multi-pass Conversion

In multi-pass encoding, `ffmpeg` processes the video stream multiple times to ensure the output video is close to the specified bitrate. `ffmpeg` creates a log file for each pass. In the initial passes, the audio is not processed and video output is not saved (dumped on null device). In the final pass, however, you will have to specify the audio conversion settings and the output file. In the next example, the conversion from the previous section is performed using two passes.

This is the first pass.

```
ffmpeg -y -i net-video.mp4 \
         -s 320x240 -c:v mpeg4 -b:v 194k -r 24 \
         -f mp4 -pass 1 -passlogfile /tmp/ffmpeg-log-
         -an /dev/null
```

☞ Windows users should use `NUL` instead of `/dev/null`.

And, this is the last pass.

```
ffmpeg -y -i net-video.mp4 \
         -s 320x240 -c:v mpeg4 -b:v 194k -r 24 \
         -pass 2 -passlogfile /tmp/ffmpeg-log-net-vid
         -c:a libmp3lame -ac 2 -b:a 96K \
         portable-video.mp4
```

Multiple passes of the first kind may be required for achieving a particular bitrate. Use the same video conversion settings for all passes.

☞ When the streams meet the specified bitrates, you will also know exactly how big the file will be. Just multiply the bitrate with the duration of the video. The reverse is also true. You can target a particular file size (allowing for some deviation) by specifying a proportional bitrate for both the audio and video. Conversion with constant bitrate was popular when DVD videos were encoded (ripped off) to fit on a CD.

Conversion for Maximum Compression and Quality

Multimedia codecs provide a trade-off between speed, quality, and compression. Now that we have almost unlimited online and offline space, constant quality rather than constant bitrate is preferred. With the H.264 codec, you can achieve the required quality and compression in *one pass* using the `-crf` (CRF or Constant Rate Factor) option and by specifying a processing “preset.” The `-crf` option affects quality.

```
x264 Presets     x264 Tune      x264 Profiles
~~~~~~~~~~~~     ~~~~~~~~~      ~~~~~~~~~~~~~
ultrafast        film           baseline
superfast        animation      main
veryfast         grain          high
faster           stillimage
fast             psnr
medium           ssim
slow             fastdecode
slower           zerolatency
veryslow
placebo
```

Figure 5-2 This extract from the output of an old script shows preset and tuning variables supported by the H.264 encoder

```
ffmpeg -i solar.mp4 \
       -c:v libx264 -crf 21 -preset fast \
       -c:a copy \
       solar-CONVERTED.mp4
```

Figure 5-3 The `ffmpeg` output stream details will tell you which pixel format has been used

The CRF range is from 0 (lossless) to 63 (worst) for 10-bit pixel formats (such as `yuv420p10le`) and 0 to 51 for 8-bit pixel formats (such as `yuv420p`). You can determine the pixel format from the `ffmpeg` output of a similar file conversion. The median can be 21 for 8-bit encoder and 31 for 10-bit encoder.

What the heck is a pixel format? All that you need to know about pixel format (at this stage) is that it is a data-encoding scheme used to specify the colors of each pixel (dots) in a video frame. FFmpeg supports these pixel formats: `monob, rgb555be, rgb555le, rgb565be, rgb565le, rgb24, bgr24, 0rgb, bgr0, 0bgr, rgb0, bgr48be, uyvy422, yuva444p, yuva444p16le, yuv444p, yuv422p16, yuv422p10, yuv444p10, yuv420p, nv12, yuyv422`, and `gray`.

In addition to the processing preset, you can also specify a `-tune` option depending on the kind of video that you have selected. The values `psnr` and `ssim` are used to generate video quality metrics and are not normally used in production. `zerolatency` output can be used for streaming. `fastdecode` can be used for devices that do not have a lot of processing power. `grain` is to prevent the encoder from being confused by grainy videos.

Audio Conversion

This command uses the Lame MP3 encoder to convert an Ogg audio file to a 128K-bitrate two-channel (stereo) MP3 file.

```
ffmpeg -i alarm.ogg \
       -c:a libmp3lame \
       -ac 2 \
       -b:a 128K \
       alarm.mp3
```

> ☞ There is a better method for converting to MP3 files. You will find it in Chapter 11.

Audio Extraction

Some video files have great sound. Music videos are good examples. How do you extract their audio? Well, drop the video stream and copy the audio stream to an audio file.

```
# Matroska audio
ffmpeg -i music-video.mp4 -c:a copy music-video.mka
# MPEG4 audio - FFmpeg flounders
ffmpeg -i music-video.mp4 -vn -c:a copy music-video.m
```

☞ Without -vn, the video stream will get copied to the m4a file! Hurray for redundant options! Le paranoid survive!

Matroska audio or ".mka" files support several audio codecs. The ".m4a" files support AAC (MPEG4 audio) codec.

If you already know that the audio stream in the MP4 file has been encoded with MP3 codec (as they do sometimes), you can `-codec:a copy` the audio stream to a ".mp3" file. Most of the time, however, you will have to *encode* it to MP3. Files with extension ".mka" and ".m4a" are not supported by many playback devices. The following command converts the audio stream of the video file using the Lame encoder to create a two-channel (stereo) MP3 file encoded at 128K bitrate.

```
ffmpeg -i music-video.mp4 \
       -c:a libmp3lame -b:a 128K -ac 2 \
       music-video.mp3
```

You can simultaneously output audio in different bitrates using multiple –`map` options.

```
ffmpeg -i music-video.mp4 \
  -vn \
  -map 0:a -c:a libmp3lame -b:a 128K music-high.mp3 \
  -map 0:a -c:a libmp3lame -b:a 64K music-low.mp3
```

☞ As one understands, this is strictly for limited doomsday archival purposes…. Several films and music records have been lost to studio fires. Anything can happen. Cite the 2020 pandemic.

🤓

Extract Stills from a Video (Video-to-Image Conversion)

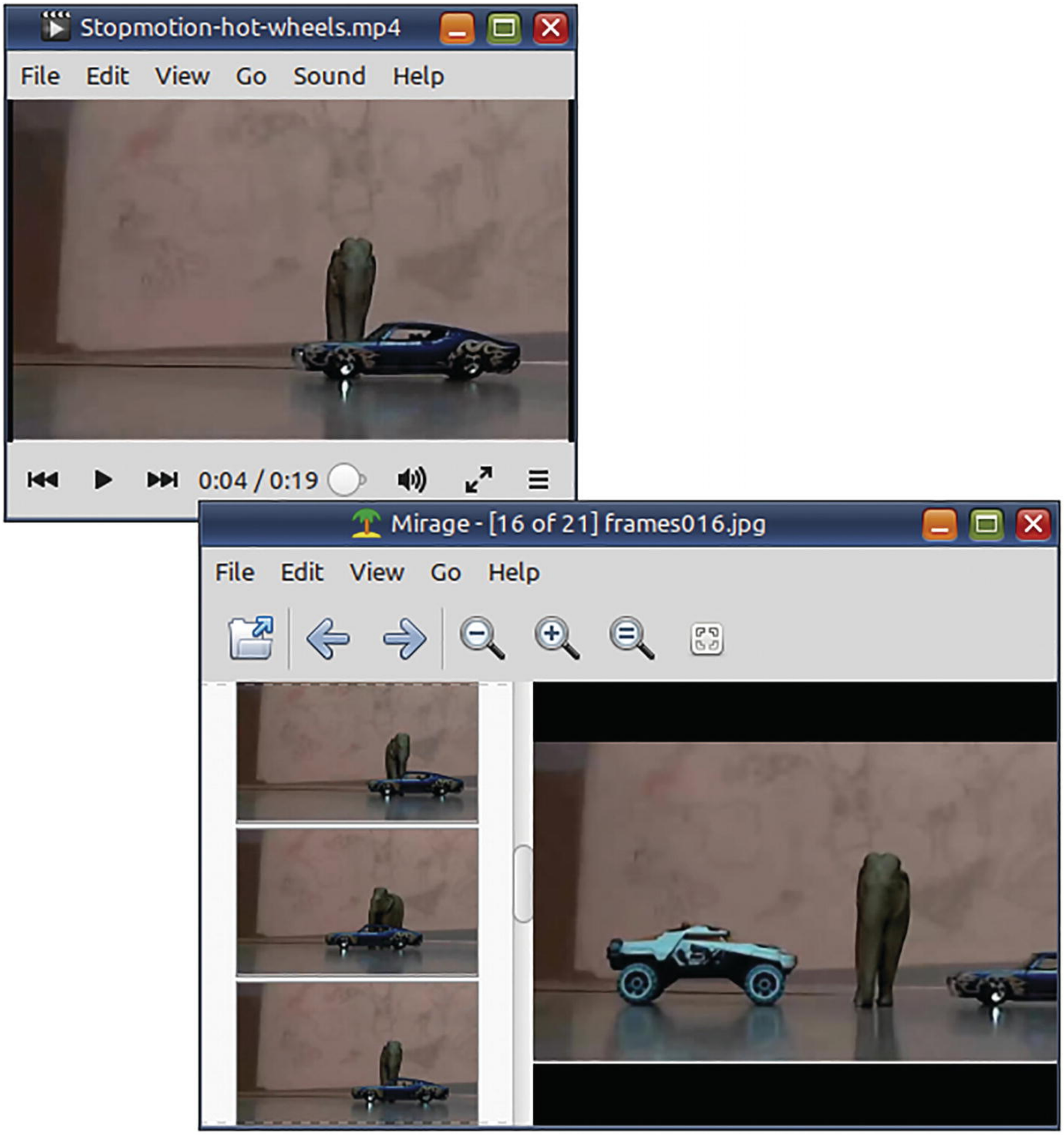


Figure 5-4 A video and the still-image frames extracted from it

To extract video frames as image files, you need to use the `-f image2` option. The numbering of the output images is specified in the name of the output file. The format mask of the output file is similar to that of the `printf` function in the C programming language. In the mask used in the next command, `%` is for character output, `0` is for padding with zeros instead of spaces, `3` is for the total number of digits, and `d` is for integer numbers.

```
# Extract images at the rate of 1 frame per second fr
ffmpeg -y -i Stopmotion-hot-wheels.mp4 \
       -r 1 \
       -f image2 \
       frames%03d.jpg 2> /dev/null
```

☞ Most videos are encoded with a frame rate of 24, 25, 30, or even 60 frames per second. Be careful with your extraction rate and length of the video, or you will quickly run out of space.

Use the `–r` option to restrict the number of images generated for each second of the source video. You can omit the `–r` option to extract all frames (and let it be determined by the frame rate of the source video) but

- Use small video clips as the source
- Use `–t` and `–ss` options (described in Chapter 6) to restrict the extracted duration of the source video

Image-Conversion Settings

Table 5-2 lists some FFmpeg conversion options that are useful when working with image files. Although this book will describe how to use them, more comprehensive information will be found in the official FFmpeg documentation.

Table 5-2 `ffmpeg` image-conversion options and examples

Option	Purpose
`-f image2`	Force conversion to and from images
`-f image2pipe`	Force image conversion for output piped over to another command
`-loop 1`	Repeat the processing of the input image indefinitely
`-pix_fmt yuv420p`	Use `yuv420p` pixel format when converting to image formats

Create Video from Images (Image-to-Video Conversion)

FFmpeg can also do the reverse by creating a video from several images (when they are numbered serially). The duration of the video depends on the number of images available and frame rate you have specified. If the -r option in the video-to-image conversion was higher (in the previous command), say between 12 and 30, a lot more images would have been extracted, and this video would have been smoother.

```
ffmpeg -r 1 -i frames%03d.jpg \
       -s qvga -pix_fmt yuv420p \
       Stopmotion-hot-wheels-reconstituted.mp4 2> /de
ffplay -autoexit \
       Stopmotion-hot-wheels-reconstituted.mp4 2> /de
```

☞ All input images should be of the same format and dimensions.

☞ The -pix_fmt yuv420p option is necessary to ensure such unusual video files play all right in most media player devices.

Create a Slideshow from Several Images

In the previous section, the output video ran out quickly because there were not many input images. If you want each input image to appear for longer than a second, then you need to specify a -framerate option for them as well. An input frame rate of 1/3 ensures that a frame plays for 3 seconds.

```
ffmpeg -y -framerate 1/3 -i image%02d.jpg \
         -filter:v \
           "scale=eval=frame:w=640:h=480:
```

```
            force_original_aspect_ratio=decrease,
            pad=640:480:(ow-iw)/2:(oh-ih)/2:yellow"
        -pix_fmt yuv420p -r 24 \
        slide.mp4
```

☞ You will learn more about filters in Chapter 7.

The preceding command also takes care of images with irregular dimensions and ensures that they are resized appropriately.

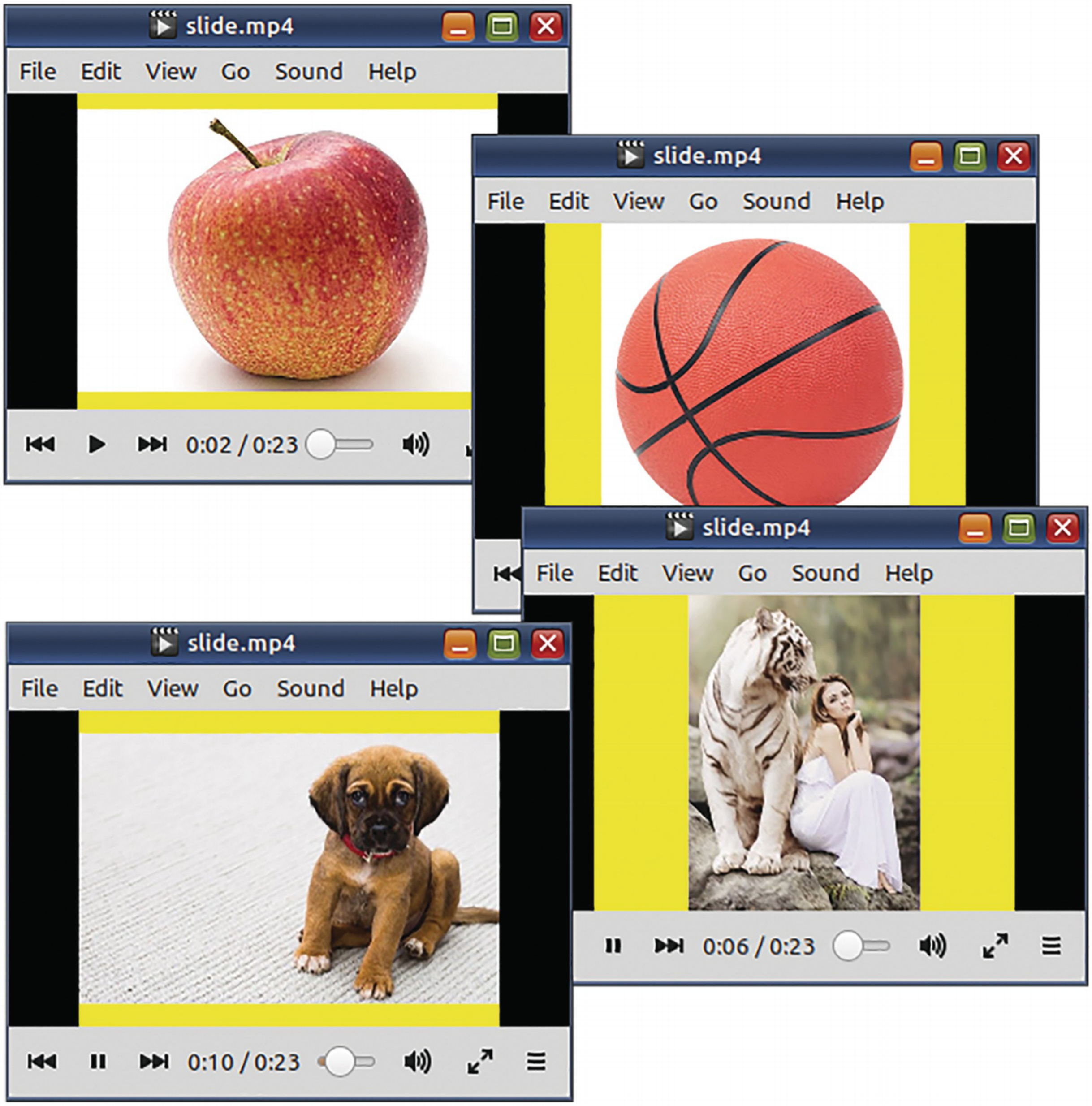


Figure 5-5 This video was created from several disproportionate images

When you have input images in no particular naming sequence, then you can pipe them like this:

```
cat *.png | \
     ffmpeg -y -f image2pipe \
```

```
              -framerate 1/3 -i - \
              -filter:v \
                "scale=eval=frame:w=640:h=360:
                 force_original_aspect_ratio=decrease,
                 pad=640:360:(ow-iw)/2:(oh-ih)/2:black"
              -c:v libx264 -r 24 -s nhd -pix_fmt yuv420
              slide2.mp4
```

Create a GIF from a Video

The ancient GIF format supports only 256 colors. You need to use `palettegen` and `paletteuse` filters to downsample the source video to this limited number of colors.

```
ffmpeg -y  -i bw.m4v \
       -filter_complex \
         "fps=7,scale=w=320:h=-1:flags=lanczos,split[
          [v1]palettegen=stats_mode=diff[p];
          [v2][p]paletteuse=dither=bayer:bayer_scale=
        bw-4.gif
```

You need to experiment a lot with the filters to understand what will work and what will not. A set of values that do well to optimize the file size for one source video may do poorly for another video. GIF optimization is extremely unpredictable. Learn more from this article:

- https://engineering.giphy.com/how-to-make-gifs-with-ffmpeg/

In an experiment with the production of a GIF file from a video, I found that

- With a `bayer_scale` of 0 (with the `dither=bayer` mode), the animation is smooth but suffers from the appearance of a dotted texture. The file size is on the higher side.
- When moving to the highest value of 5 (default is 2), the frames are clearer but start to suffer from intermittent banding. The file size is smaller.

The results may be quite different for another video file.

If you are stuck with an older version of FFmpeg that does not have the `palettegen` and `paletteuse` filters, you can make FFmpeg output the frames to ImageMagick (`convert` or `magick`). (The hyphens in the following command refer to standard output and input.)

```
ffmpeg -y -i bw.m4v \
       -filter:v "fps=10,scale=w=320:h=-1:flags=lancz
       -c:v ppm \
       -f image2pipe - | \
  convert -delay 10 -  \
          -loop 0 \
          -layers optimize \
```

```
            bw.gif
```

APNG

A better alternative to GIF animations is APNG. This format has limited support from image-viewing and image-editing applications but has near-universal support from desktop and mobile web browsers. Like PNG and unlike GIF, APNG supports millions of colours. This means that its colours will not have to be downsampled and will be very close to those in the source content. APNG animation files are typically bigger than animated GIFs.

If you are converting GIF animations to APNGs, then ImageMagick is the tool you should use, not `ffmpeg`.

```
magick animated.gif animated.apng
```

The image frames in a GIF will already be downsampled to 256 colours. To create a richer animated PNG, try to use the source frames in PNG format.

```
magick -delay 200 -loop 0 \
       chapter-image-*.png \
       -units PixelsPerInch -density 72 -resize '>x30
```

```
        animation-unlikely-stories.apng
```

If you are converting a video to APNG, then you can use `ffmpeg`.

```
ffmpeg -i bw.m4v \
       -vf "scale=w=250:h=-2, hqdn3d, fps=6" \
       -dpi 72 -plays 0 \
       bw.apng
```

In this command, `-dpi` is an APNG encoder option and `-plays` is an APNG muxer option. The *high-quality denoise 3d* filter reduces blemishes introduced by the scaling filter. Learn more about these options from the official documentation or by typing:

```
ffmpeg -help muxer=apng
ffmpeg -help encoder=png
ffmpeg -help filter=hqdn3d
```

Create a Video Using an Image and an MP3

How do you play an MP3 in a media player that will only play MP4 files? Find a thumbnail or album art for the MP3 and churn it out as a video. The following command uses an image as a video stream encoded with MJPEG codec.

```
ffmpeg -i Blobfish_face.jpg -i blobfish.mp3 \
       -c:v mjpeg -c:a copy \
       -map 0:v:0 -map 1:a:0 \
       -disposition:v:0 attached_pic \
       "Weird Fins - 17 - The Blobfish.mp4"
```

This command generates only one image frame in the MP4. The image frame is not encoded as a regular video stream for the entire duration of the audio.

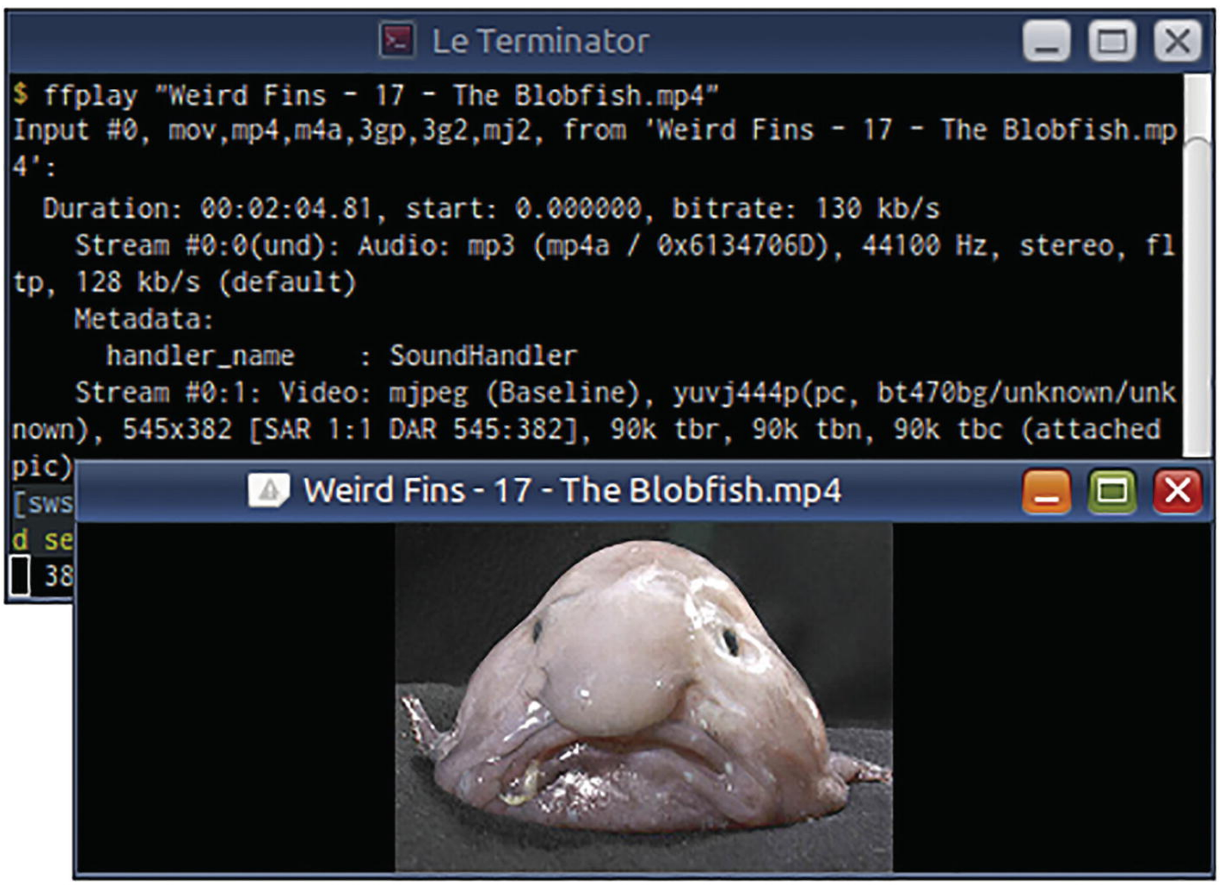


Figure 5-6 This video does not really have any video, just one frame from an image

However, not all media players will accept this trickery. On my computer, Totem media player does not show the image at all and plays it like a regular audio file. VLC displays the image because it uses FFmpeg internally. If your player shirks its duty, you will have to encode the image for the full duration of the audio.

```
ffmpeg -y -i  blobfish.mp3 \
  -loop 1 -framerate 12 -i Blobfish_face.jpg \
  -shortest -s qvga -c:a copy \
  -c:v libx264 -pix_fmt yuv420p \
  "Weird Fins - 17 - The Blobfish (no tricks).mp4"
# The album art image loops forever so the
# podcast audio creates the shortest output stream
```

☞ This MP3 was part of 18 MP3 files of the “Weird Fins” podcast published by the US NOAA. It got lost and buried when they redesigned their site. Some years ago, I recovered these files, tagged them and uploaded them to Archive.org.

Convert Online Videos to Audio

YouTube-DL is an open source command-line program that can download online videos for offline use. It supports several online video sites. Many journalists use it to grab still images for their articles about Internet videos. However, the entertainment industry has decided to challenge the legal status of this utility. The Electronic Frontier

Foundation (EFF) and surprisingly GitHub (owned by Microsoft) have come up with a defense initiative for its survival.

- https://youtube-dl.org

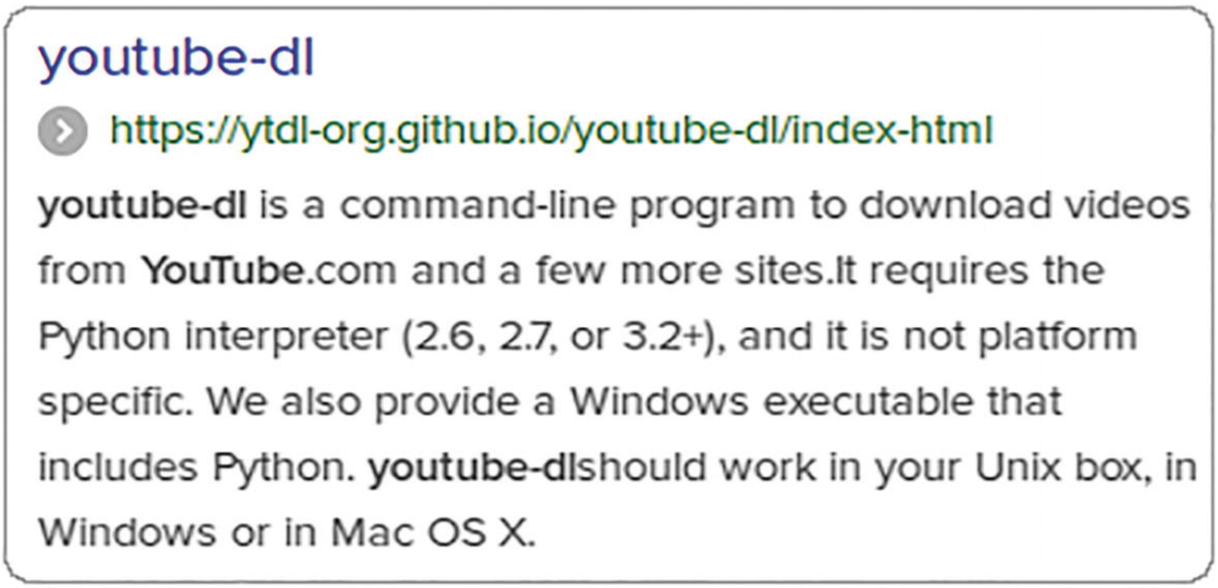


Figure 5-7 This is a description of `youtube-dl` published by a search engine

Assuming that your `~/bin` directory is in the `$PATH` environment variable, you can install `youtube-dl` locally using the following:

```
wget https://yt-dl.org/downloads/latest/youtube-dl \
     -O ~/bin/youtube-dl
chmod +x ~/bin/youtube-dl
youtube-dl --version
```

☞ YouTube-DL will run from anywhere. You do not have to install the file to a privileged location like the site says.

☞ If `youtube-dl` does not run, maybe Python 3 is not in the `PATH`. Start it with `/usr/bin/python3 youtube-dl ....`

You can make `youtube-dl` use `ffmpeg` to convert the downloaded files. Many audio podcasts are posted to online video sites. To only listen to them in the Audacious media player, I use a command like this:

```
youtube-dl -f 140 -x  \
           --audio-format mp3  \
           --exec 'audacious {} & ' \
           https://www.youtube.com/watch?v=yypDkqAErx
```

`youtube-dl` will not only download and convert the audio (from AAC) to MP3 (using `ffmpeg`), but it will also launch a command when the conversion process is complete. That command can be for your media player. `youtube-dl` will replace `{}` in the command string with the name of the output (MP3) file.

Convert Text to Audio

If your `ffmpeg` executable has been built-in with support for the `libflite` text-to-speech synthesizer library, then you can convert text content to spoken words.

```
ffmpeg -f lavfi \
       -i "flite=textfile=speech.txt:voice=slt" \
       speech.mp3
```

This speech filter supports several voices. On my computer, it lists `awb`, `kal`, `kal16`, `rms`, and `slt` as available voices. Unfortunately, the female voice sounds a bit dopey.

```
ffprobe -f lavfi "flite=list_voices=1"
```

I like the male-only `espeak` utility better. The defaults are good, and you can change several settings.

Conversion Settings for Specific Storage Medium

If you use the -target option, certain conversion settings appropriate for the specified storage option will be applied. The values for this option can be `vcd`, `svcd`, `dvd`, `dv`, and `dv50`. They can be prefixed with `ntsc`, `pal`, or `film` for more specific targets. For the actual settings used by these targets, refer the official FFmpeg documentation.

```
ffmpeg -i movie.avi -target ntsc-dvd movie.mpg
```

☞ VCD (MPEG-1), DVD (MPEG-2), and DV (digital tape) are very old targets and consume more space than MPEG-4.

☞ If you want to extract still images from movies, optical media is usually the best source.

Summary

In this chapter, you learned how to convert multimedia content in the form of audio, video, image, and text. You also learned to customize conversion settings to suit different formats, coder/decoders, and mediums. In the next chapter, you will learn how to edit videos using `ffmpeg`.

V. Subhash, *Quick Start Guide to FFmpeg*
https://doi.org/10.1007/978-1-4842-8701-9_6

6. Editing Videos

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I used to save DVDs as ISO files (whole-DVD backups) so that I could play them on my media player box. Each ISO took up several gigabytes (GBs) on my hard disk that I eventually ran out of space. Now, I use FFmpeg and store DVDs as MP4s of around just one GB.

While FFmpeg makes it very easy to convert multimedia files, as you learned in the previous chapter, storing them in their entity is not always feasible or required. Sometimes, you need just a few clips, not the whole shebang. You may want to combine parts of one video with parts of other videos. You can also downsize the videos to conserve space. In `ffmpeg` terms, you want to cut, concatenate, and resize videos. In this chapter, you will learn to do just that.

Resize a Video

You can resize a video using the `-s` option. The dimension of a video is usually specified as *Width***x***Height*. That is an "x" as in "x-mas" in the middle. When editing or converting videos, you will have to specify the video dimension using this syntax. The next command resizes a VGA-size (640x480) video to a VCD-size (352x288) video.

```
ffmpeg -i dialup.mp4 \
       -s 352x288 \
       dialup.mpg
```

FFmpeg supports certain easy-to-remember literals that you can use in place of the actual numbers for the –s option. They are listed in Table 6-1.

Table 6-1 FFmpeg option and values for setting the dimensions of a video

Option	For
-s	Video dimensions (literal or actual)

Literal	Dimensions	Literal	Dimensions	Li
ntsc	720x480	uxga	1600x1200	h
pal	720x576	qxga	2048x1536	2

Option	qntsc	352x240	sxga	1280x1024	2I
	qpal	352x288	qsxga	2560x2048	2I
	sntsc	640x480	hsxga	5120x4096	4I
	spal	768x576	wvga	852x480	4I
	film	352x240	wxga	1366x768	4I
	ntsc-film	352x240	wsxga	1600x1024	nh
	sqcif	128x96	wuxga	1920x1200	hc
	qcif	176x144	woxga	2560x1600	w
	cif	352x288	wqsxga	3200x2048	fw
	4cif	704x576	wquxga	3840x2400	hv
	16cif	1408x1152	whsxga	6400x4096	ql

Option	For qqvga	160x120	whuxga	7680x4800	2l	
	qvga	320x240	cga	320x200	4l	
	vga	640x480	ega	640x350	ul	
	svga	800x600	hd480	852x480	ul	
	xga	1024x768	hd720	1280x720		

A video's horizontal dimension divided by the vertical dimension is sometimes referred to as the **aspect ratio**. This is further influenced by the dimensions of individual pixels that make up the video. (Remember that a video frame is a matrix of dots or pixels in lines and columns.) This pixel-level aspect ratio is known as the **sample aspect ratio (SAR)**.

When a video is resized, `ffmpeg` (or whichever video authoring software that is used) would have automatically adjusted the pixel dimensions (or the SAR) from square to rectangular so that the video will be played with the proper aspect ratio.

If you want a video to be played at a particular aspect ratio, you need to set the **display aspect ratio (DAR)**. This value is calculated from the width-and-height ratio multiplied by the SAR. If for some reason, the SAR value is not present in the video, it is assumed to be 1. If this makes the video distorted, set the desired DAR using the `setdar` filter and let `ffmpeg` figure out the internal SAR.

```
ffmpeg -i "distorted.mpg" \
         -vf setdar=dar=4/3 \
         restored.mpg
```

☞ You will learn more about filters in Chapter 7.

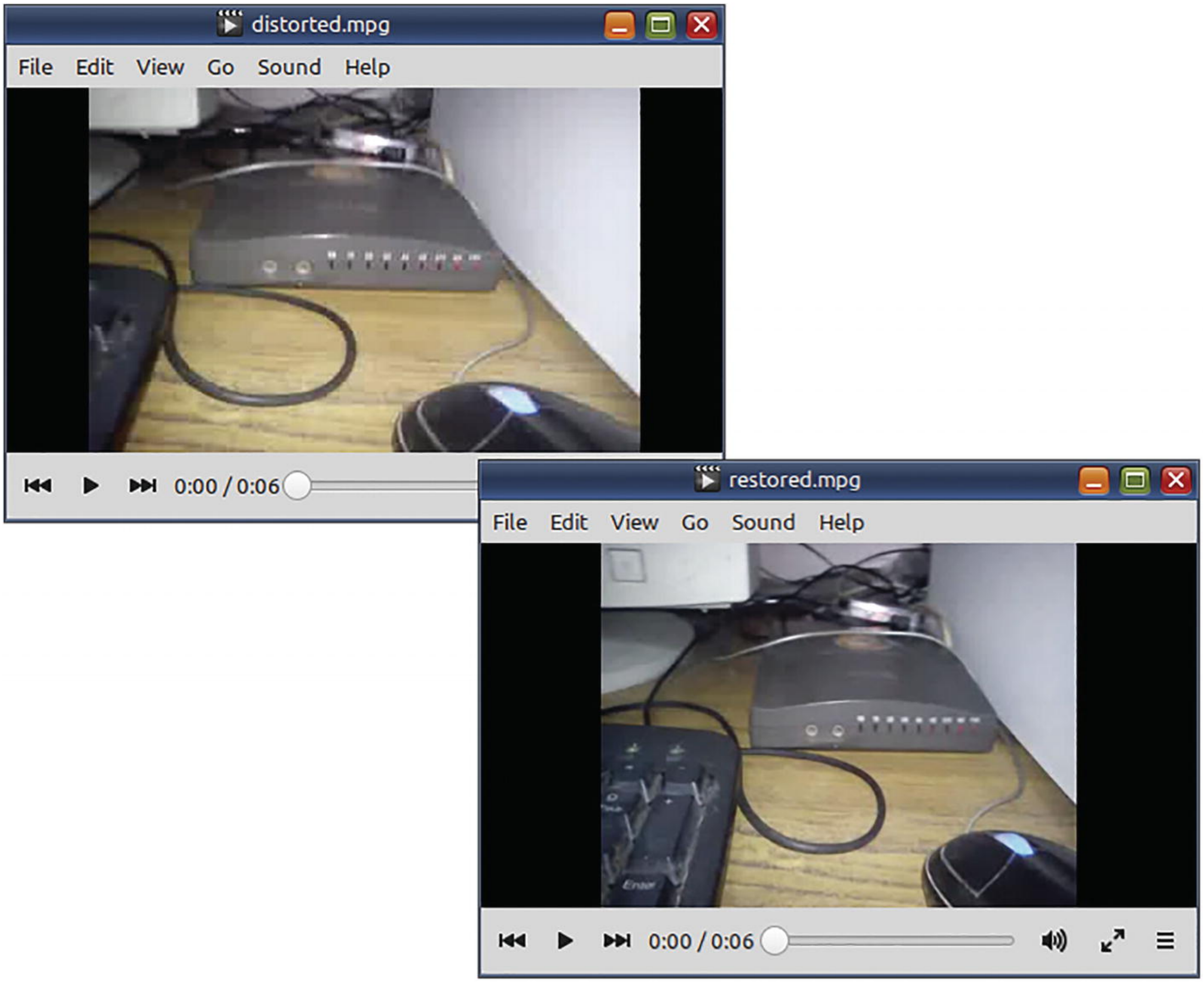

Figure 6-1 The distortion in the background video was fixed using a filter that changed the DAR (display aspect ratio)

These ratios may seem similar but there are subtle differences, as presented in Table 6-2.

Table 6-2 Terms related to video dimensions

Term	Description

Term	Description
Aspect ratio	= video width ÷ video height_______________________________________ *Standard definition ratio is 4:3. For widescreen, it is 16:9*
Sample aspect ratio (SAR) a.k.a **pixel aspect ratio**	= pixel width ÷ pixel height _______________________________________ *For square pixels, it is 1. For rectangular pixels, it will be a fraction*
Display aspect ratio (DAR)	= (video width ÷ video height) × sample aspect ratio or = video aspect ratio × sample aspect ratio

Editing Options

Some often used video- and audio-editing options are listed in Table 6-3.

Table 6-3 More ffmpeg options for editing

Option	For
-t	Duration (in hh:mm:ss[.xxx] format or in seconds) of the output file
-ss	Timestamp of playback location (in hh:mm:ss[.xxx] format or in seconds) from which processing needs to be performed
-c:v, -c:a, -c:s	Use specified encoder (not codec) for specific type of stream ——— If you use the value `copy` as in `-c copy`, `ffmpeg` will not use an encoder and just copy the stream(s)

Cut a Portion of a Video

If the video segment that you want to remove is the beginning, then use the `-ss` option to specify the timestamp from which the content needs to be copied.

```
ffmpeg -ss 00:01:00 -i sponsored-video.mp4 \
       the-video.mp4
```

> ☞ Use the `-ss` option before the `-i` option so that `ffmpeg` can quickly jump to the location of the specified timestamp. If you place it after the input file and before the output file, there will be a delay as `ffmpeg` decodes all the data from the beginning to the timestamp and then discards it (as it is not wanted)!

The timestamp values can be specified in the format `hh:mm:ss.ms`. Parts that are zero in the beginning can be omitted, as shown in Table 6-4.

Table 6-4 Examples of time or duration values

Usage	Implication
20	20 seconds
1:20	One minute and 20 seconds
02:01:20	Two hours, 1 minute, and 20 seconds
02:01:20.220	Two hours, 1 minute, 20 seconds, and 220 milliseconds

Usage	Implication
20.020	20 seconds and 20 milliseconds

☞ Before the milliseconds value, there needs to be a dot, not a colon.

If the video segment that you want to remove is the ending, then use `-t` option to specify the duration of the content that needs to be copied from the beginning.

```
ffmpeg -i long-tail.mp4 \
       -t 00:01:00 \
       no-monkey.mp4
```

If you want to cut from the middle, then you need to use both options.

```
ffmpeg -ss 00:01:00 -i side-burns.mp4 \
       -t 00:1:10 \
       clean-shaved.mp4
```

In this case, `ffmpeg` starts cutting `-t` duration of content from the timestamp specified by the `-ss` option, not from the beginning.

All of these commands will re-encode the video. Because the (raw) source video (from which the input video was created) is not being used, the output video will have lesser quality and have freshly introduced blemishes and artifacts.

You may encounter another problem here. When you do not specify conversion settings, then FFmpeg will use its own default encoder settings. If your uncut video had better quality than encoder defaults, then you may end up with lesser quality. If the input file had lower quality, then the encoder defaults may result in increased file size.

To avoid such problems, run `ffprobe` on the input file and use similar conversion settings with `ffmpeg`.

```
~/Desktop
$ ffprobe lucas.mp4
Input #0, mov,mp4,m4a,3gp,3g2,mj2, from 'lucas.mp4':
  Duration: 00:00:20.02, start: 0.000000, bitrate: 575 kb/s
    Stream #0:0(und): Video: h264 (Constrained Baseline) (avc1 / 0x3163
661), yuv420p, 640x360 [SAR 1:1 DAR 16:9], 472 kb/s, 29.97 fps, 29.97 t
r, 30k tbn, 59.94 tbc
    Metadata:
      handler_name    : VideoHandler
    Stream #0:1(eng): Audio: aac (mp4a / 0x6134706D), 44100 Hz, stereo,
fltp, 96 kb/s
    Metadata:
      handler_name    : SoundHandler

~/Desktop
$ ffmpeg -i lucas.mp4 \
>        -vcodec libx264 -b:v 472k -r:v 30 \
>        -acodec libfaac -b:a 96k \
>        -t 0:0:10 \
>        lucas-cut.mp4
```

Figure 6-2 The `ffprobe` output shows settings that you can use for the next `ffmpeg` task

Cut Without Re-encoding

Apart from losing quality, re-encoding takes time. Cutting without re-encoding does not have these disadvantages. Use the option `–codec copy` to ensure there is no re-encoding and the original quality is retained.

```
ffmpeg -ss 00:01:00 -i dog-eared.mp4 \
       -t 00:1:10 \
       -codec copy \
       clean-cut.mp4
```

There are disadvantages with this option too. The entirety of the audio and video information may not be present at the timestamps you have specified for FFmpeg to make a clean cut. A few seconds of the video may have to be sacrificed or go out of sync. Out-of-sync audio by one or two seconds is not really a problem in videos where the speaker remains in the background.

Use `–codec copy` only when the container of the output file supports the existing codec of the input stream you are trying to copy. You cannot copy streams from an OGV file to a MP4 file, but you can do that with an MKV output file. First, check whether input codecs are among the default codecs listed by the muxer of the output container.

```
ffmpeg -help muxer=matroska | head -5 ; \
ffmpeg -help muxer=ogv | head -5; \
ffmpeg -help muxer=avi | head -5 ; \
ffmpeg -help muxer=mp4 | head -5
```

These commands list the default extensions and codecs used by some popular containers.

```
Muxer matroska [Matroska]:
    Common extensions: mkv.
    Mime type: video/x-matroska.
    Default video codec: h264.
    Default audio codec: vorbis.
Muxer ogv [Ogg Video]:
    Common extensions: ogv.
    Mime type: video/ogg.
    Default video codec: theora.
    Default audio codec: vorbis.
Muxer avi [AVI (Audio Video Interleaved)]:
    Common extensions: avi.
    Mime type: video/x-msvideo.
    Default video codec: mpeg4.
    Default audio codec: mp3.
Muxer mp4 [MP4 (MPEG-4 Part 14)]:
    Common extensions: mp4.
    Mime type: video/mp4.
    Default video codec: h264.
```

```
      Default audio codec: aac.
```

Append Videos (Concatenate)

If you need to put together several videos to create one big video containing all of them, then you can use the `concat` demuxer. To use it, you need to first create a text file containing file names or full pathnames of the input videos. The file details should be formatted like this:

- One line should be used for each input file.
- The relative or absolute pathname of a file should be wrapped in quotation marks and preceded by the word "file."

```
file '/tmp/video.mp4'
file '/home/yourname/Desktop/video1.mp4'
file '/media/USB1/DCIM/DS00002.mp4'
```

Ideally, the file locations should be relative to the current directory and have simple file names. Because these files do not satisfy that condition, I have used the option `-safe 0` in this `ffmpeg` command. The next command will re-encode the preceding input files using the specified MP4 settings.

```
ffmpeg -f concat \
       -safe 0 \
```

```
        -i list.txt \
        -c:v libx264 -r 24 -b:v 266k -s qvga \
        -c:a libmp3lame -r:a 44000 -b:a 64k -ac 2 \
        mixology.mp4
```

☞ The default for the `-safe` option is `1`. In production environments, it prevents rogue users from using files that would otherwise crash FFmpeg-based software systems.

☞ Use the `-f concat` option setting before the `-i` option.

I advise against the use `-f concat` demuxer. The output files have a tendency to confuse and crash media players. If input videos are not of the same type, the concatenation will fail or the output file will not be playable. The same thing can happen if some of the input files are `-codec copy` veterans. You are lucky if conversion starts at all. If you are forced to use the `concat` demuxer, then read about it in the official documentation. The text file supports other directives (not just `file`) to make it more informative to the demuxer.

For more resilient concatenations, use the `concat` filter as described in Chapter 7.

```
ffmpeg -i engine.mp4 -i coach.mp4 \
    -filter_complex \
      "[0:v:0][0:a:0][1:v:0][1:a:0]concat=n=2:v=1:a=1
```

```
    -map '[v]' -map '[a]' \
    -c:v libx264 -r 24 -b:v 266k -s qvga \
    -c:a libmp3lame -b:a 64k -ac 2 \
    -f mp4 \
    train.mp4
```

Whether you use -codec copy or the concat filter, all the input files should be of the same type (same dimensions, codecs, frame rates, etc.).

Don't Knock `-codec copy`

After spending considerable time with FFmpeg, you will realize that a lot of multimedia software generate audio/video files that seem to play fine but have a lot of internal encoding errors. Strangely enough, FFmpeg's notorious `-codec copy` option fixes a good many of these container errors.

```
ffmpeg -i smugly.mp4 -codec copy smooth.mp4
```

Summary

FFmpeg provides some very neat options to edit multimedia files from the command line. With some files, you may be able to `-codec` `copy` the streams. With others, you will have to re-encode them. Both methods have advantages and disadvantages.

In the next chapter, you will finally learn about the `ffmpeg` filters that I have been all along teasing you with.

V. Subhash, *Quick Start Guide to FFmpeg*
https://doi.org/10.1007/978-1-4842-8701-9_7

7. Using FFmpeg Filters

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In the previous chapters, you would have encountered several filters. A great deal of FFmpeg functionality is hidden in them. Most users avoid filters or use them sparingly because the online examples of filters tend to be cryptic. There is a method to the madness. You can crack it. In this chapter, you will learn what filters are and how to use them.

Filter Construction

In an `ffmpeg` command, a filter is used to perform advanced processing on the multimedia and metadata data decoded from the input file(s). A **simple filter** consumes an input stream, processes it, and generates an output stream. The input and output will be of the same type. An **audio filter** (used with the option `-filter:a` or `-af`) consumes an audio stream and outputs an audio stream. A **video**

filter (specified by a `filter:v` or `-vf` option) consumes a video stream and outputs a video stream.

You can daisy-chain multiple simple filters to create a **filter chain**. In such a filter chain, the output of one filter is consumed by a subsequent filter. Thus, as a whole, the filter chain will also have one input and one output.

When such a linear filter chain is not possible, you need to use a **complex filtergraph** (with the option `-filter_complex`). A complex filtergraph can contain several filters or filter chains. The constituent filters can have zero to several inputs. They can consume streams of different types and output streams of different types. The number of inputs need not match the number of outputs. It is not necessary for a filter to consume the output of the previous filter.

Some filters known as **source filters** do not have inputs. There are also **sink filters** that do not generate any outputs.

In an `ffmpeg` command, you specify a filter in this fashion:

- `[input label1][input label2]...[input_labelN]filter=key1=value1:key2=value2...keyN=valueN[output label1][output label2]...[output labelN];`

You need to follow these rules when using filters:

- When a filter is expected to create an output stream, label it with a name in square brackets ([ ]).
- Use these labeled output streams as inputs for other filters or use them in `-map` options. `ffmpeg` automatically names the unlabeled input of the first filter as `[in]` and the unlabeled output of the last filter as `[out]`.
- Between two filters that are part of a linear filter chain (when you daisy-chain them), use a comma (,) as a delimiter. This implies that the output of the first filter is to be consumed as input by the second filter.
- Between two filters that are part of a nonlinear complex filtergraph, use a semicolon (;) as a delimiter. Specify the inputs and outputs using stream identifiers or labels for each filter. If you do not specify input streams, `ffmpeg` will select streams using an internal logic. (Read the official FFmpeg documentation about it.) If the selected input stream cannot be used by the filter, `ffmpeg` will encounter an error. Similarly, when you do not label the output streams, `ffmpeg` will attempt to dump them in the next output file. If the container of the next output file does not support those output streams, `ffmpeg` will encounter an error.
- Specify filter-specific options as key-value pairs. You need to use a colon (:) as a delimiter between them. You can omit the

option names (keys) and only use values if you specify them in the same order as specified in the official FFmpeg documentation or help output. This cryptic style is error-prone, difficult to understand, and therefore not recommended.

☞ There are lots of filters and you need to pore over pages of documentation to find the one that will work for you.

Filter Errors

Sometimes, you will encounter a “No such filter” error. This is probably because (out of habit) you placed a semicolon after the last filter. Some filters have an exact number of inputs or outputs. If you fail to identify one of them, `ffmpeg` will throw an error. Other common filter errors are caused when a labeled input or output is not consumed. If you use an output label more than once, you will get an ‘Invalid stream specifier’ error. An output stream can only be labelled once and used once. If you want to use a filter output stream as input for more than one filter, use the `split` or `asplit` filters to duplicate the stream.

Filter-Based Timeline Editing

Many filters support a generic `enable` option. It can be used to specify the start and end timestamps when the filter should be applied. For example, the option `enable='between(t, 6, 12)'` would ensure that the filter is applied on the video between 6th and 12th seconds of the audio or video.

☞ In the output for `ffmpeg -filters` command, the filters with the flag “T” support timeline editing.

Expressions in FFmpeg Filter Definitions

In the values of some filter options, you can specify algebraic expressions that combine explicit numbers, functions, and some *constants*. (The last two are listed in Table 7-1.) The section *Expression Evaluation* in the documentation describes several functions that can be used in the expressions. FFmpeg defines three *constants* that can be used in any filter.

Table 7-1 Functions and constants used in `ffmpeg` filter expressions

Functions			
abs(x)	floor(expr)	log(x)	sin(x)
acos(x)	gauss(x)	lt(x, y)	sinh(x)
asin(x)	gcd(x, y)	lte(x, y)	sqrt(expr)

Functions			
atan(x)	gt(x, y)	max(x, y)	squish(x)
atan2(x, y)	gte(x, y)	min(x, y)	st(var, expr)
between(x, min, max)	hypot(x, y)	mod(x, y)	tan(x)
bitand(x, y)	if(x, y)	not(expr)	tanh(x)
bitor(x, y)	if(x, y, z)	pow(x, y)	taylor(expr, x)
ceil(expr)	ifnot(x, y)	print(t)	taylor(expr, x, id)
clip(x, min, max)	ifnot(x, y, z)	print(t, l)	time(0)
cos(x)	isinf(x)	random(x)	trunc(expr)

Functions			
cosh(x)	isnan(x)	root(expr, max)	while(cond, expr)
eq(x, y)	ld(var)	round(expr)	
exp(x)	lerp(x, y, z)	sgn(x)	

Constants

PI (22/7)	E (Euler's number or exp(1) ~ 2.718)	PHI (golden ratio or (1+sqrt(5))/2 ~ 1.618)	QP2LAMBDA 118

Several filters define their own *constants*. These are actually real-time variables whose values can change depending on the input files, the processing options, or even time. You need to look at the documentation for each filter to see what these filter constants represent.

☞ You should try to become proficient in the use of filter expressions. They are force multipliers.

☞ When you specify a filter within double quotes (" "), the commas separating the parameters of a function will have to be escaped as `\,` to prevent `ffmpeg` from interpreting them as delimiters used to separate two filters.

Inset Video (Picture-in-Picture Overlay)

Sometimes, people in news media need to use a sign-language inset video. The following `ffmpeg` command scales down a video containing the sign-language track and positions it over the right corner of a news report.

```
ffmpeg -y -i Delphine.mp4 -i accessibility.mp4  \
  -filter_complex \
     "[1:v]scale=w=150:h=150[inset];
      [0:v][inset]overlay=x=W-w-20:y=20[v]" \
  -map '[v]' -map 0:a:0 \
  Delphine-with-accessibility.mp4
```

This command may also be written without the names and only the values of the filter options.

```
ffmpeg -y -i Delphine.mp4 -i accessibility.mp4  \
  -filter_complex \
     "[1:v]scale=150:150[inset];
      [0:v][inset]overlay=W-w-20:20[v]" \
  -map '[v]' -map 0:a:0 \
  Delphine-with-accessibility.mp4
```

☞ If you encounter such commands, they will seem very cryptic. You will have to look up the filter in the official documentation or the help output (`ffmpeg -help filter=scale`) and ascertain the order of the used filter options.

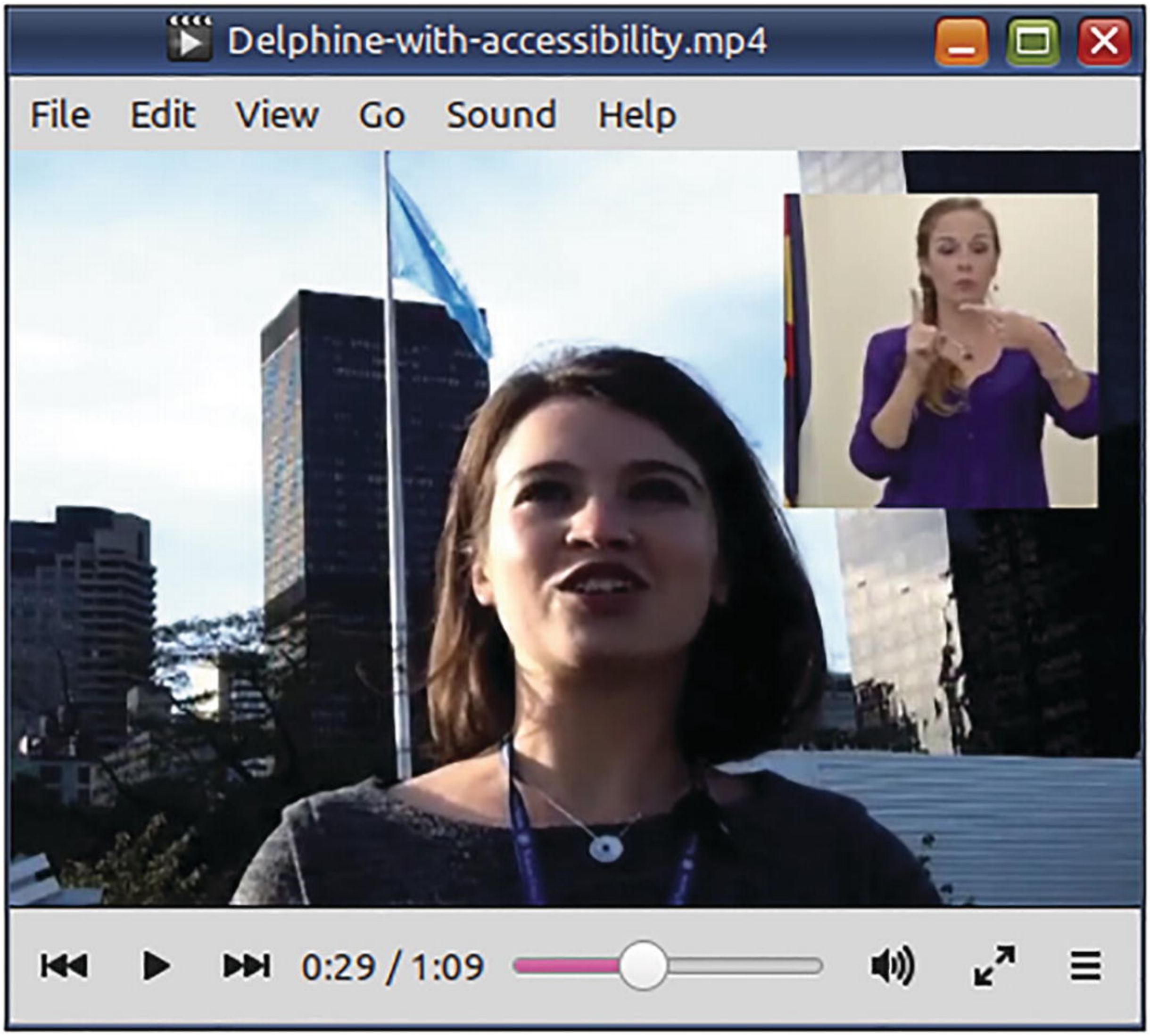

Figure 7-1 The `overlay` filter has been used to place the sign-language video track in the top-right corner of a news report video

The `scale` filter specifies actual width and height values (`150:150`) to which the inset video needs to be resized. The `overlay` filter specifies x- and y-coordinates of the top-left corner of the inset video on the news report video. The x-coordinate uses a *filter expression* (`W-w-20`) with *filter constants* `W` (width of the background video) and `w` (width of the inset video) to correctly inset the video 20 pixels away from the right edge of the background video. The y-coordinate is specified with the actual value, that is, 20 pixels from the top edge.

The input for the `scale` filter is the inset video (`[1:v]` or the video stream of the second input file). Its output is labeled `[inset]`. The inputs for the `overlay` filter are the news report (`[0:v]` or the video stream of the first file) and the output of the `scale` filter labeled previously as `[inset]`. The `overlay` filter has one output and it is labeled `[v]`. This overlaid video and the original audio of the news report (`0:a:0`) are then mapped into the output file.

To construct a *filter expression* with useful *filter constants*, you need to refer to the documentation of the filter. If these expressions try to hurt your brain (they will initially), you can specify explicit values. The preceding command can be rewritten as follows:

```
ffmpeg -y -i Delphine.mp4 -i accessibility.mp4  \
  -filter_complex \
     "[1:v]scale=150:150[inset];
      [0:v][inset]overlay=370:20[v]" \
  -map '[v]' -map 0:a:0 \
  Delphine-with-accessibility.mp4
```

Split Video (Side-by-Side Overlay)

When you place two videos side-by-side, their heights should be the same. If you place them one above the other, their widths should be the same. Else, there will be some empty space in the final video.

The sign-language video in the previous section is a 332×332-pixel video. It is smaller than the news report video. If we want them placed side-by-side, the news report video's height needs to be reduced to the height of the sign-language video.

This `scale` filter in this `ffmpeg` command does that. To maintain the same aspect ratio (width ÷ height) of the scaled video, the new width is specified using the filter expression `332*iw/ih`. (The value -2 would have worked as well. As to how it would, **R**efer **T**he **F**ine **M**anual. ☺) This multiplies the aspect ratio with the new height. (`iw` and `ih` represent filter constants for the width and height of the input video.)

```
ffmpeg -y -i Delphine.mp4 -i accessibility.mp4 \
       -filter_complex "[0:v]scale=332*iw/ih:332[sv];
                        [sv]pad=(iw+332):332:0:0[fram
                        [frame][1:v]overlay=W-w:0[v]"
       -map '[v]' -map 0:a:0 \
       Delphine-et-accessibility.mp4
```

Figure 7-2 The `scale` filter was used to reduce the height of the first video. The `pad` filter has been used to expand the frame of the scaled video. The `overlay` filter has been used to place the second video in the empty area of the expanded frame

> ☞ Because the second video is a sign-language video, I discarded its audio. If it were needed, I would have mixed the two audio streams or assigned them to the left and right speaker channels, as described in Chapter 8.

After the `scale` filter, the frame size of the scaled video is expanded sideways so that the second video can be placed in the new empty area. The `pad` filter uses the expression `iw+332` to arrive at the new expanded size of the frame. It then places the scaled video at the top-left corner (`0:0`) of the new frame. That is, the scaled video will be on the left side of the expanded frame.

In the empty area on the right side of the expanded frame (`[frame]`), we place the second input file (`[1:v]`) using the `overlay` filter.

Without using filter expression, the last `ffmpeg` command can be rewritten with actual values as follows:

```
ffmpeg -y -i Delphine.mp4 -i accessibility.mp4 \
       -filter_complex "[0:v]scale=498:332[sv];
                        [sv]pad=830:332:0:0[frame];
                        [frame][1:v]overlay=498:0[v]"
       -map '[v]' -map 0:a:0 \
       Delphine-et-accessibility.mp4
```

☞ When you want to use the same command on another set of files with different dimensions, you will have to recalculate and re-specify the values. Filter expressions can eliminate a lot of this hassle so use them when you can.

If you do not want the news video to be downscaled, then you could put some white space… (in this case) yellow space around the second video. In the next command, filter expressions and actual values have been used to correctly position the second video in the middle of the expanded frame.

```
ffmpeg -y -i Delphine.mp4 -i accessibility.mp4 \
```

```
ffmpeg -y -i Delphine.mp4 -i accessibility.mp4 \
    -filter_complex
      "[0:v:0]pad=w=(iw+360):h=ih:x=0:y=0:color=yellow[
       [frame][1:v:0]overlay=x=W-360+(360-w)/2:y=(H-h)/
    -map '[v]' -map 0:a:0 \
    -t 0:0:12 -pix_fmt yuv420p \
    Delphine-et-accessibility-et-margin.mp4
```

☞ It is much more easier and faster to use the filters `hstack` and `vstack`. However, these filters require the input videos to have the same pixel format (data encoding scheme of pixel color) and the same dimensions (height for `hstack` and width for `vstack`.)

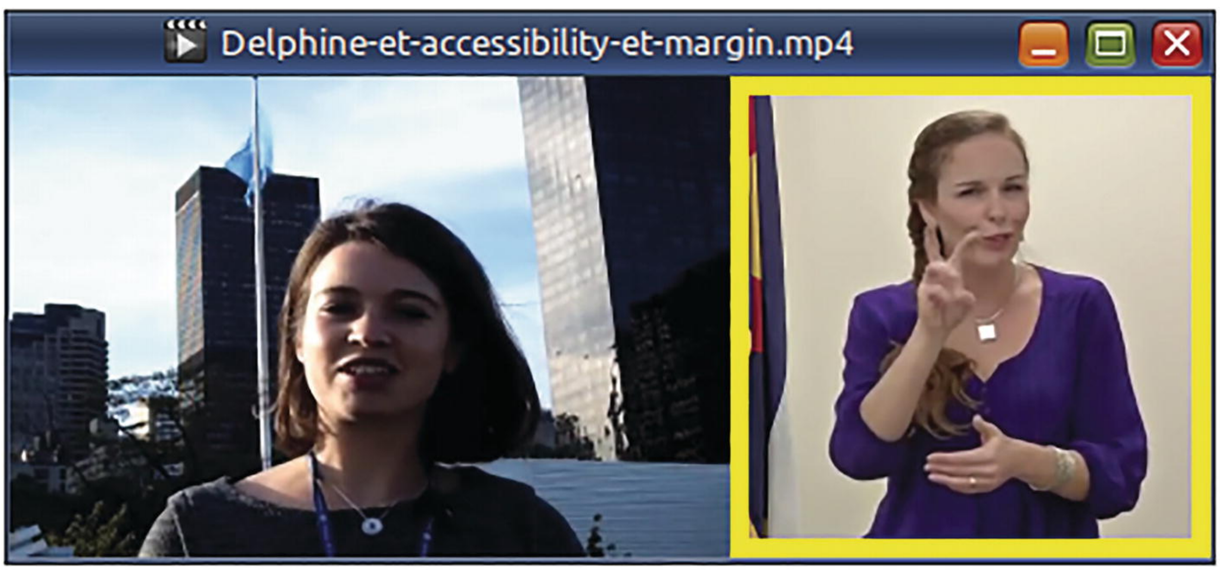

Figure 7-3 The `pad` filter was used to expand the width of original frame by 360 pixels while maintaining the same height. The expanded area was given a yellow background that was 360×360 pixels. Using filter expressions with the `overlay` filter, the 332×332-pixel second video was placed right in the middle of the yellow background

Append Videos Using a Filter

In Chapter 6, you learned to concatenate several videos using the `concat` demuxer. The `concat` filter provides more control if you have only a few input files.

```
ffmpeg -i engine.mp4 -i coach.mp4 \
  -filter_complex \
    '[0:v:0][0:a:0][1:v:0][1:a:0]concat=n=2:v=1:a=1[v
  -map '[vo]' -map '[ao]' \
  -c:v libx264 -r 24 -b:v 266k -s qvga \
  -f mp4 train.mp4
```

> ☞ This will re-encode the input files, as will any other filter.

Specify the video and audio streams of the input clips or segments in the order that they need to be appended by the filter. `[0:v:0]` `[0:a:0]` refers to the video and audio streams of the first input clip. `[1:v:0][1:a:0]` refers to the video and audio streams of the second clip. The filter option `n` refers to the number of input clips. `v` refers to the number of output video streams, and `a` refers to the number of output audio streams. The concatenated video and audio streams are the filter outputs labeled as `[vo]` and `[ao]`. These labeled outputs are then mapped to the output file.

Delete a Portion of a Video in the Middle

Sometimes, you need to delete part of a video. For that, you can use the `trim`, `atrim`, and `concat` filters. In this command, the second scene (between seconds 16 and 36) is deleted by eliminating it using `trim` and `atrim` filters.

```
ffmpeg -y -i barbara.mp4 \
  -filter_complex \
    "[0:v:0]trim=start=0:end=16, setpts=PTS-STARTPTS[
     [0:v:0]trim=start=36:end=44, setpts=PTS-STARTPTS
     [0:a:0]atrim=start=0:end=16, asetpts=PTS-STARTPT
     [0:a:0]atrim=start=36:end=44, asetpts=PTS-STARTP
     [lv][rv]concat=n=2:v=1:a=0[v];
     [la][ra]concat=n=2:v=0:a=1[a]" \
  -map '[v]' -map '[a]' barb-cut.mp4
```

> ☞ I have used seconds instead of timestamps because the “hh:mm:ss” format requires a lot of nonintuitive escaping.

The `concat` filter is prone to timestamp errors. The `setpts` and `asetpts` filters may be able to fix them. A filter setting with `asetpts=N/SAMPLE_RATE/TB` will generate new timestamps by counting actual samples in the processed audio segments, but it can be used only with constant frame rate videos. A better value is to use

`PTS-STARTPTS` (similar to the video filter), as it will also remove empty regions in the audio.

Rotate a Video

Some videos that people take from a mobile phone are rotated by 90 or 180 degrees from normal. You can manually fix them by specifying a `transpose` filter.

```
# Rotate to right
ffmpeg -i slt.mp4 \
       -filter:v "transpose=1" \
       slt-rotated-1.mp4
# Rotate to left
ffmpeg -i slt.mp4 \
       -filter:v "transpose=2" \
       slt-rotated-2.mp4
# Rotate to left and flip vertically
ffmpeg -i slt.mp4 \
       -filter:v "transpose=0" \
       slt-rotated-0.mp4
# Rotate to right and flip vertically
ffmpeg -i slt.mp4 \
       -filter:v "transpose=3" \
       slt-rotated-3.mp4
```

For the `transpose` filter option `dir`, a value of 1 or 2 turns the video 90 degrees **right or left**. Values 0 and 3 turn the video **left or right** and also vertically flip them. Mobile phone users should stick with the first two values.

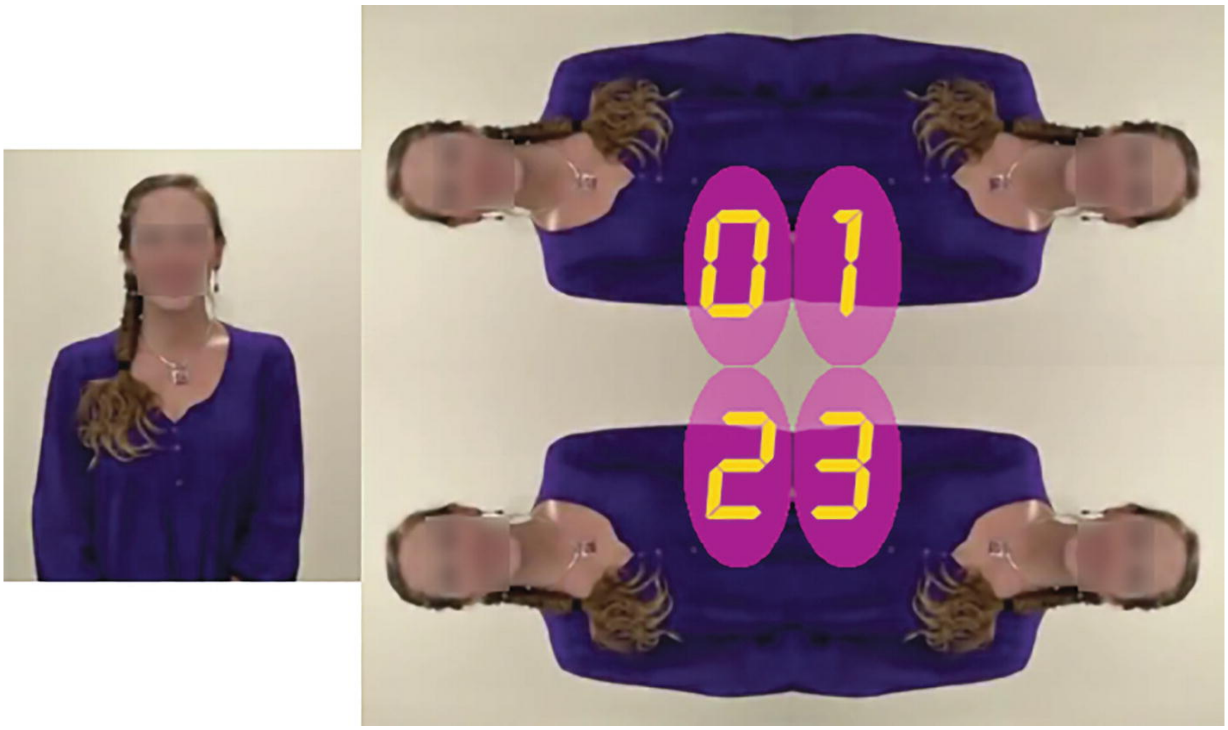

Figure 7-4 These still images show `dir` values that can be used with the `transpose` filter

The `transpose` filter option `passthrough` can have values `none`, `portrait`, and `landscape`. The value `none` is default. One of the last two values will be particularly useful in automated scripts to prevent unnecessary rotation, that is, when the video is already in the orientation specified by the `passthrough` filter option. It will also prevent `ffmpeg` from autorotating a video and then applying your transpose setting (causing further rotation).

You can rotate videos by more discrete levels than multiples of 90 degrees. The `rotate` filter accepts values in radians rather than degrees. The following `ffmpeg` command rotates a video by 16 degrees.

```
ffmpeg -y -i malampuzha-lake.mp4 \
       -filter_complex \
            "rotate=angle=16*PI/180:fillcolor=brown"
       malampuzha-lake-tilt-16-chopped.mp4
# Rotates video but corners get cut off
```

☞ If the video becomes distorted, correct it using `setdar` filter.

☞ To convert degrees to radians, it has to be multiplied with $\pi/180$.

To prevent the corners from getting chopped off, the frame dimensions need to be increased. You can use the `rotw` and `roth` functions for determining these new dimensions. The two functions use these formulas internally.

- rotw(θ) = Height×Sine(θ) + Width×Cosine(θ)
  roth(θ) = Width×Sine(θ) + Height×Cosine(θ)

```
# Rotate video and enlarge the frame to prevent
# corners from getting cut off
ffmpeg -y -i malampuzha-lake.mp4 \
       -filter_complex \
          "rotate=angle=16*PI/180:
           ow=trunc(rotw(16*PI/180)/2)*2:
           oh=trunc(roth(16*PI/180)/2)*2:
           fillcolor=brown" \
       malampuzha-lake-tilt-16.mp4
```

As FFmpeg requires that the new width and height be even numbers, that is, divisible by 2, the calculated dimensions are first divided by 2, truncated off, and then multiplied by 2.

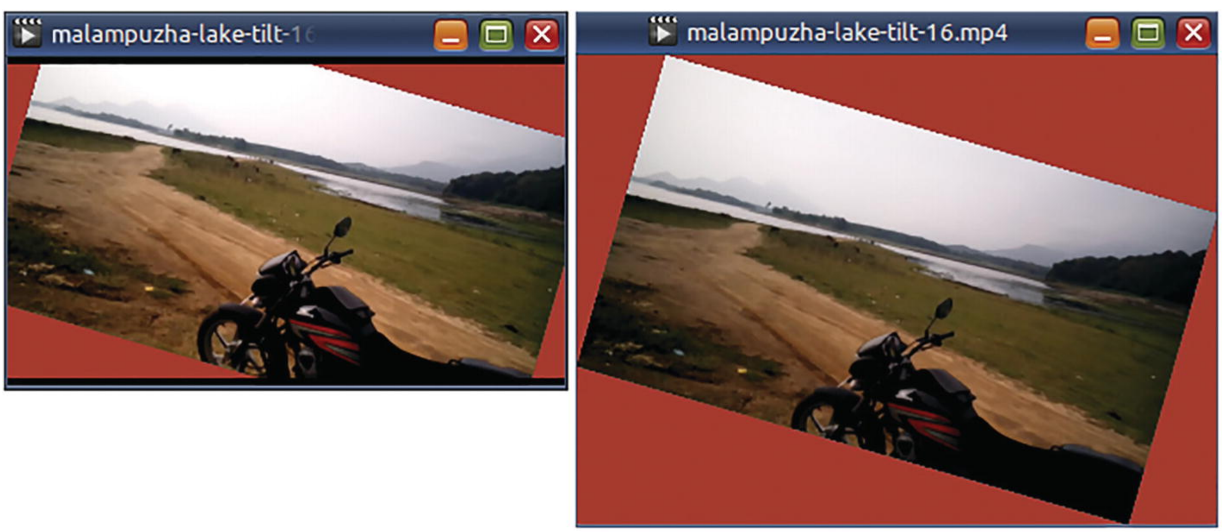

Figure 7-5 The first video has the original dimensions, but the rotated content has chopped-off corners. The second video has bigger dimensions to accommodate the extruding corners

Flip a Video

Some videos are flipped for some reason. Use `vflip` or `hflip` to set them right.

Figure 7-6 These still images show which filter to us for what effect

```
ffmpeg -i exhibit.mp4 \
       -filter:v "vflip" \
       exhibit-upside-down.mp4
ffmpeg -i exhibit.mp4 \
       -filter:v "hflip" \
       exhibit-half-crazy.mp4
ffmpeg -i exhibit.mp4 \
       -filter:v "hflip,vflip" \
```

```
        exhibit-totally-flipped.mp4
```

Brighten a Video (Adjust Contrast)

It is inevitable that some of your videos are dark, even when they were captured in broad daylight. You can use the `eq` filter to adjust the brightness. However, adjusting the brightness requires a subsequent adjustment of the contrast. The ranges for the options of this filter are listed in Table 7-2.

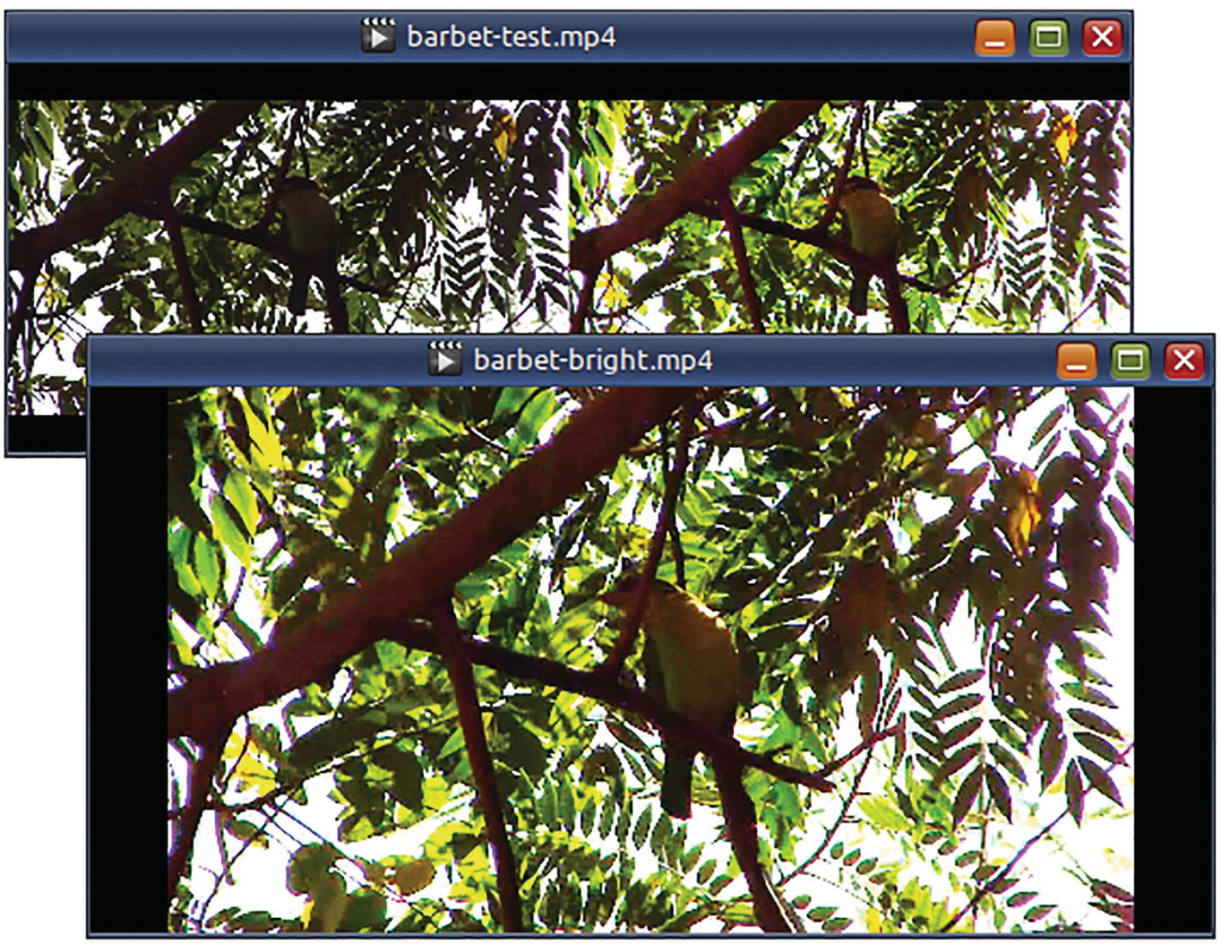

Figure 7-7 After cumulative applications of brightness, saturation, and contrast filters, more detail of the green barbet is visible. Forget the background

First, I decided to do a side-by-side comparison.

```
ffmpeg -y -i barbet.mp4 \
  -filter_complex \
    "[0:v]pad=(iw*2):ih:0:0[frame];
     [0:v]eq=brightness=0.2[bright];
     [bright]eq=saturation=3[color];
     [color]eq=contrast=2[dark];
     [frame][dark]overlay=W/2:0[out]" \
  -map '[out]' -map 0:a \
  barbet-test.mp4
```

Table 7-2 Options for filter eq

Filter option	Lowest	Highest	Default
Brightness	-1	1.0	0
Contrast	-1000	1000	1
Saturation	0	3	1
Gamma	0.1	10	1

After some trial-and-error attempts, I applied the filters to the original video.

```
ffmpeg -y -i barbet.mp4 \
  -filter_complex \
    "[0:v]eq=brightness=0.2[bright];
     [bright]eq=saturation=3[color];
     [color]eq=contrast=2[dark]" \
  -map '[dark]' -map 0:a \
  barbet-bright.mp4
```

Generate a Test Video

In the good old days, when there was just one TV channel in India, the transmission began in the evening with a 30-minute video test – something like this!

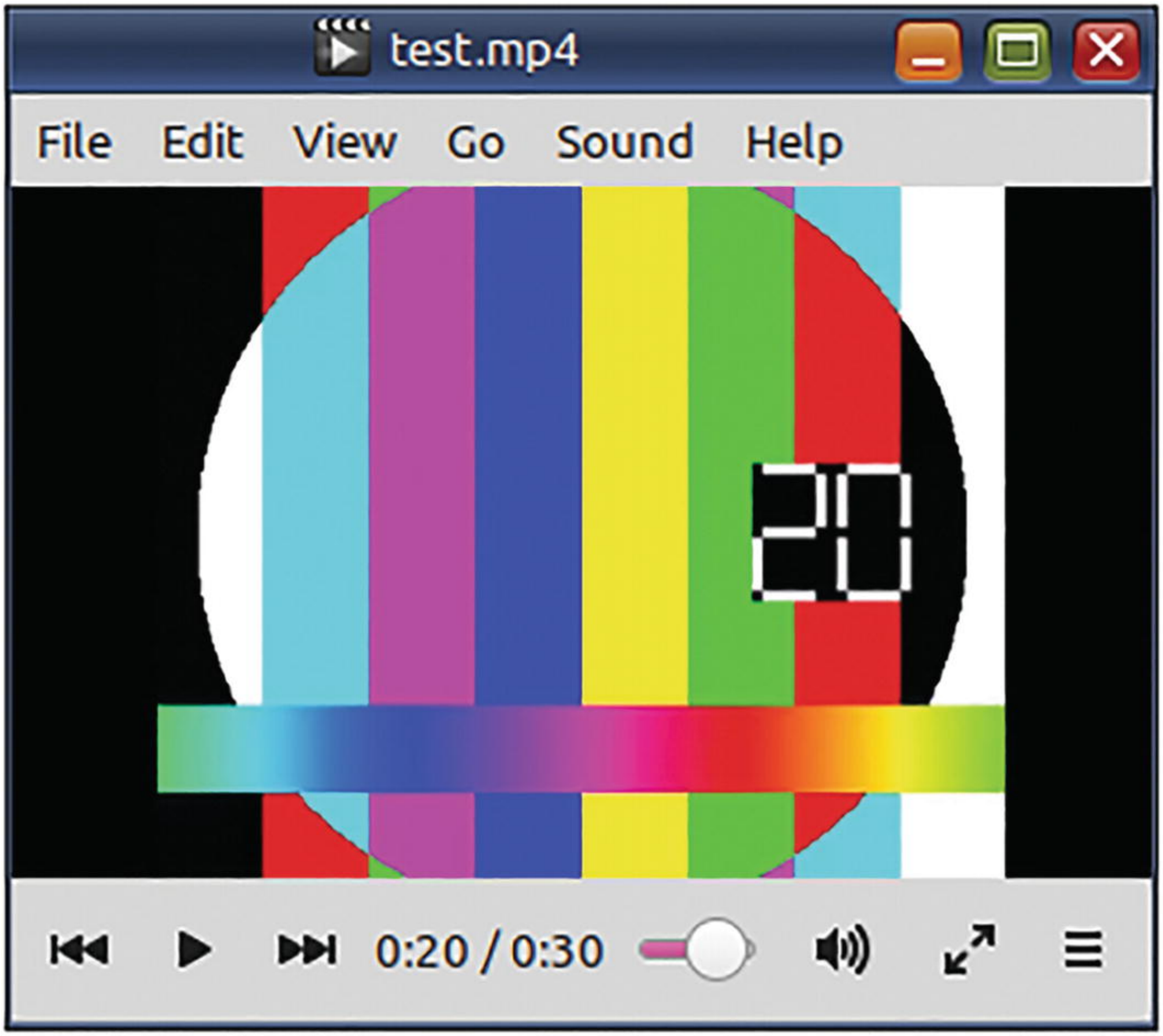

Figure 7-8 The `testsrc` filter is a source filter that generates a test video stream

The test video has a color pattern, a scrolling gradient, and a changing timestamp. The audio is a low white noise. I do not know who needs this video, but if it floats your boat, then here is the command to create it.

```
ffmpeg -f lavfi \
       -i "testsrc=size=320x260[out0];
           anoisesrc=amplitude=0.06:color=white[out1]
```

```
        -t 0:0:30 -pix_fmt yuv420p \
        test.mp4
```

☞ This command uses a set of filters as a pseudo file source (`-f lavfi`). It requires that the filter outputs be labeled `out0, out1, out2,…`.

☞ Filters whose name end in "`src`" are *source filters*. They do not require an input stream.

Remove Logo

In 2019, a newspaper in New York published an opinion alleging bias against women in government experiments. NASA's Apollo Space Program was then celebrating its 50th anniversary.

```
ffmpeg -i apollo-program.mp4 \
        -filter:v "delogo=x=520:y=10:w=100:h=50" \
        apollo-program-you-are-dead.mp4
```

Figure 7-9 With the `delogo` filter, it is very easy to remove an unwanted logo from a video

☞ After applying the filter, the logo has disappeared from the top-right corner.

☞ This video is only a simulation.

Fade into Another Video (And in Audio Too)

In order to prove aliens do not exist and have fun while doing that, I took videos from two authoritative US government agencies – NASA and IRS. The videos are in public domain, as the agencies are taxpayer-funded. The NASA video clearly states that there are no aliens, but I am not interested in their explanation. The IRS video is a tax advisory for noncitizens, also known as aliens. That is the fun part. In the output video, the first video plays fine until six seconds after which it fades out in three seconds. As the first video fades away, the second video starts fading in for three seconds. After that, it plays for six seconds.

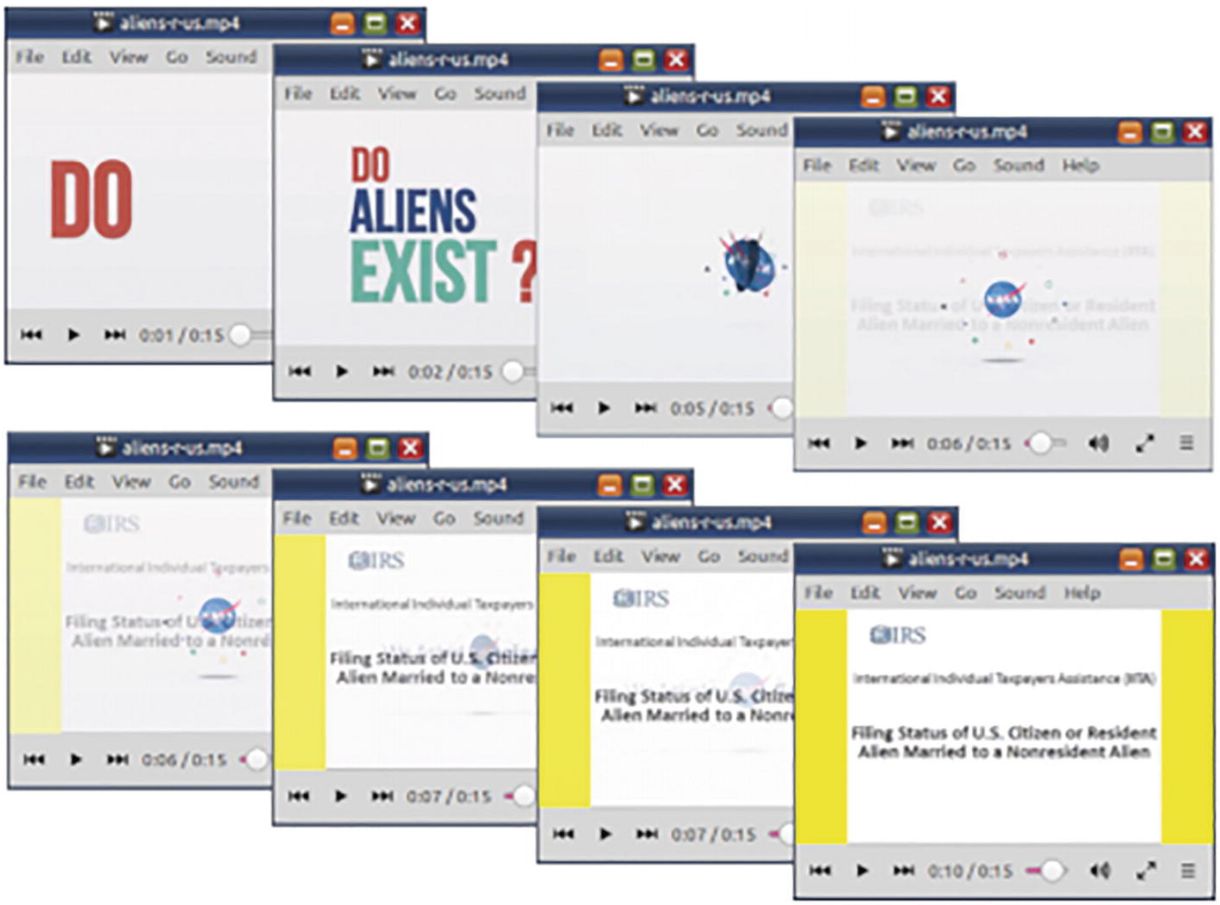

Figure 7-10 These screenshots show the crossfade sequence involving the two input videos

Mixing these two videos can be done with one command, but for clarity, I have split it into four commands. (You should combine the filters to avoid multiple re-encoding.) The crossfade effect is performed by the `fade` filter for video and the `afade` filter for audio. The `trim` and `atrim` filters are used to divide the video and audio tracks into two parts – one where the stream plays normally and another where the fade filters take effect. I used `overlay` and `amix` filters to mix the second parts. After that, the `concat` filter was used to put three segments together – normal playback from the first file, crossfade effect from both files, and then normal playback from the second file.

```
# Make the second video same size as the first
ffmpeg -y -i irs-tax-advice-for-alien-mates.mp4 \
 -filter:v "pad=w=640:h=ih:x=(ow-iw)/2:y=0:color=yell
 -t 0:0:20 -pix_fmt yuv420p \
 irs-tax-advice-for-alien-mates2.mp4
# Create the fade-in-fade-out video
ffmpeg -y -i Do-Aliens-Exist-We-Asked-a-NASA-Scientis
 -i irs-tax-advice-for-alien-mates2.mp4 \
 -filter_complex \
  "[0:v:0]trim=start=0:end=6, setpts=PTS-STARTPTS, fp
   [1:v:0]trim=start=3:end=9, setpts=PTS-STARTPTS, fp
   [0:v:0]trim=start=6:end=9, setpts=PTS-STARTPTS, fp
   [1:v:0]trim=start=0:end=3, setpts=PTS-STARTPTS, fp
   [v3]fade=t=out:d=3:alpha=1, setpts=PTS-STARTPTS, f
   [v4]fade=t=in:d=3:alpha=1, setpts=PTS-STARTPTS, fp
   [nasafade][irsfade]overlay, setpts=PTS-STARTPTS, f
   [v1][fading][v2]concat=n=3:v=1:a=0[v]" \

 -map '[v]' -pix_fmt yuv420p \
 aliens-r-us-v.mp4
# Create the fade-in-fade-out audio
ffmpeg -y -i Do-Aliens-Exist-We-Asked-a-NASA-Scientis
    -i irs-tax-advice-for-alien-mates2.mp4 \
    -vn \
    -filter_complex \
     "[0:a:0]atrim=start=0:end=9, asetpts=PTS-STARTPT
      [1:a:0]atrim=start=0:end=9, asetpts=PTS-STARTPT
      [a1][a2]acrossfade=duration=3" \
```

```
     aliens-r-us-a.m4a
# Mix the video and audio
ffmpeg -i aliens-r-us-v.mp4 -i aliens-r-us-a.m4a \
       -codec copy \
       aliens-r-us.mp4
```

Crop a Video

For some screenshots in the beginning of this chapter, I needed a public-domain video of a sign-language translator. I found one but it was too big. I grabbed a still image from the video using a media player and edited it in GIMP.

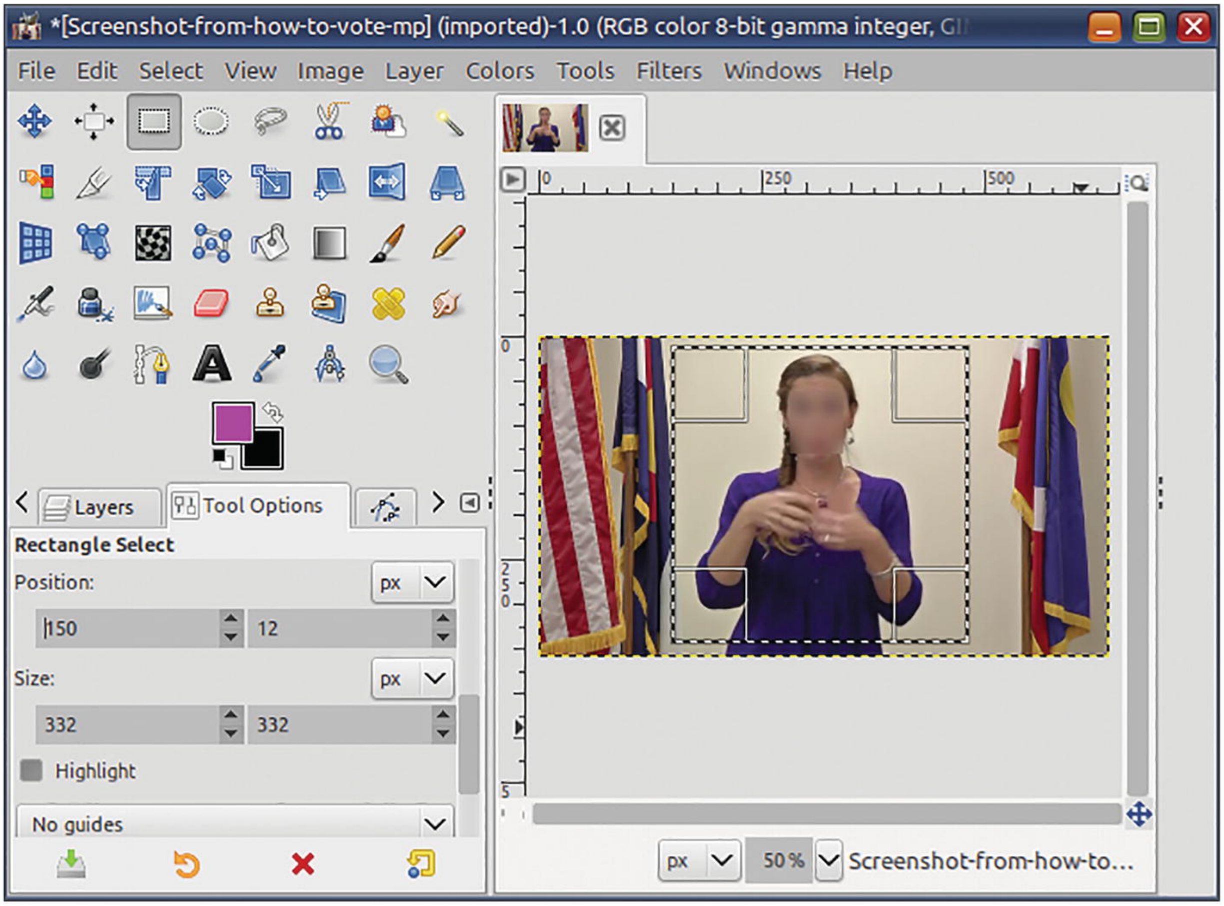

Figure 7-11 First, take a screengrab from the video. Then, use an image-editing program to identify the location (150,12) and dimensions (332,332) of the region you want to cut out

I then selected the region that I wanted cut into. I noted down the coordinates and dimensions of the region from GIMP's *Tool Options* panel. I used the details from GIMP in the options for a `crop` filter that I used on the video.

```
ffmpeg -i how-to-vote.mp4 \
       -filter:v "crop=332:332:150:12" \
       accessibility.mp4
```

Figure 7-12 The `crop` filter cut into a portion of a video

Blur or Sharpen a Video

When this video was shot, there was a lot of camera refocusing and the action was blurry. The `smartblur` filter almost fixes this when it is set to *sharpen* the video.

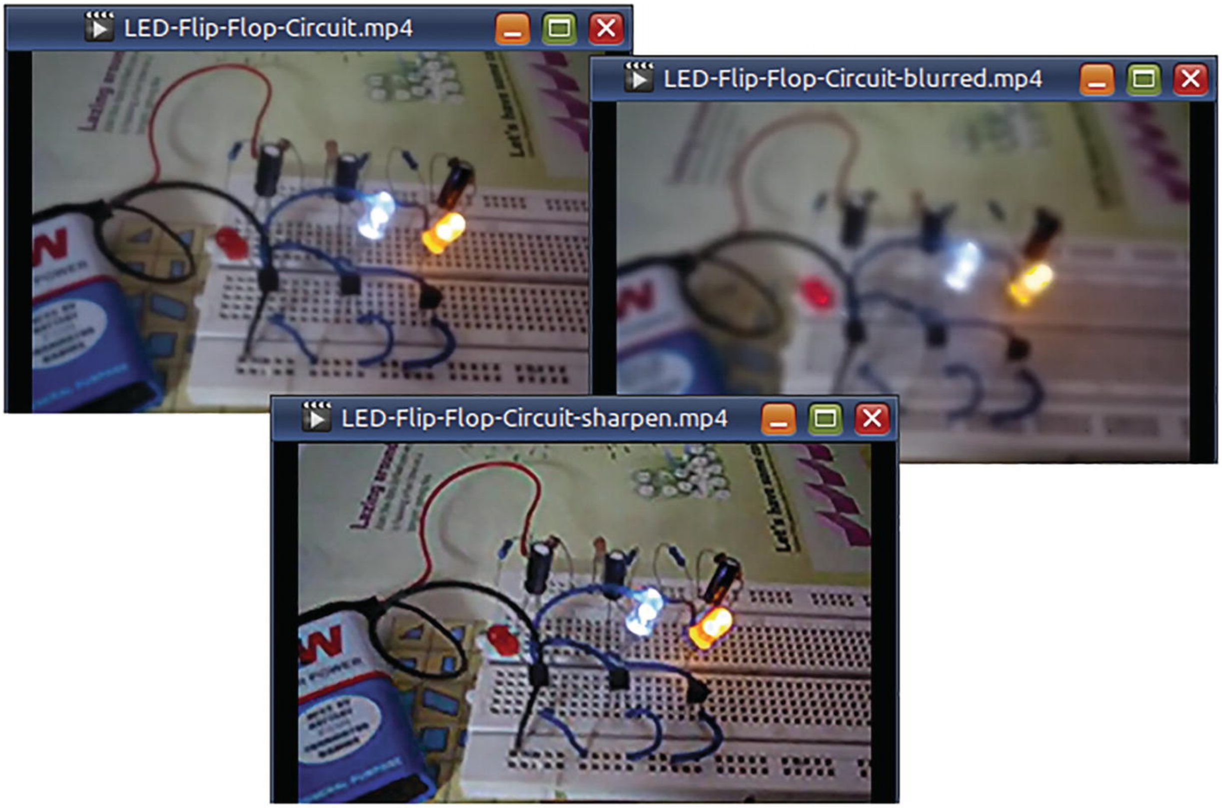

Figure 7-13 With the `smartblur` filter, you can blur or sharpen a video

```
ffmpeg -i LED-Flip-Flop-Circuit.mp4 \
       -filter:v
         "smartblur=luma_radius=5:luma_strength=1.0:
          luma_threshold=30" \
       LED-Flip-Flop-Circuit-blurred.mp4
ffmpeg -i LED-Flip-Flop-Circuit.mp4 \
       -filter:v
         "smartblur=luma_radius=5.0:luma_strength=-1.
         luma_threshold=30" \
       LED-Flip-Flop-Circuit-sharpen.mp4
```

The `smartblur` filter can blur or sharpen videos *without affecting the outlines*. It works on the brightness of the pixels. The `luma_radius` (0.1 to 5) represents the variance of the Gaussian blur filter. `luma_strength` (-1 to 1) varies between sharpness to blurring. `luma_threshold` (-30 to 30) varies the focus of the filter from the edges to interior flatter areas.

Blur a Portion of a Video

Sometimes, you need to protect the identity of some people (e.g., bystanders) who are not really the focus of a video. Use the `boxblur` filter. This command tries to blur two regions in a video where human faces appear.

```
ffmpeg -y -i stilt.mp4 \
  -filter_complex \
    "[0:v]crop=260:80:400:550[c1];
     [0:v]crop=100:60:1:550[c2];
     [c1]boxblur=6:6[b1];
     [c2]boxblur=6:6[b2];
     [0:v][b1]overlay=400:550[v1];
     [v1][b2]overlay=1:550[v]" \
   -map '[v]' -map 0:a -c:a copy \
  stilt-masked.mp4
```

Unlike `smartblur`, it does not respect object outlines. And, contrary to its name, `boxblur` does not blur inside the box or a part of the video. It affects the whole frame of the input video stream.

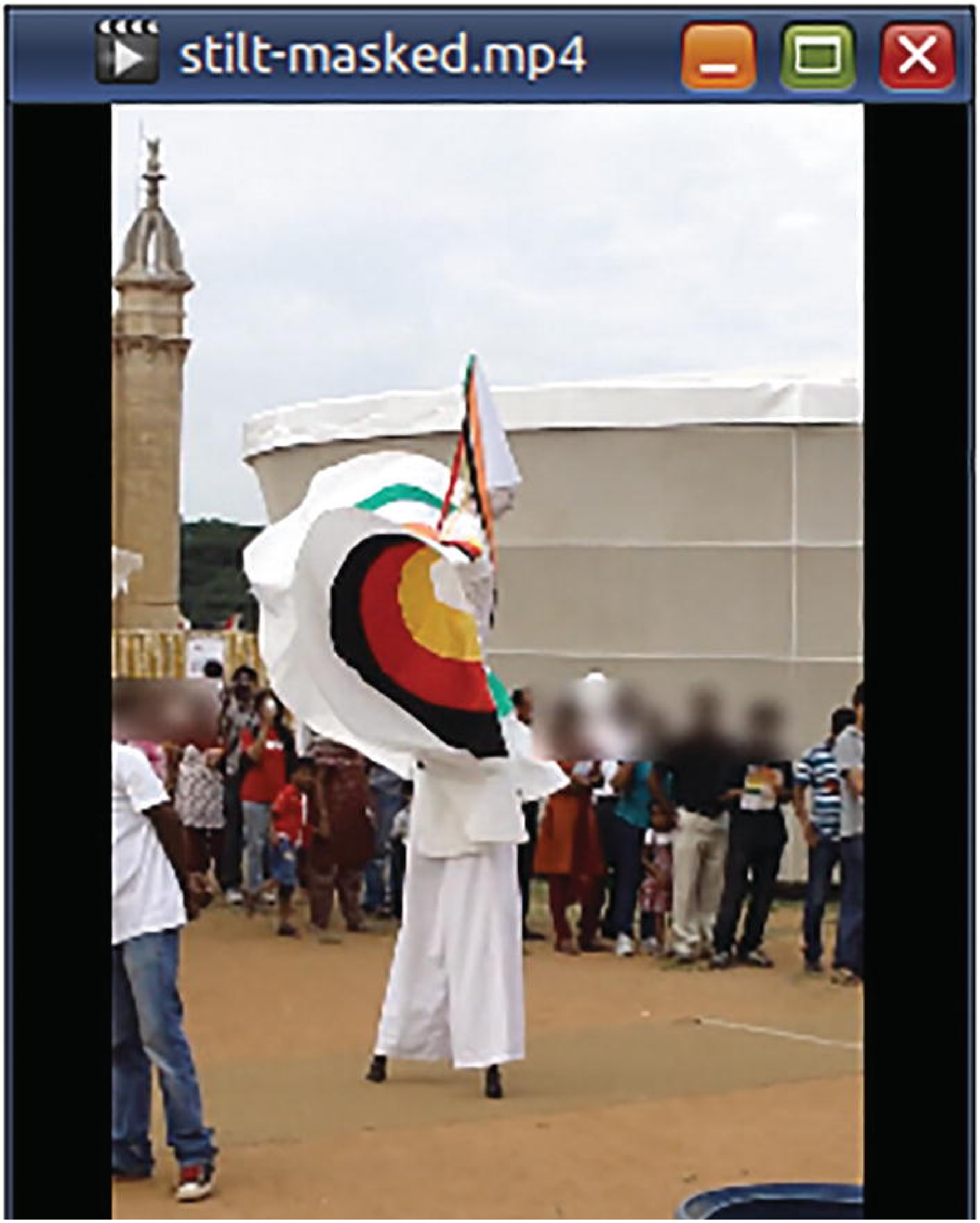

Figure 7-14 With the `boxblur` filter, you can blur content without discrimination of any outlines

☞ To avoid any doubt or confusion, I would like to state that I have masked faces of private individuals (even in public-domain content) in several screenshots using an image-editing program. In this screenshot, however, the effect was achieved using the `ffmpeg` filter `boxblur`.

Draw Text

To draw text on video, you need to use the `drawtext` filter and also specify the location of the font file. When you are drawing several pieces of text, it is better to daisy-chain your texts (using commas, not semicolons).

```
ffmpeg -y -i color-test.mp4 \
  -filter_complex \
    "[0:v:0]drawtext=x=(w-tw)/2:y=10:fontcolor=white:
        shadowx=1:shadowy=1:text='Detonation Sequence
```

```
        fontsize=25: fontfile=AllertaStencil.ttf, \
     drawtext=x=(w-tw)/2:y=60:fontcolor=white: \
        shadowx=1:shadowy=1: \
        text='This TV will self-destruct in t seconds
        fontsize=15:fontfile=Exo-Black.ttf[v]" \
  -map '[v]' -map 0:a:0 -pix_fmt yuv420p \
  idiot-box-1.mp4
```

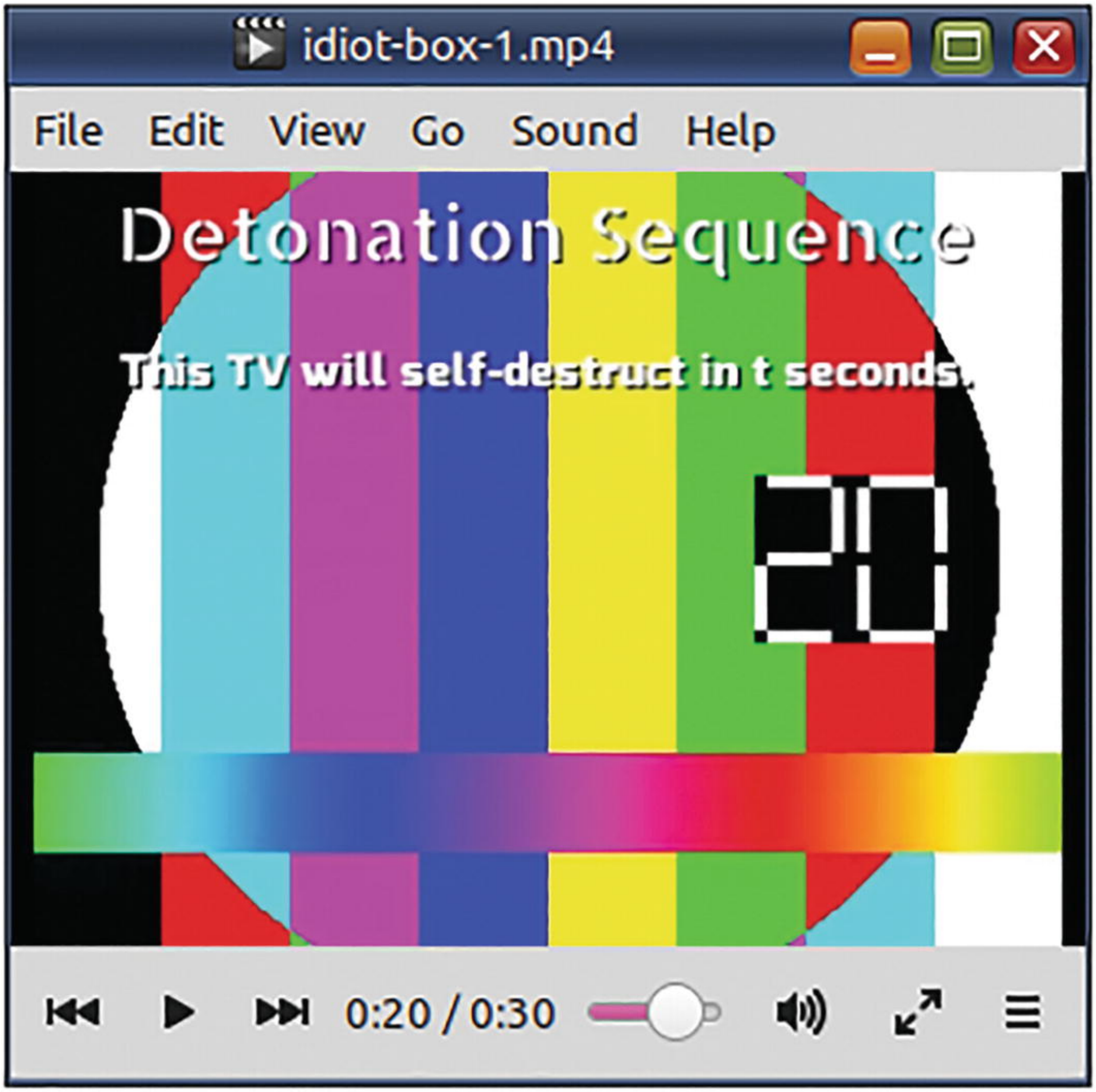

Figure 7-15 With the `drawtext` filter, you can draw text formatted with fonts, styles, shadows, transparencies, etc. on video

Draw a Box

You can use the `drawbox` filter to render all kinds of boxes, filled or bound, with all sorts of colors and transparencies.

```
ffmpeg -y -i color-test.mp4 \
 -filter_complex \
   "[0:v:0]drawbox=x=20:y=3:w=280:h=36:color=tomato@0
    drawbox=x=11:y=49:w=294:h=40:color=lime:t=1, \
    drawtext=x=(w-tw)/2:y=10:fontcolor=white: \
        shadowx=1:shadowy=1:text='Detonation Sequence
        fontsize=25: fontfile=AllertaStencil.ttf, \
    drawtext=x=(w-tw)/2:y=60:fontcolor=white: \
        shadowx=1:shadowy=1: \
        text='This TV will self-destruct in t seconds
        fontsize=15:fontfile=Exo-Black.ttf[v]" \
 -map '[v]' -map 0:a:0 -pix_fmt yuv420p \
 idiot-box-2.mp4
```

The part of the color value after the `@` symbol refers to the transparency level. It ranges from 0 (fully transparent) to 1 (opaque). If you specify the value `fill` for the filter option `t` or `thickness`, then the box will be filled with that color. Otherwise, it applies to the border.

Figure 7-16 With the `drawbox` filter, two rectangles around the text. (See original video in previous section.) The first rectangle is filled with red. The second rectangle is bordered green

Speed Up a Video

When you increase the playback speed of a video, its duration decreases. When you slow down a video, its duration increases.

There is no one filter that changes the speed of both the audio and the video. You need to use two different filters – one for video and one for audio. The two filters do not work in the same way. The two need to be calibrated correctly so that the same effect is achieved on both the audio and the video.

For the video, you need to set the `setpts` video filter to a fraction of the `PTS` filter constant. If you want to double the speed of the video, divide PTS by 2. If you want the video to be four times fast, then divide PTS by 4. For the audio, you need to use the `atempo` filter. The range of this filter is from half the speed to 100 times. The following command fast-forwards a video by four times (4x).

```
ffmpeg -y -i barb.mp4 \
  -filter_complex \
    "[0:v]setpts=PTS/4[v];
     [0:a]atempo=4[a]" \
  -map '[v]' -map '[a]' \
  barb-speed.mp4
```

☞ In older versions of FFmpeg, the maximum limit of the `atempo` filter was just 2. To go beyond that limit, multiple filters had to be daisy-chained: `atempo=2, atempo=2`

Slow Down a Video

In the *Tom & Jerry* film *Baby Puss*, one of the alley cats tries to dance with a seemingly innocuous doll. In the middle of it, I thought, the doll had become possessed and slammed the cat down on the floor! I slowed the video down with Ffmpeg, and my suspicions were confirmed.

To slow down a video, you need to use the same filters as in the previous section, but the multipliers will have to be different.

This command slows down the video and the audio to one-fourth.

```
ffmpeg -y -i tom.mp4 \
  -filter_complex \
    "[0:v]setpts=PTS*4[v];
     [0:a]atempo=0.5, atempo=0.5[a]" \
  -map '[v]' -map '[a]' \
  possessed-doll.mp4
```

☞ Note the different multiples used for video and audio to achieve the same effect. The audio filter has been used twice because of the limitation in its range.

☞ Read previous section for more information on these two filters.

Laurie Lennon, from the Lennon Sisters family, has published a tribute video for the *Merrie Melodies* number “Oh, Wolfie!”. When I saw it for the first time some years ago, I felt the tempo was too high. I slowed the audio down in Audacity. (I have all songs featuring *Lou* as MP3 files, complete with Wolfie's and Droopy's crazy antics.) For my 2020 book, I tried to do the same using FFmpeg and apply the change to the video as well. My calculation became easier when I used seconds. The original video was 114 seconds, and my slowed-down audio was 128 seconds.

```
# 128/114 and 114/128
ffmpeg -y -i Laurie-Lennon-Original.mp4 \
    -filter_complex \
    "[0:v]setpts=PTS*(128/114)[v];
     [0:a]atempo=(114/128)[a]" \
  -map '[v]' -map '[a]' \
  Laurie-Lennon-Slow.mp4
```

The links to these videos and those used in other examples in this book are available online:

- www.vsubhash.in/ffmpeg-book.html

Summary

The examples in this chapter would have amply demonstrated that a lot of useful and powerful multimedia-processing abilities are hidden in the filters functionality. You need to read the relevant documentation to make full use of a filter. *Filter expressions* using built-in real-time variables (*filter constants*) and functions provide a lot of versatility and extensibility to command-line users that would have otherwise been limited to programmers who use the `libav` *libraries*.

In this book, the teaching portion about FFmpeg functionality ends here. The subsequent chapters are topic-specific for those who want quick answers to a particular type of problem and do not want to read through dense explanatory text before finding the answer. You will find some information repeated or not mentioned at all.

V. Subhash, *Quick Start Guide to FFmpeg*

https://doi.org/10.1007/978-1-4842-8701-9_8

8. All About Audio

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In this chapter, you will learn to perform several tasks related to audio content. While it is convenient to have a separate chapter just for audio, you will find some information repeated from other chapters. If there is no explanation, then it must be self-explanatory.

Most audio-related tasks can be performed using audio filters. If any of the filters used in this chapter seem too complicated, find out what the official FFmpeg documentation has to say on them. If you are unfamiliar with using filters, read Chapter 7.

Convert from One Audio Format to Another

```
ffmpeg -i alarm.ogg \
       -c:a libmp3lame \
       -ac 2 \
       -b:a 128K \
       alarm.mp3            # Ogg to MP3
```

Extract Audio from a Video

```
ffmpeg -i music-video.mp4 \
       -c:a libmp3lame \
       -ac 2 \
       -b:a 128K \
       music-video.mp3      # Audio saved as MP3
```

Convert a MIDI File to MP3 or Ogg

You may have noted that there are no codecs for MIDI. That is because MIDI files are quite different from ordinary sound files. Ordinary sound files contain the wave form encoded in a predefined format. In contrast, MIDI files are merely a collection of references to a common sound bank.

Timidity is the Linux way of playing MIDI files. You can use Timidity to playback MIDI files in WAVE format and write it to its *standard output*. Simultaneously, FFmpeg can be made to consume the wave output as its input file (from its *standard input* over a pipe) and convert it as a regular sound file.

```
timidity yamaha.midi -Ow -o - | ffmpeg -i - -b:a 128k
```

The `-Ow` makes Timidity to output the playback in WAVE format. Its `-o` option is used to specify the output file. Instead of an output file, we use `-` to make it write to the *standard output*. The Timidity output is then piped over to an FFmpeg command, where it is captured from the *standard input* with yet another `-` (hyphen).

Change Volume

FFmpeg can increase the loudness of an audio file using its `volume` filter. The filter accepts a multiple either as a number (scalar) or in decibels (logarithmic).

```
ffmpeg -i sarah.mp3 -af 'volume=3' sarah-more.mp3
```

I had an audio file that continued to have low volume, even after trebling the levels. I opened it in Audacity and found the reason.

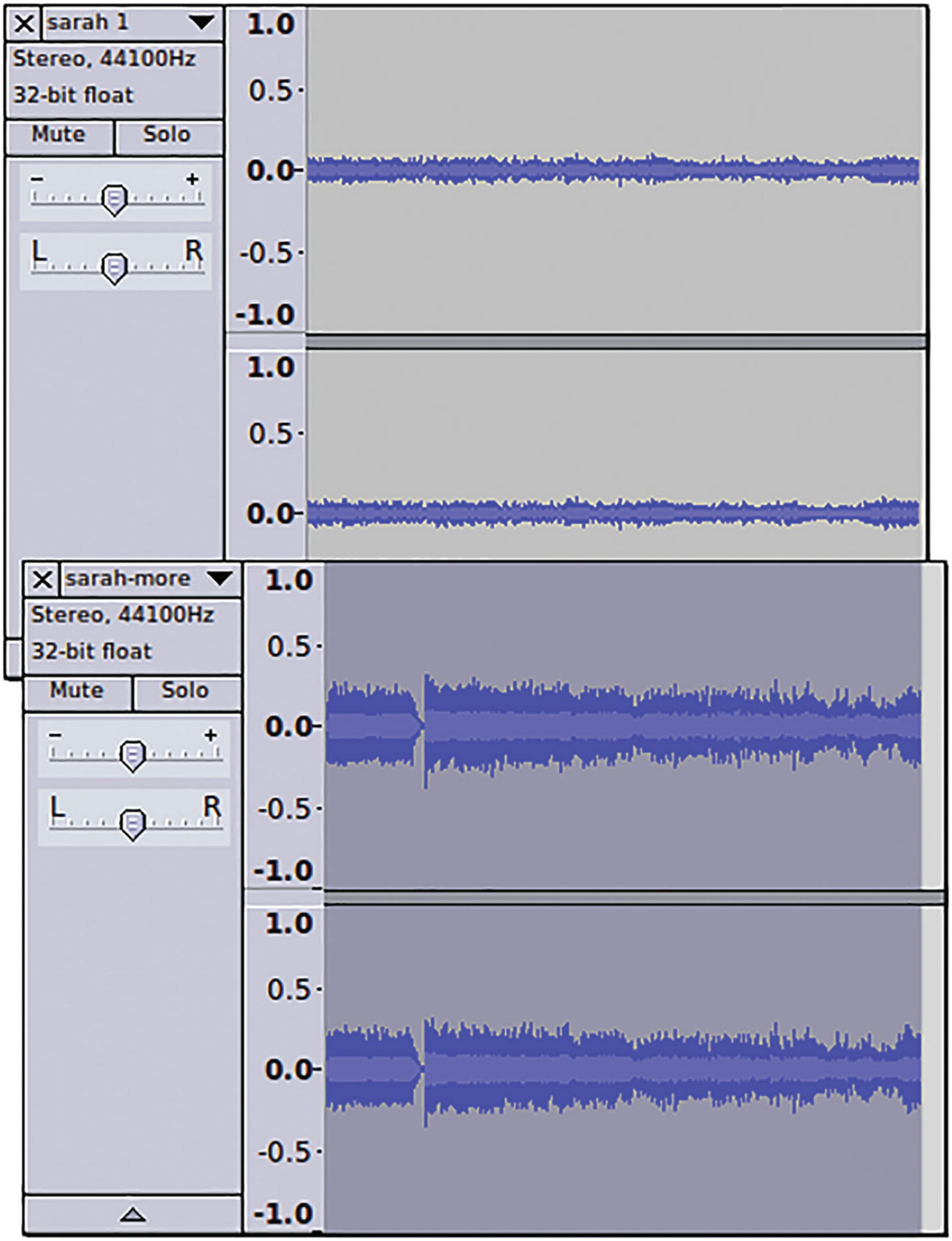

sarah 1
Stereo, 44100Hz
32-bit float
Mute
Solo
L
R
1.0
0.5
0.0
-0.5
-1.0
1.0
0.5
0.0
sarah-more
Stereo, 44100Hz
32-bit float
Mute
Solo
L
R
1.0
0.5
0.0
-0.5
-1.0
1.0
0.5
0.0
-0.5
-1.0

Figure 8-1 Audacity confirms that irrationally increasing the volume is not making much of a difference

Increasing sound like this is based on guesswork. It might work. It may also damage your hearing and/or your speaker system. The correct approach is to normalize the sound after observing the decibel levels in the current waveform.

```
ffmpeg -i sarah.mp3 -af "volumedetect" -f null -
```

```
~/Desktop
$ ffmpeg -i sarah.mp3 -af "volumedetect" -f null /dev/null
[Parsed_volumedetect_0 @ 0x226c100] mean_volume: -32.4 dB
[Parsed_volumedetect_0 @ 0x226c100] max_volume: -17.3 dB
[Parsed_volumedetect_0 @ 0x226c100] histogram_17db: 6
[Parsed_volumedetect_0 @ 0x226c100] histogram_18db: 15
[Parsed_volumedetect_0 @ 0x226c100] histogram_19db: 56
[Parsed_volumedetect_0 @ 0x226c100] histogram_20db: 452
[Parsed_volumedetect_0 @ 0x226c100] histogram_21db: 1676
```

Figure 8-2 Run the `volumedetect` filter before increasing the volume. It helps you in determining the highest number of decibels to which the volume can be increased without cutting into the waveform

> ☞ The `volumedetect` filter outputs text data to the *standard output*. It does not create an audio stream.

The `volumedetect` filter shows that we can safely increase the volume to 16db. If we raised the volume to 17dB or higher, normalization would cut into the waveform, and the peaks would get attenuated or chopped off. At 17dB, six sound samples (the loudest) in the waveform would be lost.

```
ffmpeg -i sarah.mp3 \
       -af 'volume=16dB' -f ogg \
       sarah-normalized.ogg
```

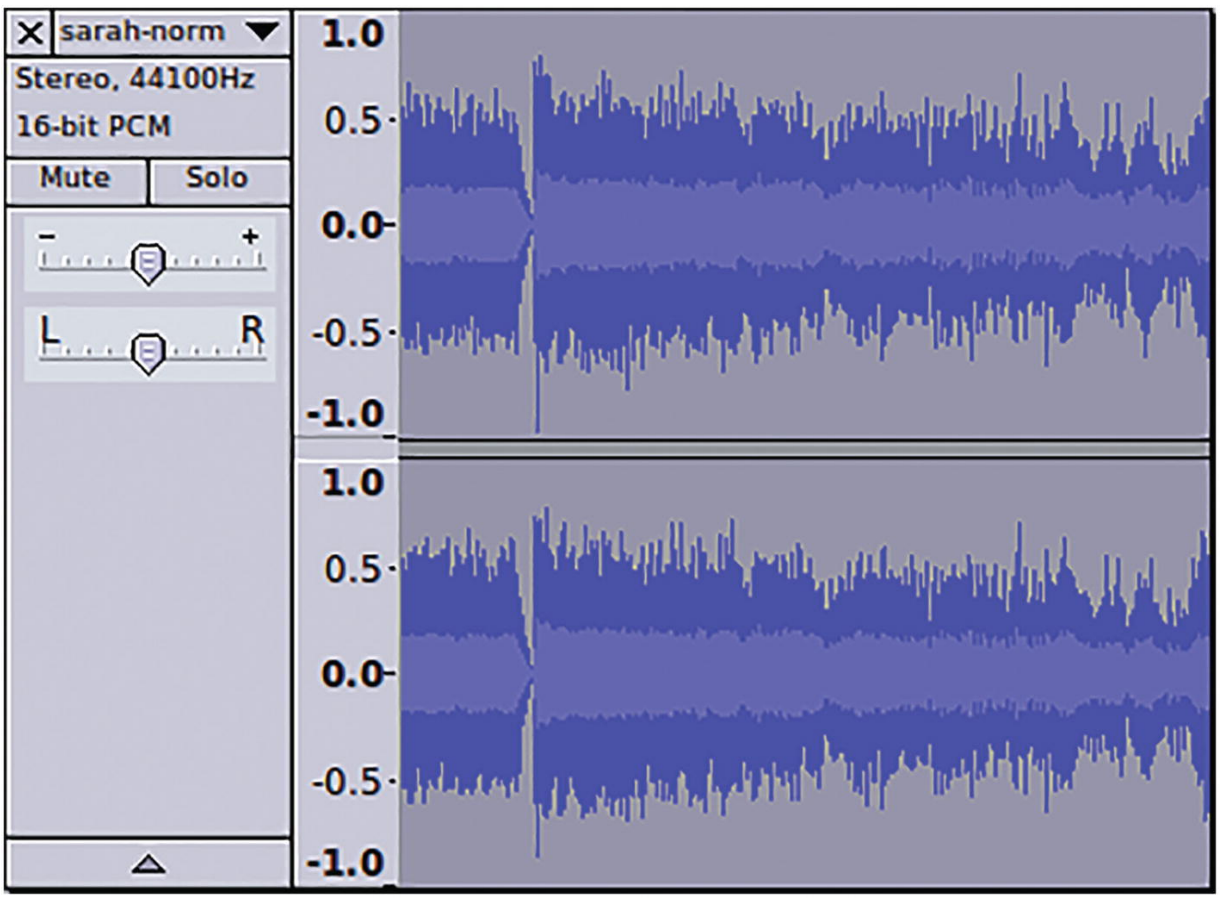


Figure 8-3 Audacity confirms that the volume has been increased without cutting into the waveform

This is fine. Now, how do you decrease the volume? Well, choose a fraction between 0 and 1 for the `volume` filter. For example, to decrease the volume by two-thirds, you should set the multiple at 0.33. (You know 1/3 = 0.33?)

```
ffmpeg -i sarah-normalized.ogg -af 'volume=0.33' sara
```

Change Volume in a Video File

Say, to irrationally increase the volume by three times,

```
ffmpeg -i sarah.mp4 \
       -c:v copy \
       -af 'volume=3' \
       -c:a libmp3lame -b:a 128k \
       sarah-more.mp4
```

To safely and intelligently increase the volume in a video file,

```
ffmpeg -i sarah.mp4 \
       -af 'volumedetect' \
       -vn \
       -f null \

       /dev/null
# Displays that the loudest samples are at 17dB
```

```
# Increase the volume to 16dB (to safely normalize th
ffmpeg -i sarah.mp4 \
       -c:v copy \
       -af ’volume=16dB’ \
       -c:a libmp3lame -b:a 128k \
       sarah-normalized.mp4
```

To decrease volume by two-thirds in a video file, you need to use fractions:

```
# Reduces volume by two-thirds (or to one-thirds)
ffmpeg -i sarah-normalized.mp4 \
         -c:v copy \
         -af ’volume=0.33’ \
         -c:a libmp3lame -b:a 128k \
         sarah-less.mp4
```

Dynamic Range Compression/Normalization

Sometimes, normalization does not make any difference. The volume seems to be unchanged. Examining the audio in Audacity can show you the problem. There are volume spikes in some locations while much of the file is at low volume. (These spikes usually occur when the mic is shaken or bumped while it is recording.) Normalization cannot proceed as long as the spikes remain. The solution is to identify the low-volume regions and expand the waveform. This more selective normalization is known as Dynamic Range Normalization. Alternatively, you could bring down the high-volume regions to the level of the rest of the audio. This selective compression of the waveform is known as Dynamic Range Compression (DRC).

Both techniques make irreversible changes to the waveform, so do not use them indiscriminately. DRC is the bane of popular music today and makes it very boring.

In Carl Orff's composition of *O Fortuna* or Ryuichi Sakamoto's score for the end credits of the movie *Femme Fatale*, the music starts on a low note, building slowly in a steady crescendo and abruptly drops off a high cliff. Applying DRC on such an audio would ruin the composer's intent. However, a recording of a teleconferencing session where multiple participants are heard speaking at different volumes would be an ideal candidate for DRC.

The `dynaudnorm` filter can perform both functions, but the default is normalization. When the `guasssize` option is set at the lower end of 3, it behaves like a typical compressor. At the other end of 300, it becomes a traditional normalizer.

```
ffmpeg -y -i train-trip-low.mp3 \
       -filter:a dynaudnorm=gausssize=3 \
       train-trip-low-dynaudnormalized.mp3
```

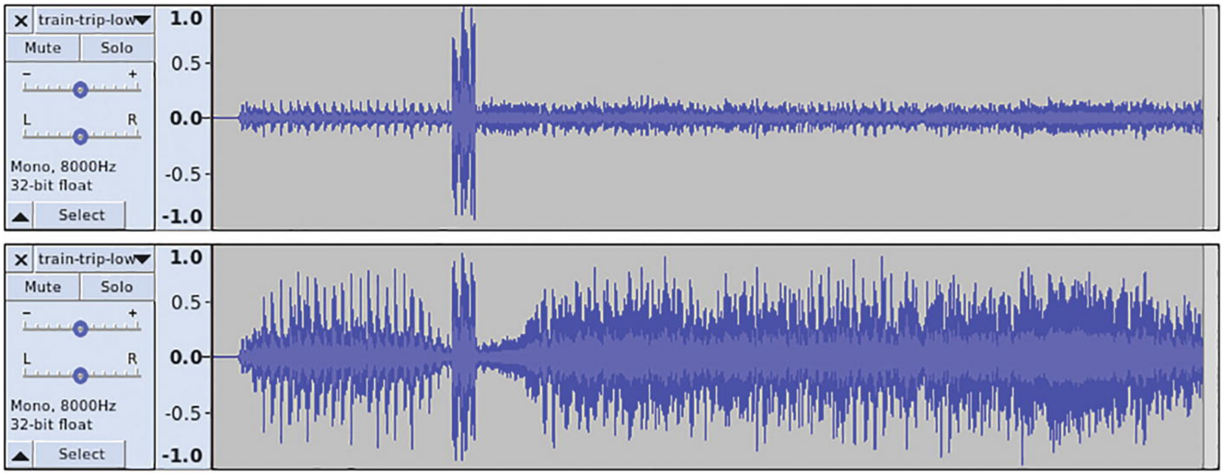


Figure 8-4 A few unexplained spikes in volume can prevent normalization from happening on the rest of the waveform. Dynamic Range Compression and Dynamic Range Normalization are not affected by these spikes and change the entire waveform

Channels

An audio stream can have one or more channels. A *channel* is an independent sequence of audio. All channels in an audio stream are of the same length, and they are played back simultaneously. The idea of having a separate channel is to have a different choice of musical instruments or sounds to play in different speakers. Audio content creators may move back and forth sounds between different channels at different volume levels. This can be useful in creating a 2D or 3D effect to the sound. Typically, each channel in an audio stream is assigned to a particular speaker. This composition of channels in a multichannel stream is known as its *channel layout*. When the number of speakers is less than the number of channels, then that particular channel may not be heard, or the device may *downmix* the channels so that the excess channels will be heard on the existing speakers.

Monaural audio has only one channel. Stereo music has two channels – left and right. Movies can have two, six, seven, eight, or more channels.

When working with channels, you will need to use filters such as `amerge`, `channelmap`, `channelsplit`, and `pan`. These filters make use of certain IDs for channels and channel layouts. Table 8-1 and Table 8-2 list these IDs.

Table 8-1 Channels

ID	Channel
FL	Front left
FR	Front right
FC	Front center
LFE	Low frequency
BL	Back left

ID	Channel
BR	Back right
FLC	Front left-of-center
FRC	Front right-of-center
BC	Back center
SL	Side left
SR	Side right
TC	Top center
TFL	Top front left
TFC	Top front center
TFR	Top front right
TBL	Top back left

ID	Channel
TBC	Top back center
TBR	Top back right
DL	Downmix left
DR	Downmix right
WL	Wide left
WR	Wide right
SDL	Surround direct left
SDR	Surround direct right
LFE2	Low frequency 2

Table 8-2 Channel layouts

ID	Layout composition

ID	Layout composition
Mono	FC
Stereo	FL+FR
2.1	FL+FR+LFE
3.0	FL+FR+FC
3.0(back)	FL+FR+BC
4.0	FL+FR+FC+BC
Quad	FL+FR+BL+BR
Quad(side)	FL+FR+SL+SR
3.1	FL+FR+FC+LFE
5.0	FL+FR+FC+BL+BR
5.0(side)	FL+FR+FC+SL+SR

ID	Layout composition
4.1	FL+FR+FC+LFE+BC
5.1	FL+FR+FC+LFE+BL+BR
5.1(side)	FL+FR+FC+LFE+SL+SR
6.0	FL+FR+FC+BC+SL+SR
6.0(front)	FL+FR+FLC+FRC+SL+SR
Hexagonal	FL+FR+FC+BL+BR+BC
6.1	FL+FR+FC+LFE+BC+SL+SR
6.1	FL+FR+FC+LFE+BL+BR+BC
6.1(front)	FL+FR+LFE+FLC+FRC+SL+SR
7.0	FL+FR+FC+BL+BR+SL+SR
7.0(front)	FL+FR+FC+FLC+FRC+SL+SR

ID	Layout composition
7.1	FL+FR+FC+LFE+BL+BR+SL+SR
7.1(wide)	FL+FR+FC+LFE+BL+BR+FLC+FRC
7.1(wide-side)	FL+FR+FC+LFE+FLC+FRC+SL+SR
Octagonal	FL+FR+FC+BL+BR+BC+SL+SR
Hexadecagonal	FL+FR+FC+BL+BR+BC+SL+SR+WL+ WR+TBL+TBR+TBC+TFC+TFL+TFR
Downmix	DL+DR
22.2	FL+FR+FC+LFE+BL+BR+FLC+FRC+BC+ SL+SR+TC+TFL+TFC+TFR+TBL+TBC+TBR+ LFE2+TSL+TSR+BFC+BFL+BFR

Swap Left and Right Channels

In some videos, sounds from the left side of the video are heard on the right channel and those from the right side are on the left channel. In such a case, you can do a switcheroo.

```
# Switch right and left channels of stereo audio
ffmpeg -i wrong-channels.mp4 \
       -c:v copy \
       -filter_complex "channelmap=map=FR-FL|FL-FR" \
       fine-channels.mp4
```

You can specify the channel settings using the `map` filter option in this format:

- `input_channel_id-output_channel_id|input_channel⏎ _id-output_channel_id|...`

This filter also has a `channel_layout` option.

Turn Off a Channel

In some video files, the narration or commentary is on one channel, and the ambient noise or background music is on the other. If what you want is on the left, you can turn the right channel off by setting its gain to zero (0).

```
# Silence right channel
ffmpeg -i moosic.mp3  \
       -c:v copy \
       -filter_complex "pan=stereo|FL=FL|FR=0" \
```

```
        moosic4lefty.mp3
```

☞ Changing the audio to mono (single-channel audio) is not an option because mono audio is played on both front and left speakers.

You can specify the channel settings in this format:

- `l|output_channel_id=gain*input_channel_id|output⏎ _channel_id=gain*input_channel_id...`

The filter option `l` is used to specify the channel layout. After that, you have to specify how much of what channel (in the input stream) you need for each channel in the output audio stream. For specifying that proportion or the gain, you can specify a multiple or a fraction. If you omit the gain, it implies that you want that channel as is or that the gain is equal to 1 (one). If you use 0 (zero), it means that you want that channel totally attenuated.

Move Channel to a Separate Audio Track

In some videos, the left and right audio channels are independent tracks. What these content creators do is place the original audio on one channel and the most annoying royalty-free music on the other. Instead of deleting the offending channel, you could move each channel to a separate audio stream while preserving the original stereo stream in a third stream.

The `channesplit` filter has a `channel_layout` filter option which by default assumes the input audio stream is stereo. Because of that, this command splits the left and right channels of the audio stream in the video to two mono streams, which I have labeled as `L` and `R`.

```
# Split channels to separate audio streams
# and also preserve existing audio stream
ffmpeg -y -ss 0:0:20 -t 0:0:20 -i zombie.mp4 \
       -c:v copy \
       -filter_complex "channelsplit[L][R]" \
       -map 0:v:0  -map ’[L]’ -map ’[R]’ -map 0:a:0 \
       -c:a:0 aac -ac:a:0 1 \
       -c:a:1 aac -ac:a:1 1 \
       -c:a:2 copy \
       zombie-tracks.mp4
```

Because the first two of the mapped output audio streams need to be freshly encoded as mono streams and the last mapped audio stream just needs to be copied without re-encoding, encoder (`-c`) and channel count (`-ac`) need to be specified on a *per-stream* basis.

☞ The `-c` and `-ac` options are limited to the streams specified by the `-map` options specified before them.

Fix Out-of-Phase Audio Channels

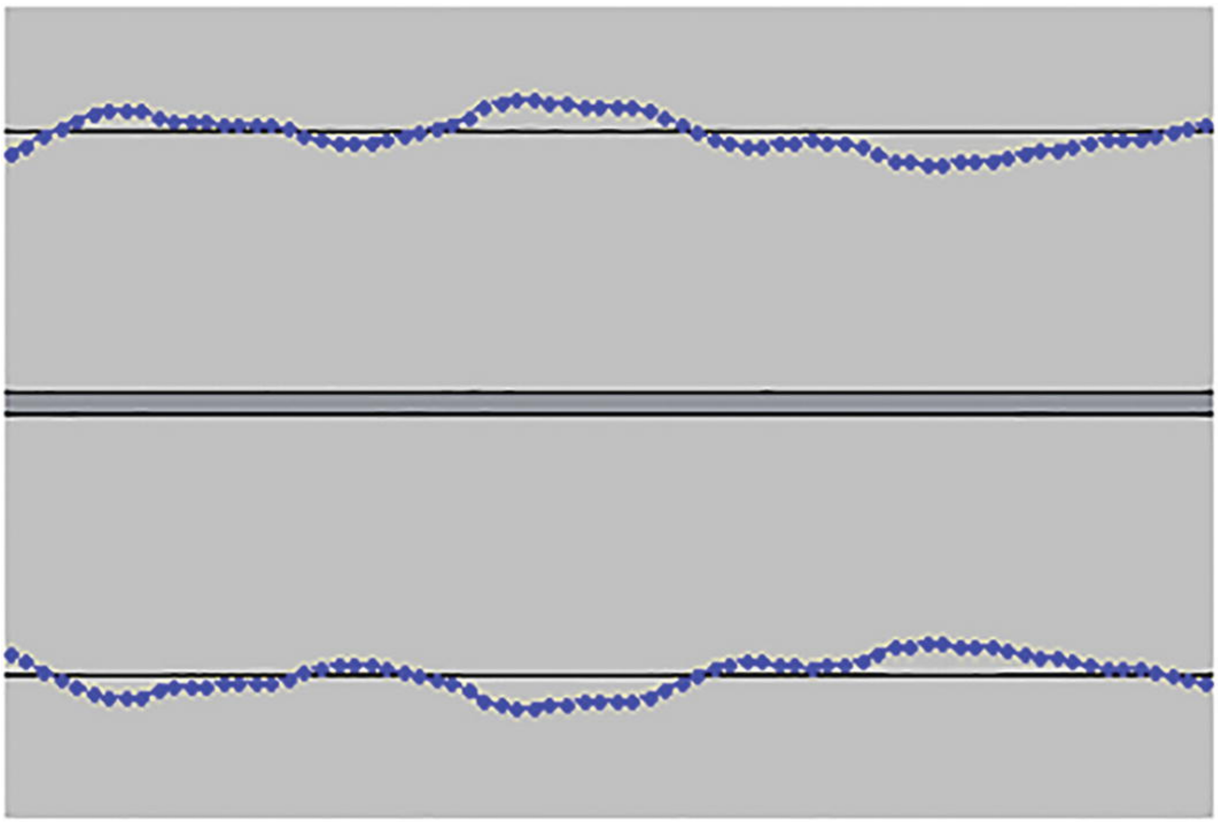
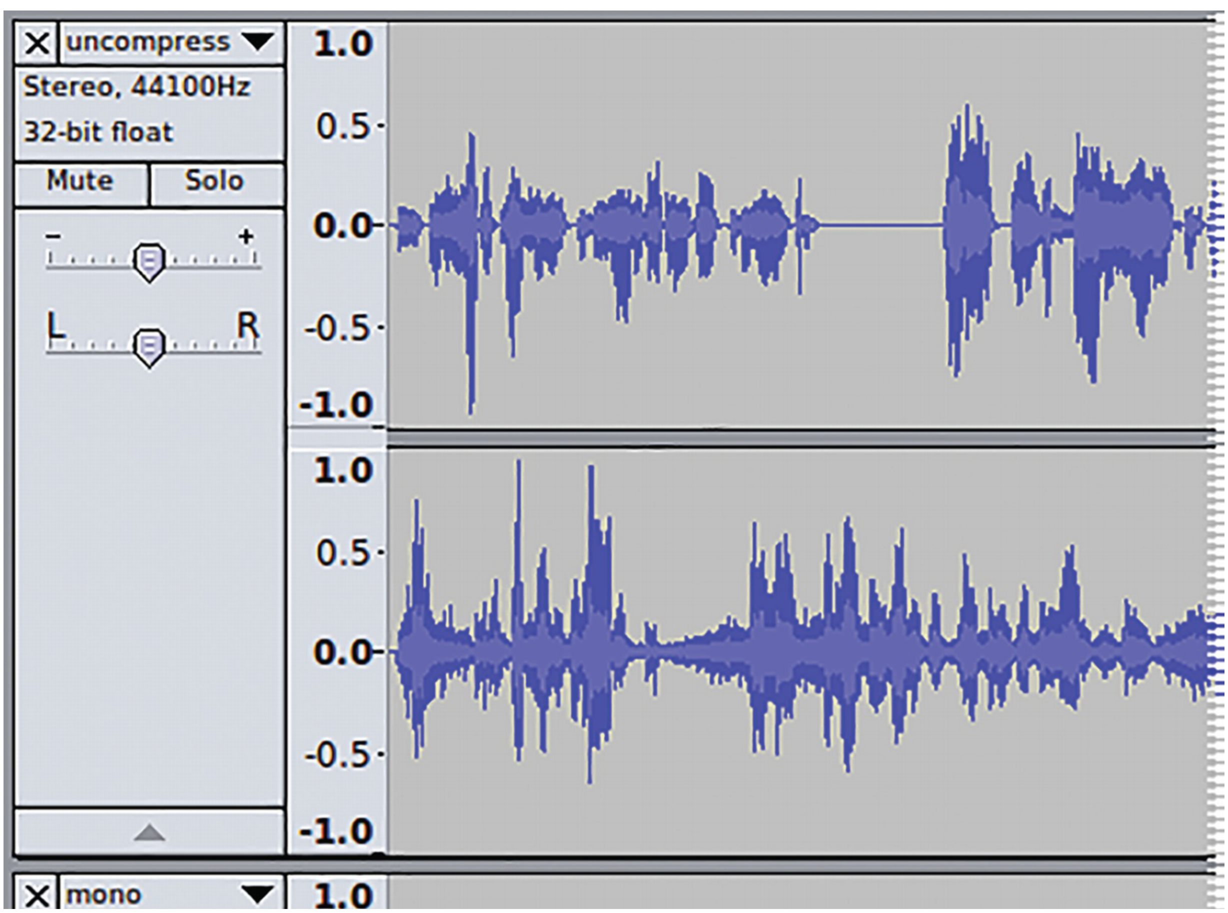


Figure 8-5 This zoomed-in waveform shows out-of-phase left and right channels

Rarely, when you downmix to mono sound, out-of-phase audio in the channels may cancel each other out. The audio will sound muted. You can fix it by saving either the left or the right channel in the input file as the only (mono) channel in the output file. (Monaural audio is played the same on both sides.)

Change Stereo to Mono

Stereo audio has two channels – left and right. Most of the time, both channels have the same audio. However, in many cases, the left channel will have some sounds that are not available in the right channel. The loudness of certain sounds may also differ. This difference will be lost when you convert to mono. Remember this before converting to mono. Mono audio cannot be converted back to stereo. It can only be made to look like stereo. You can convert stereo to mono either by downmixing both left and right channels to a mono channel or dropping one of the channels.



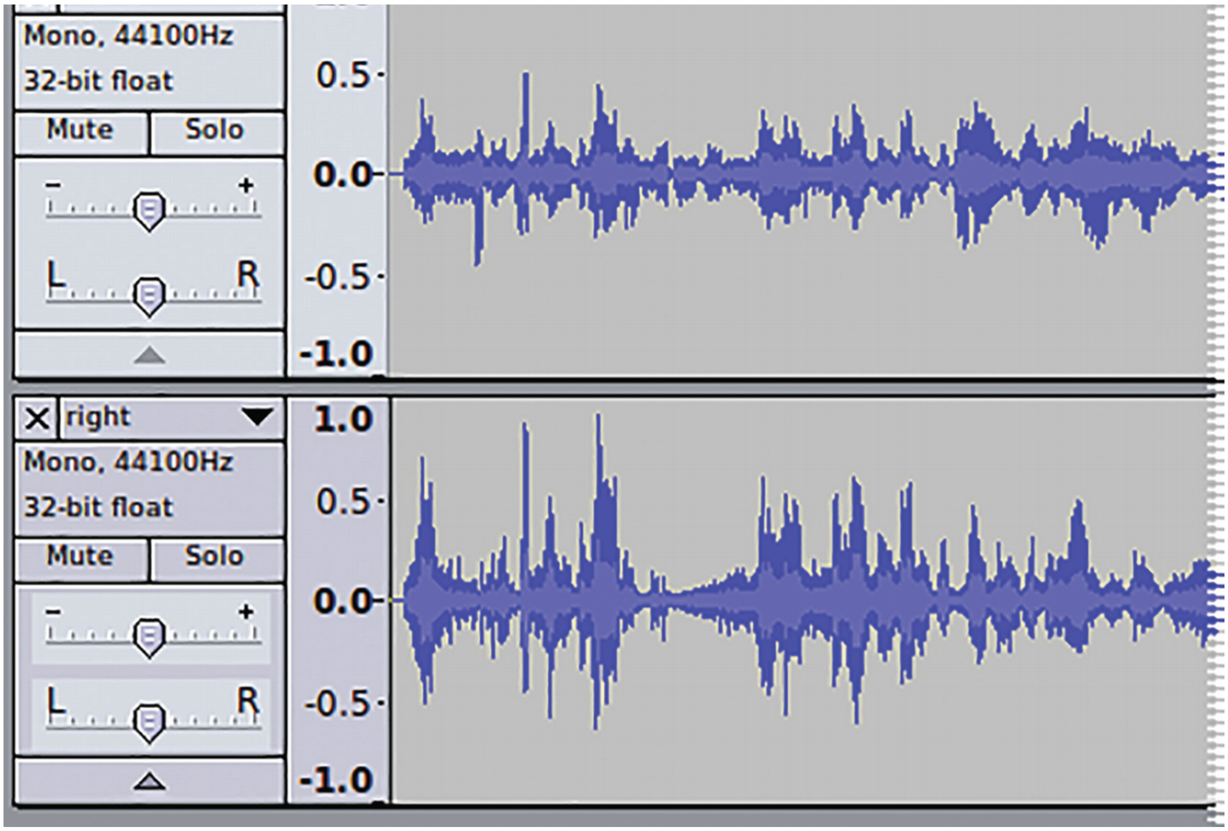


Figure 8-6 To convert from stereo to mono, you can downmix left and right channels to a single mono channel or drop one of the channels. In either case, if the two channels are different, there will be some irreversible loss of the waveform

```
# Downmix to mono
ffmpeg -i uncompressed-stereo.wav \
       -ac 1 \
       mono.mp3
# Drop left channel
ffmpeg -i uncompressed-stereo.wav \
       -filter channelmap=FR-FC:mono \
       right.mp3
```

Convert Mono to Stereo

Mono audio has only one channel. On a stereo audio output device, the same channel will anyway be played on the left and right speakers. Hence, it does not make any difference to convert mono to stereo. If at all this needs to be done, then the audio can be split with a second channel.

```
ffmpeg -i mono.mp3 \
       -ac 2 \
       stereo-kind-of.mp3
```

Make Audio Comfortable for Headphone Listening

When wearing headphones, the sounds feel like they are arising inside your head and between your ears. The `earwax` filter makes the sound feel like it is outside and in front of your head.

```
ffmpeg -i in-head.flac -filter "earwax" out-head.mp3
ffmpeg -i tl.mp4 -filter:a "earwax" -c:v copy tl-head
```

Downmix 5.1 Audio to Stereo

Using the `-ac` (audio channels) option with the necessary number of channels is enough for most downmixing operations.

```
ffmpeg -i AAC-LC-Channel-ID.mp4 \
       -ac 2 \
       stereo.mp3
```

Downmix Two Stereo Inputs to One Stereo Output

When you place two videos side-by-side each other, you need to do something about their two audio streams.

```
ffmpeg -y -i beto.mp4 -i fallon.mp4  \
  -filter_complex \
    "[0:v]pad=1280:360:0:0 [frame];
     [frame][1:v]overlay=640:0 [overlaid];
     [0:a]channelsplit=channel_layout=mono[beto];
     [1:a]channelsplit=channel_layout=mono[fallon];
     [beto][fallon]join=inputs=2:channel_layout=stere
   -map ’[overlaid]’ -map ’[audio]’ \
   fallon-aces-beto.mp4
ffmpeg -y -i beto.mp4 -i fallon.mp4  \

  -filter_complex \
    "[0:v]pad=1280:360:0:0 [frame];
     [frame][1:v]overlay=640:0 [overlaid];
```

```
  [0:a][1:a]amerge=inputs=2[audio]" \
-map '[overlaid]' -map '[audio]' \
-ac 2 \
fallon-aces-beto2.mp4
```

The first command uses `channelsplit` filter to convert stereo audio from the two input files to mono streams. It then uses the `join` filter to use the two mono streams to create a stereo stream where the mono audio from the first file is the left channel and the mono audio from the second file becomes the right channel.

The second command uses `amerge` filter to create a four-channel audio stream from the two input stereo (two-channel) streams. The `-ac 2` conversion setting downmixes the four-channel audio to a two-channel stereo output.

In the first command, the input audio streams are assumed to be of equal length. If they are not of equal length, then the `apad` filter needs to be used to add silence to last till the end of the video stream.

For the Laurie Lennon video mentioned in an earlier chapter, I had also created a video with both the original version and the slowed-down version side-by-side for comparison. The slowed-down video was of greater duration. Without adding the extra silence, FFmpeg would continue adding duplicate data at the end of the shorter stream. The process would never complete, and my computer would have run out of space.

```
// Slow MP4 was 128 seconds. The original was 114 sec
ffmpeg -i Laurie-Lennon-Slow.mp4 \
       -i Laurie-Lennon-Original.mp4 \
       -loop 1 -i bg.png \
    -filter_complex \
    "[0:v:0]scale=320:180[v1];
     [1:v:0]scale=320:180[v2];
     [2:v:0][v1]overlay=320:90[v3];
     [v3][v2]overlay=0:90[v];
     [0:a:0]channelsplit=channel_layout=mono[right];
     [1:a:0]channelsplit=channel_layout=mono,apad[lef
     [left][right]join=inputs=2:channel_layout=stereo
  -map ’[v]’ -map ’[a]’  \
  -t 0:2:08 \
  -y laurie-lennon-comparison.mp4
```

Render a Visual Waveform of the Audio

The `showwaves` filter renders a visual waveform of the input audio.

```
ffmpeg -y -i dialup-modem.mp4 \
```

```
    -filter_complex \
      "[0:a]showwaves=s=160x90:mode=line[waves];
       [0:v]drawbox=x=(iw-20-w):y=(ih-20-h):w=160:h=90:
              color=yellow@0.6:t=fill[bg];
       [bg][waves]overlay=x=(W-20-w):y=(H-20-h)[over]"
    -map '[over]' -map 0:1 \
    dialup-modem-handshake.mp4
```

Figure 8-7 This command draws a waveform of the dialup modem handshake tones on the video. To make the waveform easily visible, the command has drawn a translucent yellow box behind it

In 2021, I wrote a book on electronics. In that, I described how to create the most annoying-sounding alarm noise using a blinking LED. I wanted to publish an online video of the alarm but felt queasy about posting a video of the ceiling where the alarm was installed. FFmpeg to the rescue! I used the `showfreqs` filter to generate the “power spectrum” of the audio recording.

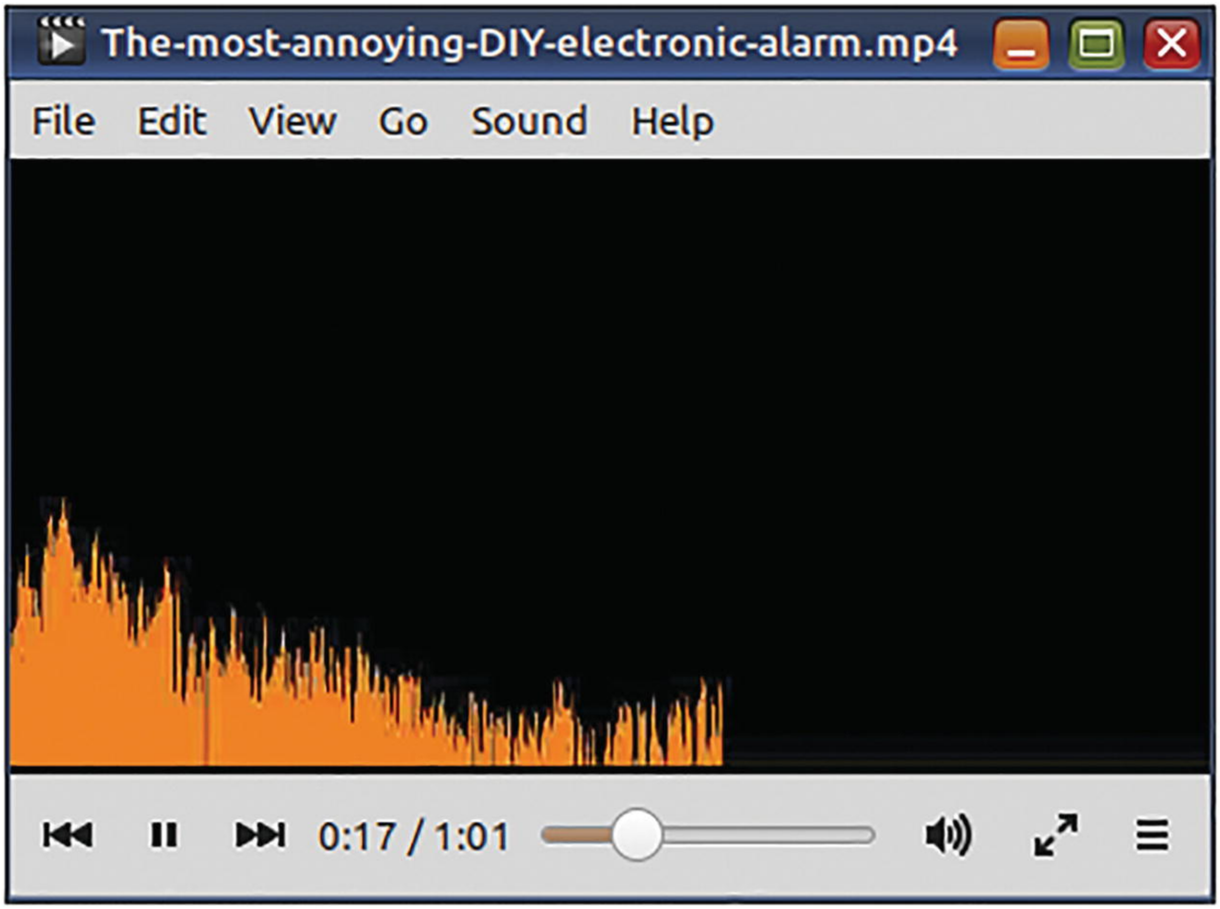


Figure 8-8 The `showfreqs` filter shows how energy in an audio signal is spread across the range of frequencies that are audible to the human ear

```
ffmpeg -i The-most-annoying-DIY-electronic-alarm.mp3
       -filter_complex \
         "showfreqs=s=640x320:mode=bar[v]" \
       -map ’[v]’ -map 0:a:0 \
       -c:v mpeg4 -b:v 466k -r 24 \
```

```
        The-most-annoying-DIY-electronic-alarm.mp4
```

There are a few other filters similar to this one. Check the documentation. These filters are very interesting.

Detect Silence

I have a shell script for censoring movies. (It uses FFmpeg, of course.) I use it to protect kids from foul dialog and unsuitable scenes. It asks for timestamps where the audio needs to be silenced and the video needs to be blacked out. After it does the job, I need to double-check these locations before the grand première on the TV. I use this command:

```
ffmpeg -i edited-movie.mp4 \
       -filter:a "silencedetect" \
       -vn -f null -
```

This command outputs timestamps wherever silence is detected. This helps me to directly skip to the censored locations using my media player on my computer.

Silence the Video

Heck, you do not want sound at all! Just remove the audio stream.

```
ffmpeg -i music-video.mp4 \
       -an \
       -c:v copy \
       sound-of-silence.mp4
```

Convert Text to Speech

If your `ffmpeg` executable has been built-in with support for the `libflite` text-to-speech synthesizer library, then you can convert text content to spoken words.

```
ffmpeg -f lavfi \
       -i "flite=textfile=speech.txt:voice=slt" \
       speech.mp3
```

This library has an option for a female voice, but I like the male-only `espeak` better. You can find other options for the `flite` filter option `voice` by typing the following:

```
ffprobe -f lavfi "flite=list_voices=1"
```

On my computer, this command lists `awb`, `kal`, `kal16`, `rms`, and `slt` as voices that are supported.

Apply a Low-Pass Filter

In an earlier chapter, I mentioned that I used Audacity to apply a *low-pass filter*. A low-pass filter makes all frequencies above a certain level to steeply drop to a zero while not disturbing all frequencies below that level. There is also a *high-pass filter* which does the opposite and attenuates frequencies below a certain level.

The audio recording in my example had a lot of noise typical of old gramophone recordings. When the low-pass filter was applied, the noise disappeared. At that time, I did not know much about FFmpeg filters. If I did, I could have fixed the audio in just one step.

```
ffmpeg -i Stopmotion-hot-wheels.mp4 \
       -filter:a "lowpass=frequency=1000" \
       -codec:v copy \
       Stopmotion-hot-wheels-audio-passed-low.mp4
```

The default option in Audacity was 1000 Hz for the frequency and 6 dB per octave for the roll-off. The roll-off specifies how steeply the frequencies are attenuated. The `lowpass` filter can apply a 3 dB roll-off if you set its `poles` option to 1. The default 2 applies a 6 dB roll-off, and I did not have to explicitly specify it in the above command.

Summary

In this chapter, you learned how to perform several tasks with audio content. You may find it helpful to initially use Audacity to understand audio problems. As you get more familiar with what ails audio content, you can rely on FFmpeg entirely. FFmpeg has a ton of audio filters, and this chapter used just a few of them. Check the FFmpeg documentation on audio filters, and you will find more exciting things you can do with audio.

V. Subhash, *Quick Start Guide to FFmpeg*

https://doi.org/10.1007/978-1-4842-8701-9_9

9. All About Subtitles

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In this chapter, you will learn to perform several tasks related to subtitles. Subtitles are dialogs that are displayed as text on a video. The subtitles may be burned into the video or be available as a separate content stream in the multimedia file. In case of the former, the subtitles cannot be turned off as they have become part of the video. In case of the latter, the subtitles can be turned on or off using a remote button or by selecting an onscreen menu option.

Videos on streaming media, optical media, and broadcast TV can have subtitles in multiple languages. Some websites maintain a crowd-sourced library of subtitles (in multiple languages) of a wide variety of movies, popular and obscure. Several video-hosting sites also display subtitles. They do not let you download subtitles separate from the video. However, there are some other websites that will fetch the subtitles if you give them the address where the original video is hosted.

Subtitles are available in many formats. Subrip (.srt) files are the most popular. Advanced Substation Alpha (.ass or .ssa) is very versatile. WebVTT (Web Video Text Tracks Format) is used by browsers for online videos. TTML is used by the broadcast industry and online applications. DVDs use `.dvdsub` files.

I prefer SSA because I can specify a custom display font with it. For use with FFmpeg, subtitles should be a stream in a media file or an external text file. Subtitles that are already burned into a video (not as a separate stream) cannot be processed by FFmpeg (or rather not covered by this book). However, FFmpeg can be used to burn subtitles permanently on a video.

Add Subtitles to a Video as an Extra Stream

To add a subtitle file to a video, you need to use a subtitle format that is compatible with the video file's container. Or, you should use a suitable encoder that will convert your subtitle file in a format that is supported by the container. The subtitle format for MP4, MOV, and 3GPP containers is known as "MPEG4 Timed Text." You will have to encode your SRT or SSA subtitle files with the encoder `mov_text` for these containers. For the versatile Matroska (MKV) format, you can straightaway use SRT and SSA subtitle files.

Suppose that you have a DVD without subtitles in your favorite language and the DVD seller released a new updated collector's edition DVD that has subtitles in that language. If you were able to download the new subtitles as an SRT file from somewhere, then you can add it to your DVD backup file as an extra stream. If you are saving the DVD as an MKV file, convert the SRT file beforehand to the Substation Alpha (SSA) format to take advantage of the ability of the latter to use a custom font.

```
ffmpeg -i dvd-movie.srt dvd-movie.ass
# Edit the SSA file in some subtitle editor
# and add your custom styles and fonts
ffmpeg -i dvd-movie.ogv -i dvd-movie.ass \
       -map 0:v -map 0:a -map 1:s \
       -c:s mov_text \
       -metadata:s:s:0 language=eng \
       dvd-movie-subtitled.mp4 \
        \
       -map 0:v -map 0:a -map 1:s \
       -codec copy \
       -metadata:s:s:0 language=eng \
       dvd-movie-subtitled.mkv
```

☞ When you add subtitles as an additional stream like this, the viewer can turn them on/off with the device remote or a screen menu option.

Did you notice something else with the above command? I subtitled the movie in two formats (MP4 and MKV) using one command. With the MP4, I had to encode the OGV streams because its codecs are not native to the MP4 container. With the MKV, I could use `-codec copy`. The MKV container supports a wide variety of codecs including those supported by OGV and MP4. If you are backing up DVDs for long-term storage, choose MKV. It is the best.

Permanently Burn Subtitles to a Video

When I was about to publish my first book, I wanted to upload a book-read video in which I read a few pages. I recorded the OGV video using the webcam program *Cheese*, but there were some issues with audio recording. So, I transcribed my narration using another program called *Gnome Subtitles* and saved the subtitles as a Substation Alpha (.ass) file. I did not want to upload the subtitles to the video-hosting sites because they use very tiny fonts. I wanted the subtitles to look bigger and with my own selection of the font. I then decided to use FFmpeg to permanently burn the subtitles on the video. I specified the font and subtitles location on the video in the subtitle file, NOT in the `ffmpeg` command. The SSA format let me do that. Using a filter, I drew a black box behind the subtitles so that they could be easily read against any background.

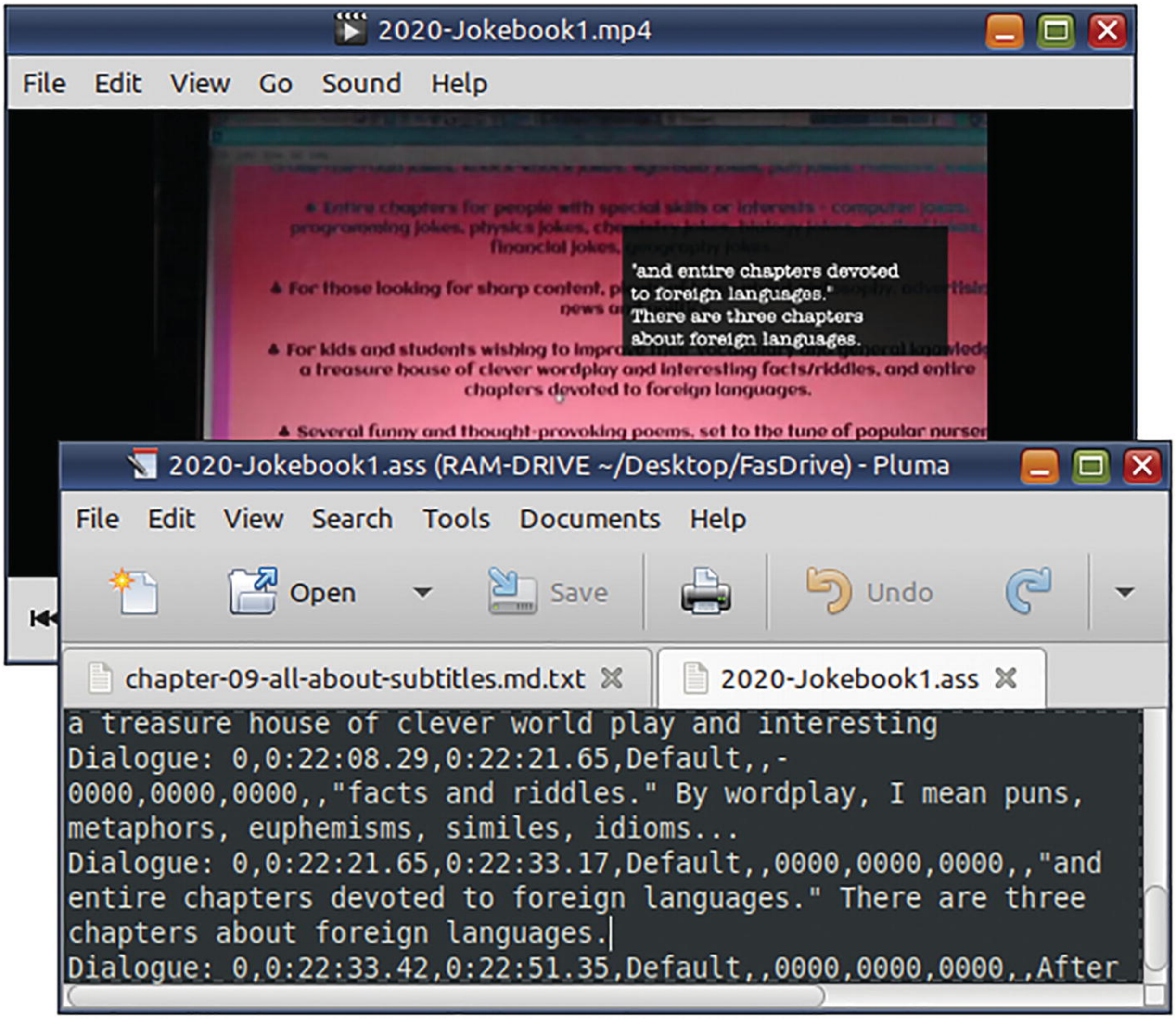


Figure 9-1 Subtitles burned into a video cannot be turned off with the remote or a menu option

```
ffmpeg -i 2020-Jokebook1.ogv \
       -filter_complex \
          "drawbox=w=250:h=100:x=360:y=90:color=black
           subtitles=2020-Jokebook1.ass" \
       -c:v libx264 -r 24 \
       2020-Jokebook1.mp4
```

☞ The `subtitles` filter has a `force_style` option to specify an SSA style for use with a subtitle format (such as SRT) that does not support styles.

☞ The black box was unnecessary. SSA has built-in support for dynamic background boxes, as you will learn later.

Add a Custom Font for Displaying Subtitles of a Video

If I wanted the subtitles in my book-read video to be optional, I could have created an MKV like this:

```
ffmpeg -i 2020-Jokebook1.ogv -i 2020-Jokebook1.ass \
       -codec copy \
       -metadata:s:s:0 language=eng \
       -attach Headline.ttf \
       -metadata:s:t:0 mimetype=application/x-truetyp
       2020-Jokebook1.mkv
```

☞ Font embedding increases subtitles portability and toggleability, but support is not universal.

☞ You should place the font file in the current directory or specify its full path.

This command adds the subtitles as an additional stream in the video. It also specifies a custom subtitle display font and embeds that font. On my PC, Totem and VLC display the subtitles with that font. However, my *WDTV HD* media player box, which I used for many years, always played the subtitles with its own built-in font.

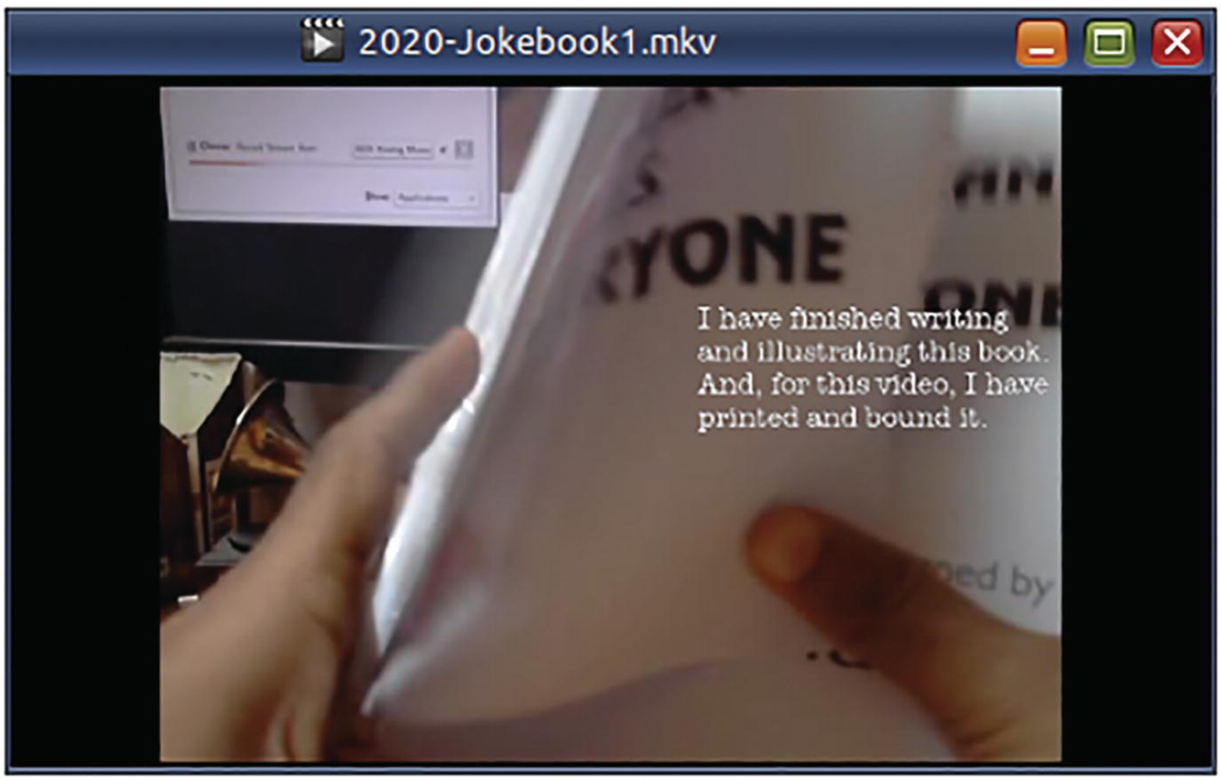


Figure 9-2 When subtitles are added as a stream, the viewer can turn them on/off using the remote or with a menu option

About the Substation Alpha (SSA/ASS) Subtitle Format

Although SRT is the popular subtitle format, I prefer the Substation Alpha (.ass or .ssa) because it supports fonts and several other cool features. You can convert SRT to SSA using `ffmpeg`.

```
ffmpeg -i dvd-movie.srt dvd-movie.ass
```

However, I prefer not to do that. I download the SRT file, let it open in a GUI program called *Gnome Subtitles*, and save it as a SSA file. After this, I run a BASH script on the .ass file to change its style statement. The style statement generated by `ffmpeg` and Gnome Subtitles refers to Windows fonts. These fonts are not available in Linux and the resultant subtitles do not look cool. My script uses a better style statement with a font I already have installed in Linux.

`ffmpeg` version:

- `Style: Default,Arial,16,&Hffffff,&Hffffff,&H0,&H0,⏎ 0,0,0,0,100,100,0,0,1,1,0,2,10,10,10,0`

Gnome Subtitles version:

- ```
  Style:
  Default,Tahoma,24,&H00FFFFFF,&H00FFFFFF,⏎
    &H00FFFFFF,&H00C0C0C0,-1,0,0,0,100,100,0,0.00,
  ⏎
  1,2,3,2,20,20,20,1
  ```

My version:

- ```
  Style:
  Default,Headline,20,&H00FFFFFF,&H006666EE,⏎
    &H00000000,&HAA00EEEE,-1,-1,0,0,100,100,0,0.00
  ,⏎
  1,4,0,2,20,20,20,1
  ```

When I used this style in the book-read video, the subtitles…

```
ffmpeg -y -i 2020-Jokebook1.ogv \ -i 2020-Jokebook1-s
       -map 0:v -map 0:a -map 1:s \
       -c:v copy -c:a copy -c:s ass \
       -metadata:s:s:0 language=eng \
       -attach Headline.ttf \
       -metadata:s:3 mimetype=application/x-truetype-
       2020-Jokebook1-shadows.mkv
```

… look like this:

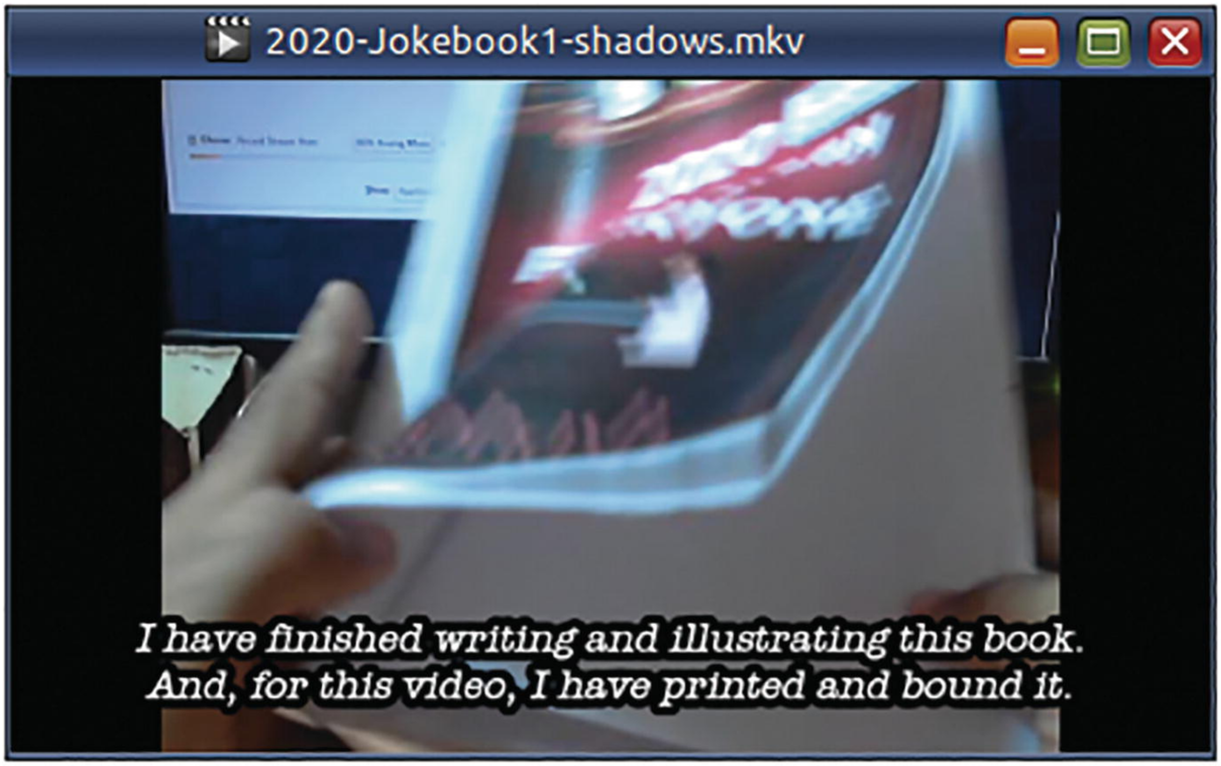


Figure 9-3 In this video, the subtitles have a text outline. (This eliminated the need to render a black box behind the subtitles using an FFmpeg filter. SSA subtitles support multiple such styles in the same file.) The subtitle shadow has been zeroed

The specification of the wonderfully useful but screwed-up SSA format is available on the matroska.org website (*Technical Info » Subtitles » SSA*). However, I will risk a description here for the style statement.

- `Style: Name, Fontname, Fontsize, PrimaryColour, SecondaryColour, OutlineColour, BackColour, Bold, Italic, Underline, StrikeOut, ScaleX, ScaleY, Spacing, Angle, BorderStyle, Outline, Shadow, Alignment, MarginL, MarginR, MarginV, Encoding`

`Name` refers to a subtitle display style. You can define and use many different styles, not just the `Default`. The colors are in hexadecimal AABBGGRR format. (*Ese*, are they *loco*? No. It is allegedly to help with video-to-text conversion.) `PrimaryColour` is the color of the subtitle text. `OutlineColour` is for the outline of the text. `BackColour` is the color of the shadow behind the text. `SecondaryColour` and `OutlineColour` will be automatically used when timestamps collide. `Bold`, `italic`, et al. are -1 for true and 0 for false. (Yeah, I know. The `bash` shell does the same.) `ScaleX` and `ScaleY` specify magnification (1-100). `Spacing` is additional pixel space between letters. `Angle` is about rotation (0-360) and controlled by `Alignment`. `BorderStyle` uses 1 (outlined and drop-shadowed text), 3 (outline box and shadow box), and 4 (outlined text and drop-shadow box). `Outline` represents the border width (1-4) of the outline or the padding around the text in the outline box. `Shadow` represents the offset (1-4) of the shadow from the text or the space around the text in the shadow box. `Alignment` takes 1 (left), 2 (center), and 3 (right). If you add 4 to them, the subtitle appears at the top of the screen. If you add 8, it goes to the middle. Then, we have margin from the left, right, and bottom edges of the screen. `Encoding` is 0 for ANSI Latin and 1 for Unicode (I think).

To really go bonkers with subtitles, I say we render subtitles with a miasma of colors, location, and tilt.

- ```
  Style:
  Default,Headline,22,&H6600FFFF,&H006666EE,⏎
     &H660000FF,&H220066EE,-1,-1,0,0,100,100,0,25.0
  0,⏎
  3,4,4,2,20,20,120,1
  ```

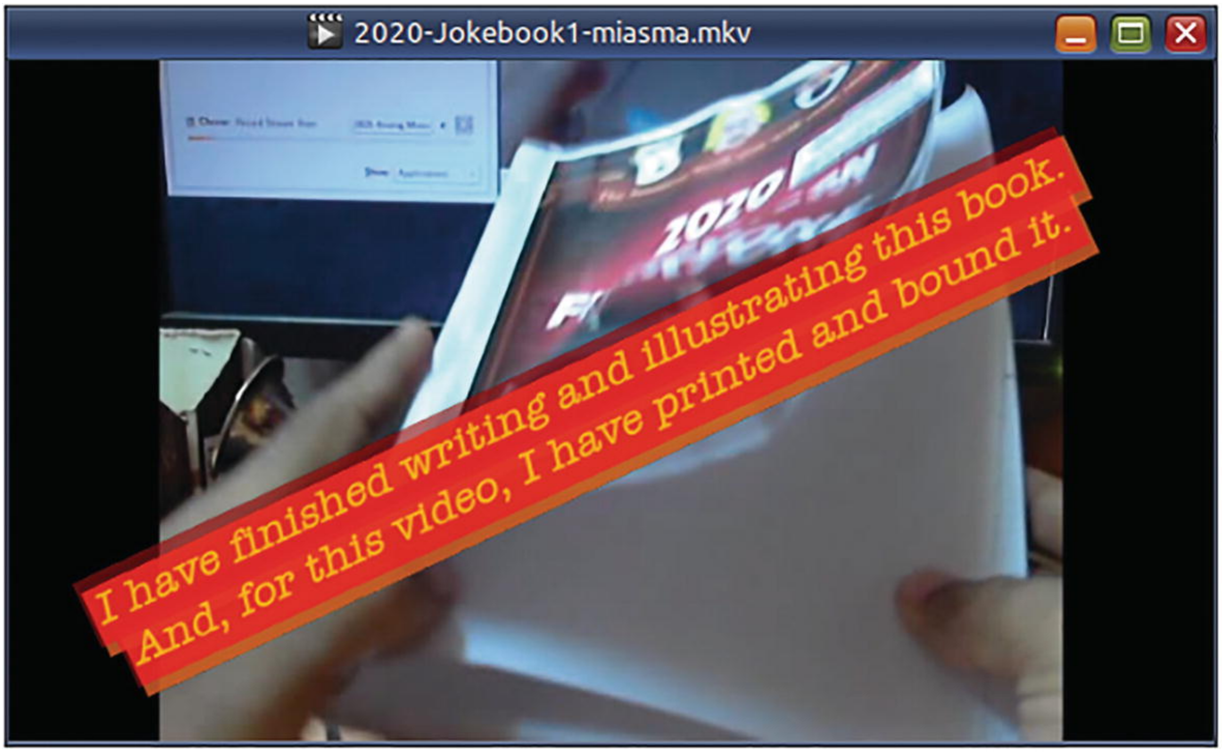


Figure 9-4 This is truly subtitles gone wild. SSA subtitle format offers the most control and options. There is a yellow shadow to the red outline. Because the colors are translucent, their intersection appears orange

Add Subtitle Files in Different Languages

When adding multiple subtitles, it is obligatory on your part to specify metadata identifying the language of each output subtitle stream.
  ```

Let us pretend that I am trying to corner the French jokebook market and have a French transcript ready as well:

```
# Multi-language subtitled MP4
ffmpeg -i 2020-Jokebook1.ogv \
       -i 2020-Jokebook1-en.ass  -i 2020-Jokebook1-fr
       -map 0:v -map 0:a -map 1:s -map 2:s \
       -c:s mov_text \
       -metadata:s:s:0 language=eng \
       -metadata:s:s:1 language=fre \
       2020-Jokebook1-subtitled-en-fr.mp4
# Multi-language subtitled MKV
ffmpeg -i 2020-Jokebook1.ogv \
       -i 2020-Jokebook1-en.ass  -i 2020-Jokebook1-fr
       -map 0:v -map 0:a -map 1:s -map 2:s \
       -c:v copy -c:a copy -c:s copy \
       -metadata:s:s:0 language=eng \
       -metadata:s:s:1 language=fre \
       2020-Jokebook1-subtitled-en-fr.mkv
```

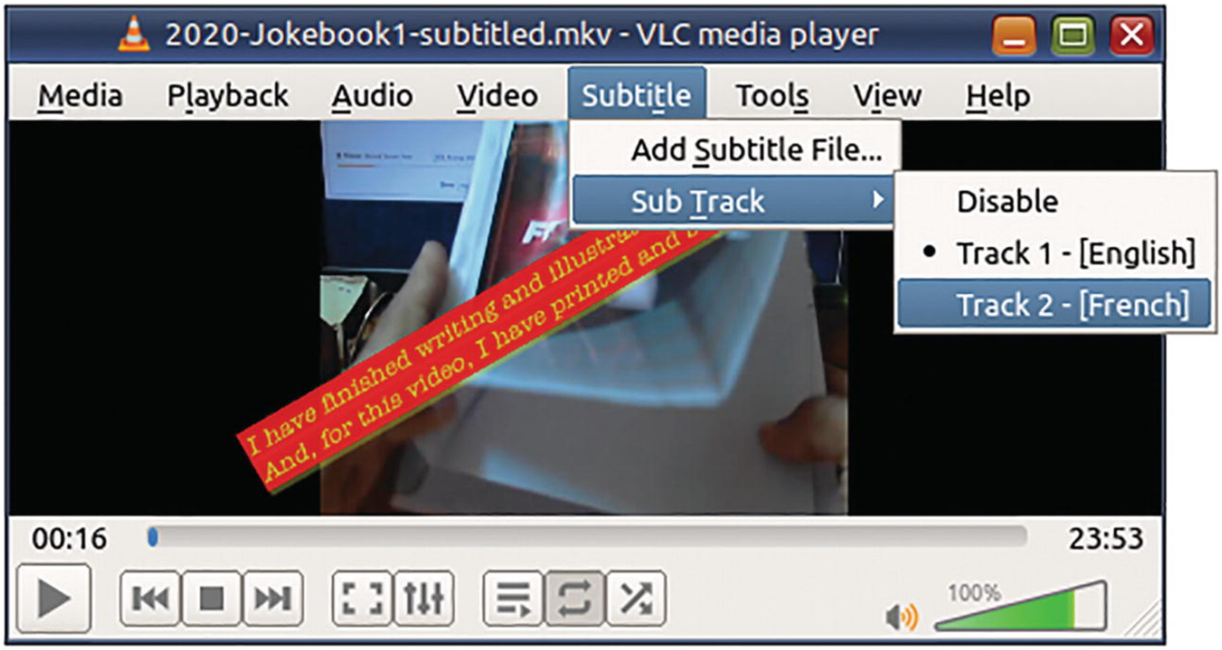


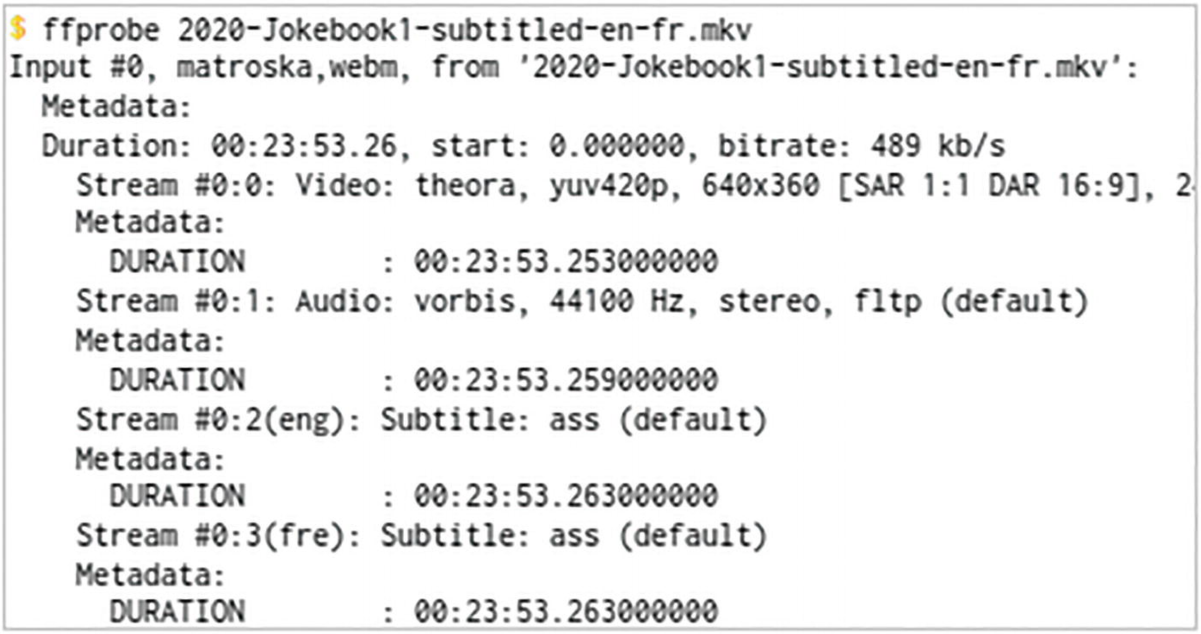
Figure 9-5 Do not forget to specify metadata for the subtitles

☞ The codes that you can use for setting the language are further described in Chapter 10.

Extract Subtitles from a Video

Use `ffprobe` to check if a video file has a subtitle stream.

```
ffprobe 2020-Jokebook1-subtitled-en-fr.mkv
```



```
$ ffprobe 2020-Jokebook1-subtitled-en-fr.mkv
Input #0, matroska,webm, from '2020-Jokebook1-subtitled-en-fr.mkv':
  Metadata:
  Duration: 00:23:53.26, start: 0.000000, bitrate: 489 kb/s
    Stream #0:0: Video: theora, yuv420p, 640x360 [SAR 1:1 DAR 16:9], 2
    Metadata:
      DURATION        : 00:23:53.253000000
    Stream #0:1: Audio: vorbis, 44100 Hz, stereo, fltp (default)
    Metadata:
      DURATION        : 00:23:53.259000000
    Stream #0:2(eng): Subtitle: ass (default)
    Metadata:
      DURATION        : 00:23:53.263000000
    Stream #0:3(fre): Subtitle: ass (default)
    Metadata:
      DURATION        : 00:23:53.263000000
```

Figure 9-6 Use `ffprobe` output to identify the subtitle formats and any metadata they might have. `und` stands for "undetermined"

If the file has only one subtitle stream, you can extract it using FFmpeg just by specifying the correct extension.

```
ffmpeg -i dvd-movie-subtitled.mp4 \
         dvd-movie-subtitle-default.ass
```

If the video has multiple subtitle streams, you need to specify mapping. The next command saves the second subtitle stream in the input file as an SSA file.

```
ffmpeg -i 2020-Jokebook1-subtitled-en-fr.mkv \
         -map 0:s:1 \
```

```
2020-Jokebook1-subtitle-fr.ass
```

Extract Subtitles from a DVD

The files in a DVD are usually encrypted or obfuscated to prevent bootlegging. There are several free DVD-ripping applications that will decrypt the VOB files and quickly extract subtitle files. Forcing `ffprobe` to find subtitle streams on big VOB files is not worth the trouble.

Summary

Subtitles are available in several formats including SRT, Substation Alpha, and MPEG4 Timed Text. The Substation Alpha is the most versatile subtitle format, and MKV seems to be the best container for it. The style specification for the Substation Alpha format may seem intimidating at first but will be accommodative in customizing subtitles for a variety of use cases.

V. Subhash, *Quick Start Guide to FFmpeg*
https://doi.org/10.1007/978-1-4842-8701-9_10

10. All About Metadata

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In this chapter, you will learn to perform several tasks related to metadata. Metadata means to data about data. Multimedia metadata refers to information such as title, artist, album, subject, genre, year, copyright, producer, software creator, comments, lyrics, and even album art images that are used to describe the video and/or audio content.

An audio or video file can have global metadata (i.e., at the file level) and stream-specific metadata too. You can use `ffprobe` and `ffmpeg -i` commands to display metadata that a file already has. You use the `-metadata` option to add new metadata.

Add Album Art to MP3

You can add several pieces of album art to an MP3 file. However, each image will need to have a unique title and comment metadata. There can be one for front cover, another for the back, and yet another for the inlay art. FFmpeg will treat all album art images as video streams, as if they were single-frame videos.

```
ffmpeg -y \
  -i Uthralikavu-Pooram.mp3 \
  -i Uthralikavu-Pooram-festival-fireworks.png \
  -i Uthralikavu-Pooram-festival-crowds.png \
  -map 0 -map 1 -map 2 \
  -metadata:s:1 title="pooram-fireworks.png" \
  -metadata:s:1 comment="Cover (front)" \
  -metadata:s:2 title="pooram-crowds.png" \
  -metadata:s:2 comment="Cover (back)" \
  -codec copy \
  -f mp3 \
  Uthralikavu-Pooram-festival-fireworks.mp3
```

☞ Album art are added as single-frame video streams, not metadata. The metadata you add for album art will apply to the video streams of those images.

There are several options for the `comment` key, as defined in the ID3 tag specification.

- https://id3.org/id3v2.3.0

There is no uniform implementation among media players. When there are more than one album art images, `ffplay` chooses the first cover image that is mapped. Some other players follow a different pecking order.

Figure 10-1 The album art displayed by different media players for the same MP3 file can be different

Set MP3 Tags

How do I add metadata to an MP3 file?

```
ffmpeg -y -i Uthralikavu-Pooram-festival-fireworks.mp
```

```
        -map 0 \
        -metadata title="Uthralikavu Pooram Festival"
        -metadata artist="V. Subhash" \
        -metadata \
           subject="Fireworks and crowds" \
        -metadata album="Pooram festival fireworks" \
        -metadata date="2013-12-26" \
        -metadata genre="Event" \
        -metadata comment="Best outdoor event I ever a
        -metadata \
           copyright="© 2013 V. Subhash. All rights re
        -id3v2_version 3 \
        -codec copy \
        Kerala-Uthralikavu-Pooram-festival-fireworks.m
```

☞ MP3 tags metadata get added at the global level. They are not stream-specific.

Figure 10-2 Media player support for MP3 tags may be buggy or not 100%. Do not break your head just because some tags do not get displayed by a media player

Export Metadata

You can export metadata to a text file using the `-f ffmetadata` option.

```
ffmpeg -i Kerala-Uthralikavu-Pooram-festival-firework
       -f ffmetadata \
       mp3-meta.txt
```

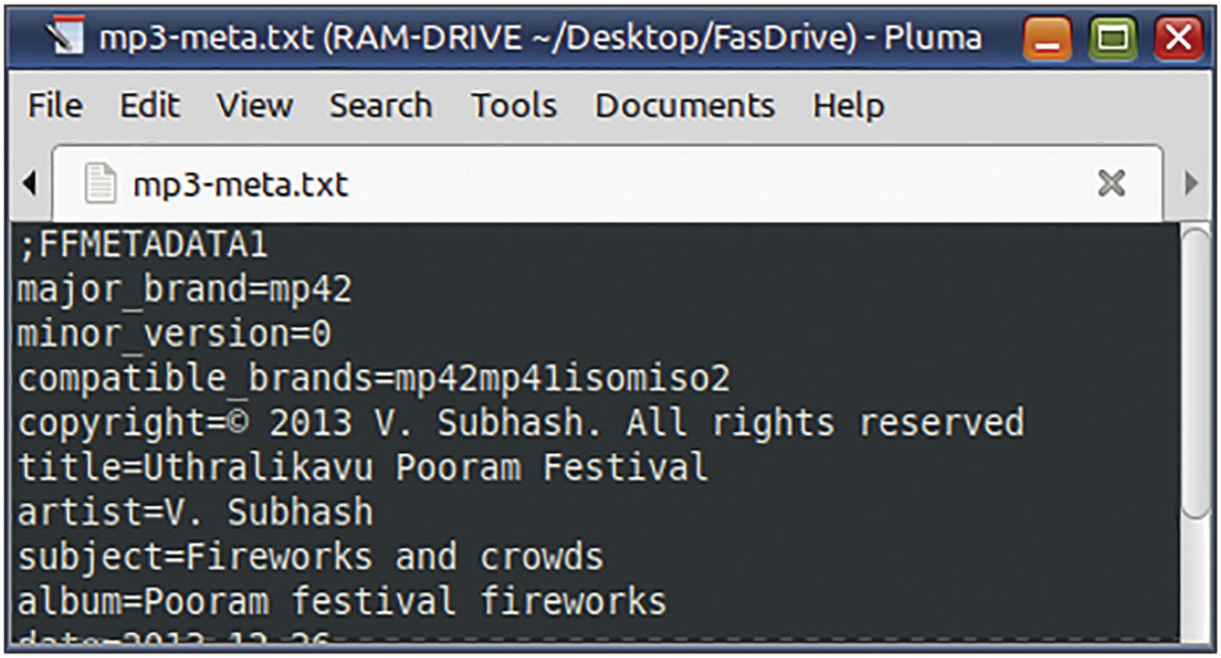

Figure 10-3 `ffmpeg` exported this text file containing name-value pairs representing the metadata of an MP3 file

Import Metadata

Let us imagine that I modified the metadata in the text file (from the previous section) using a text editor. Now, I want the updated metadata to be imported back into the audio file. How can I do it?

```
ffmpeg -y \
 -i Kerala-Uthralikavu-Pooram-festival-fireworks.mp3

 -i mp3-meta-modified.txt \
 -codec copy \
 -map_metadata 1 \
 Kerala-Uthralikavu-Pooram.mp3
```

Here, `-map_metadata 1` refers to the second input file, that is, the modified metadata file. (`-map_metadata 0` would have simply copied the metadata from the first input file, that is, the MP3 file. We did not want that.)

Extract Album Art

You downloaded an MP3 and you like the album art? If the audio file has only one album art, you can extract the image easily.

```
ffmpeg -i Blobfish.mp3 blobfish-album-art.png
```

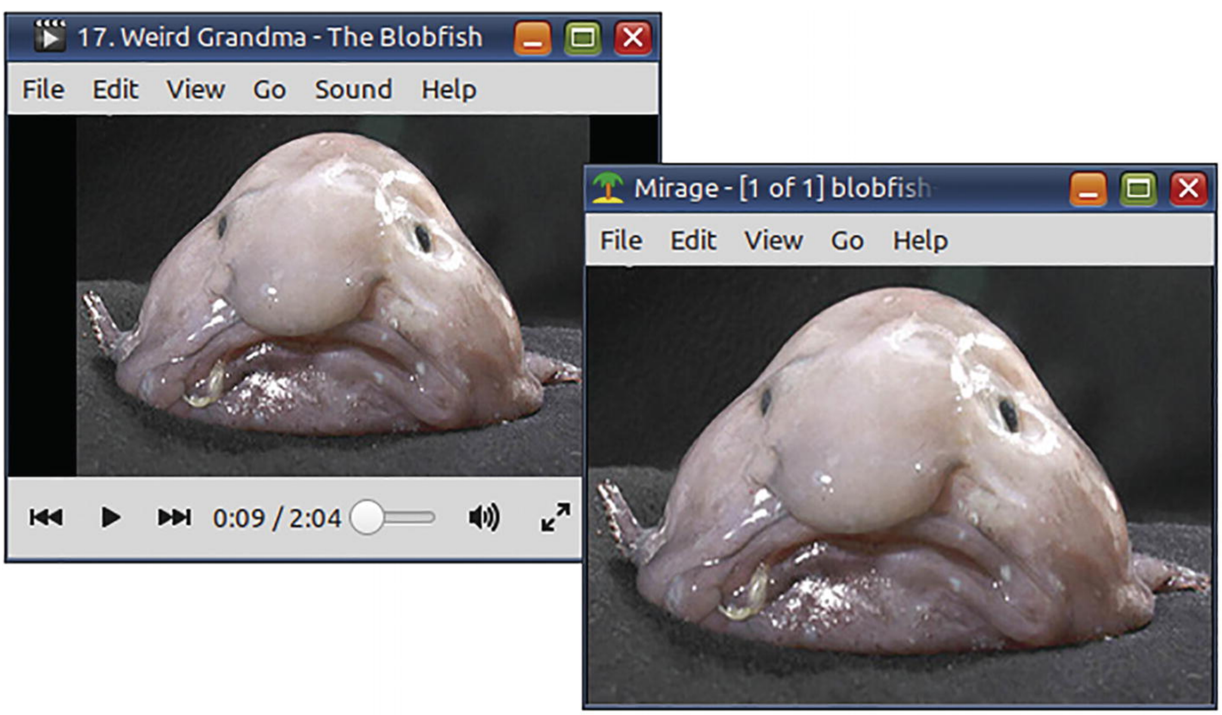

Figure 10-4 An MP3 audio file and the album art extracted from it

If there are more than one album art, you need to check the ffprobe output and then extract the album art using a map.

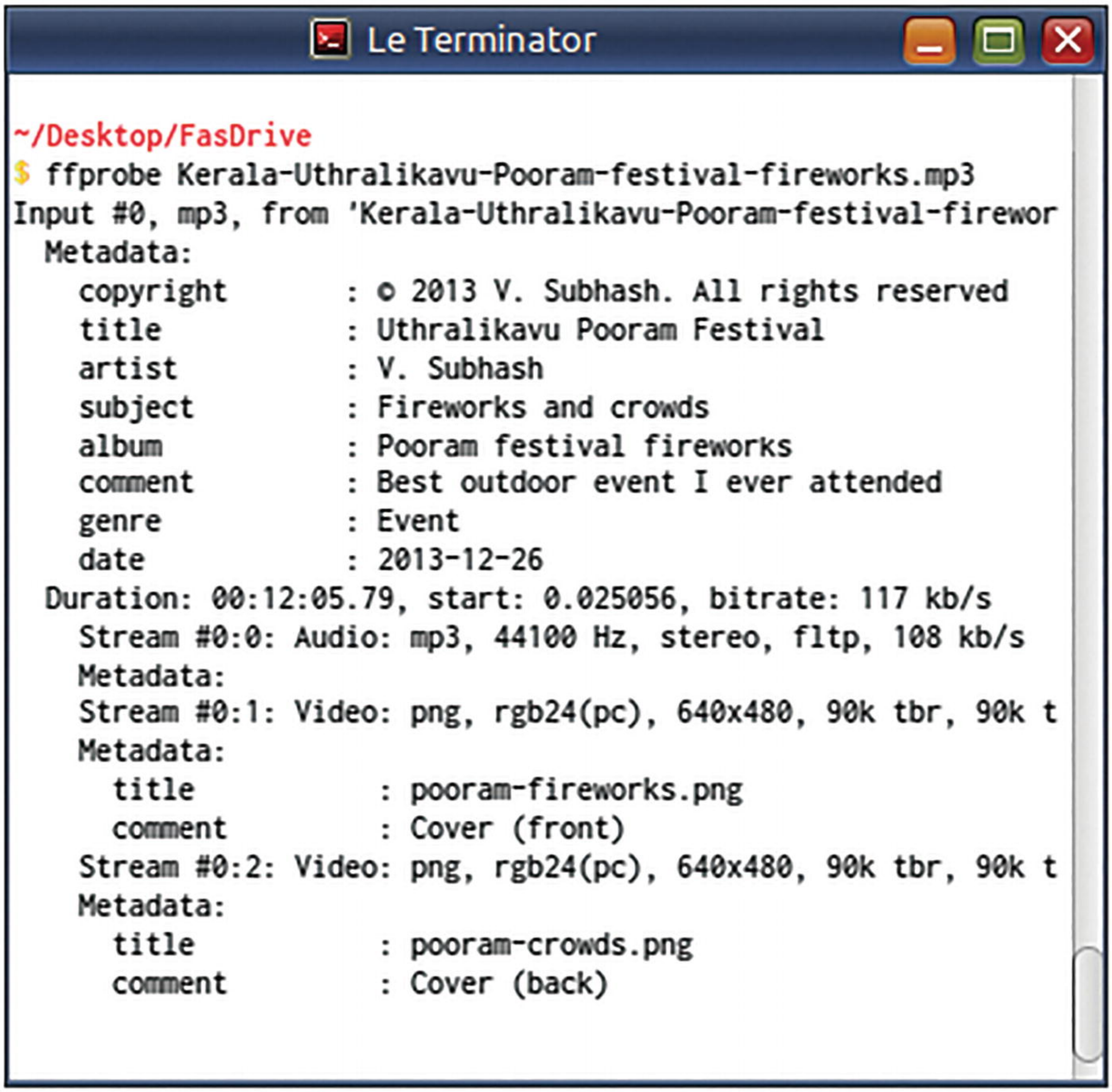

Figure 10-5 This `ffprobe` output shows the index of the streams containing the album art images

The crowds image is identified as a video stream with index `0:2` (third among all streams). To extract it, I should use the map `0:2`. To be safer, I refer to it as `0:v:1` (second video stream).

```
ffmpeg -i Kerala-Uthralikavu-Pooram-festival-firework
        -map 0:v:1 \
        crowds.png
```

Remove All Metadata

When working on an earlier chapter, I found that the Mate Screenshot app was unable to work with the video of the sign-language translator. The app names its screenshot after the title of the subject window. I noted that this video had a URL displayed in the title of the video player window. The URL came from the title metadata of the video. Because the Linux file system does not allow a file name to include a URL (because of the backslash and other illegal characters), the screenshot app may have been unable to save the image to file. When I removed the metadata, I realized that my hunch was right and I was able to take the screenshots from the metadata-free video.

To remove the metadata, I pretended to import metadata from a nonexistent input file (with index `-1`).

```
ffmpeg -i "Sign_Language_-_How_To_Vote.mp4" \
       -codec copy \
       -map_metadata -1 \
       how-to-vote.mp4
```

I have had portable media players that do not play MP3 files if they have album art. Album art cannot be removed as metadata because they are encoded as video streams. So, I use `-codec copy` and specify a `-map` for the audio stream. By omitting video streams, the output file will not have any album art.

```
ffmpeg -i Kerala-Uthralikavu-Pooram.mp3 \
       -map 0:a \
       -codec copy \
       pooram.mp3
# You can also use -vn instead of the -map option
```

Set Language Metadata for Audio Streams

Let us imagine that I created audio instructions in English, Malayalam, and Tamil for this DIY electronics video. While media players could switch between the language tracks, they would have assigned generic or confusing names to them.

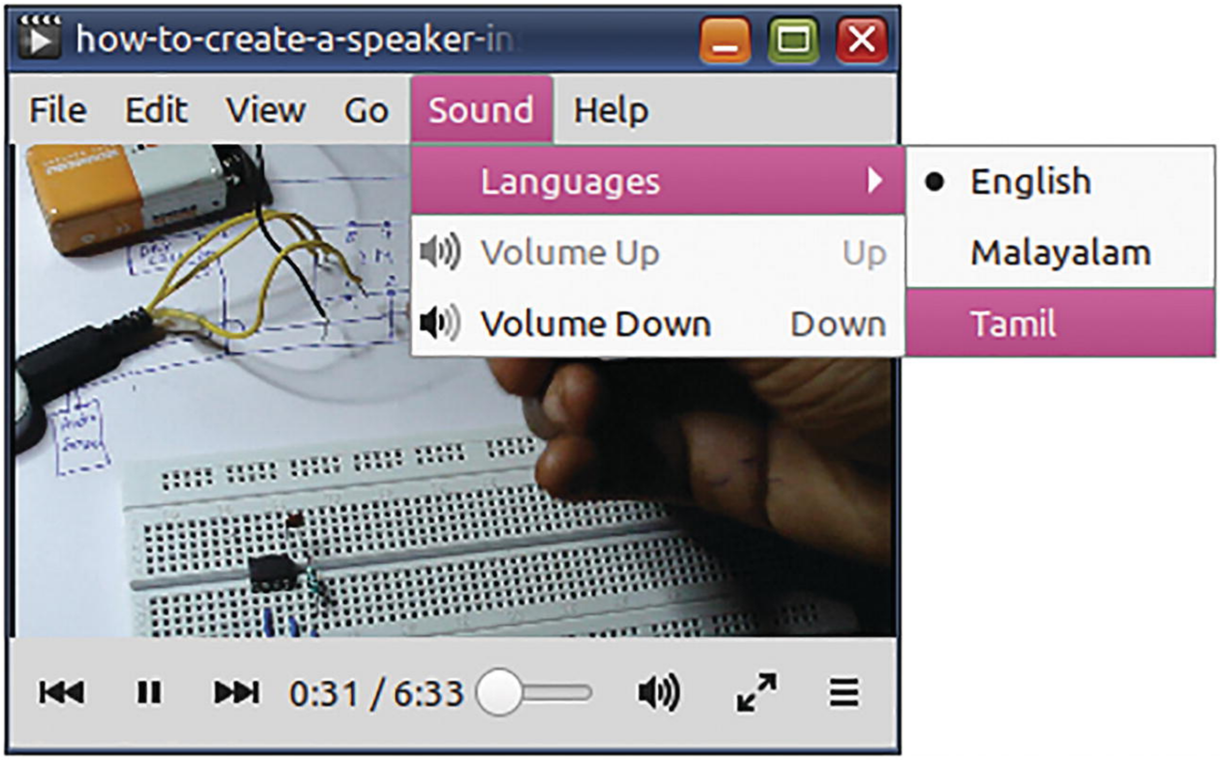

Figure 10-6 This video has audio tracks in three languages. The metadata for the audio streams helps identify the languages

The following command sets the language names using ISO codes and makes the menus a lot more informative.

```
ffmpeg -i how-to-create-a-speaker-instructions.mp4  \
       -map 0 \
       -metadata:s:a:0 language=eng \
       -metadata:s:a:1 language=mal \
       -metadata:s:a:2 language=tam \
       -codec copy \
       how-to-create-a-speaker-instructions-multilang
```

map 0 includes all streams in the first input file (#0), that is, including the video stream and the three audio streams. (If not used, there will be just one video stream and one audio stream in the output file.) -metadata:s: is used to set metadata for a stream, not a subtitle.

> ☞ Apart from s identifier for streams, FFmpeg uses identifiers p and c for DVD programs and chapters of the VOB file container. These are not covered by this book.

-metadata:s:a is used to set metadata for an audio stream specified by its index. language is the metadata key, and what follows after the = sign is the value in the metadata key-value pair. -codec copy ensures that the streams are not re-encoded – only the metadata is added.

The three-letter language codes (such as eng, mal, and tam) are specified in the **ISO 639-2** standard. Although the standard allows codes for exceptional situations (mis for “uncoded languages,” mul for “multiple languages,” qaa-qtz for “reserved for local use,” und for “undetermined,” and zxx for “no linguistic content” or “not applicable”), many software and hardware remain ignorant of them.

- www.loc.gov/standards/iso639-2/php/code_list.php

Summary

In this chapter, you learned to use ffmpeg to easily add, examine, edit, export, import, and remove metadata. Metadata can be specified at the container level (global) and for individual streams. This information can greatly enrich the experience with media players. In their absence, media players will try to make guesses and/or frustrate you with generic or wrong interface choices. Media formats and software/hardware applications may be picky and choosy about the kind of metadata they support.

With the end of this chapter, all that remains is a set of tips and tricks that could not be accommodated anywhere else.

V. Subhash, *Quick Start Guide to FFmpeg*

https://doi.org/10.1007/978-1-4842-8701-9_11

11. FFmpeg Tips and Tricks

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I like tips and tricks, and I cannot lie. I have written an entire book titled *Linux Command-Line Tips and Tricks*. The tips and tricks in this chapter are mostly about FFmpeg. If you spend a lot of time with FFmpeg, these tips will be useful. Some advanced FFmpeg solutions, which could not be accommodated elsewhere, are also included.

Customize the Terminal

FFmpeg commands tend to be very long. Modify the `~/.bashrc` file to ensure that you have enough real estate at the prompt.

```
PS1="\a\n\n\[\e[31;1m\]\u@\h on \d at \@\n\[\e[33;1m\
\w\[\e[0m\]\n\[\e[32;1m\]\$ \[\e[0m\]"
```

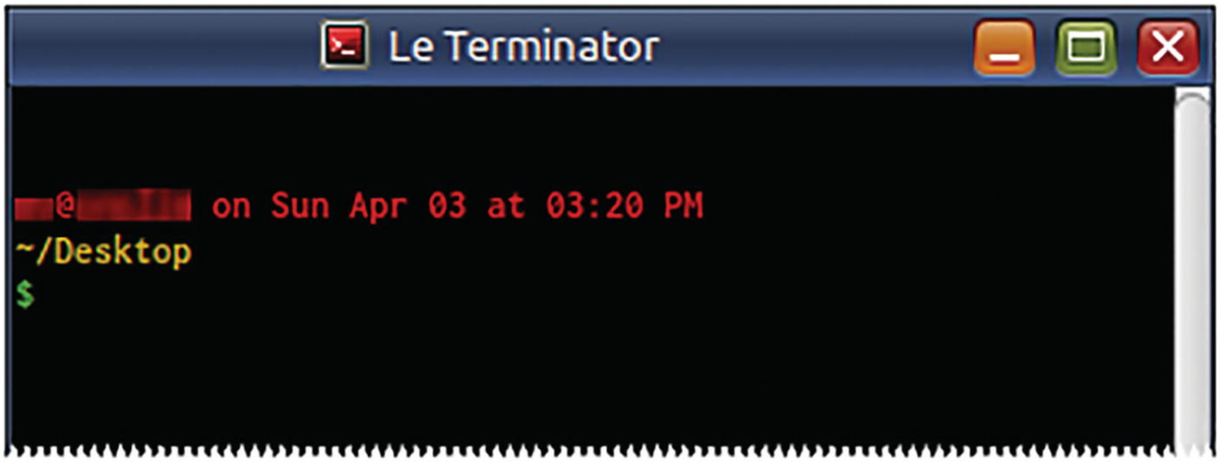


Figure 11-1 This is a very informative terminal prompt with almost the entire length of the window available for your epic `ffmpeg` commands

> ☞ For this prompt to work effectively, you need to change the background of the terminal to black.

For a minimal style of the prompt, use the following:

```
PS1="\a\n\n\[\e[31;1m\]\w\n\[\e[33;1m\]\$ \[\e[0m\]"
```

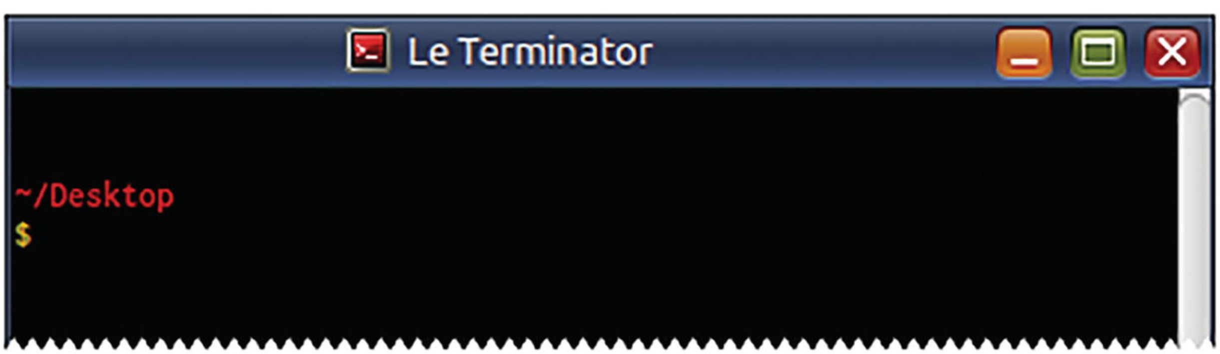


Figure 11-2 Same as in the previous screenshot but with less information overload

File Manager Automation

The first rule of software development is “Give what the user wants.” This rule implies another thing – “Do not give what the user does not want.” But, it was not to be… When the Chrome browser was released, it lacked options to change important settings. Apologists claimed that most users did not need them or know how to use them. This was no accident. For several years, there had been a shift away from “More power to users” objective to “The user is stupid” mantra. In the open source community, Gnome 3 desktop environment project became plagued with this attitude. The project decided that users of their glorious touch-me-not desktop should not be allowed to customize or personalize anything. (*Linus Torvalds finds GNOME 3.4 to be a “total user experience design failure”*; 2012; ZDnet.com) Customization and changing default settings were compared to the tragedy that was known as Myspace personal pages. They claimed that users did not need extra features. Windows 8 developers also justified the destruction of their desktop in similar terms. They removed features and claimed it was an improvement. All kinds of snake oil was used to sell this deprivation of usability – “This is the new way of doing things,” “Don’t be stuck in old ways,” “You are unwilling to change,” “Embrace change,” and the dreaded “Change is gooooooooood.”

Fortunately, not all developers succumbed to this impairment of judging faculties. Some of them developed the Mate (pronounced "mah-tay") desktop environment that continued support for the intuitive and user-friendly Gnome 2.

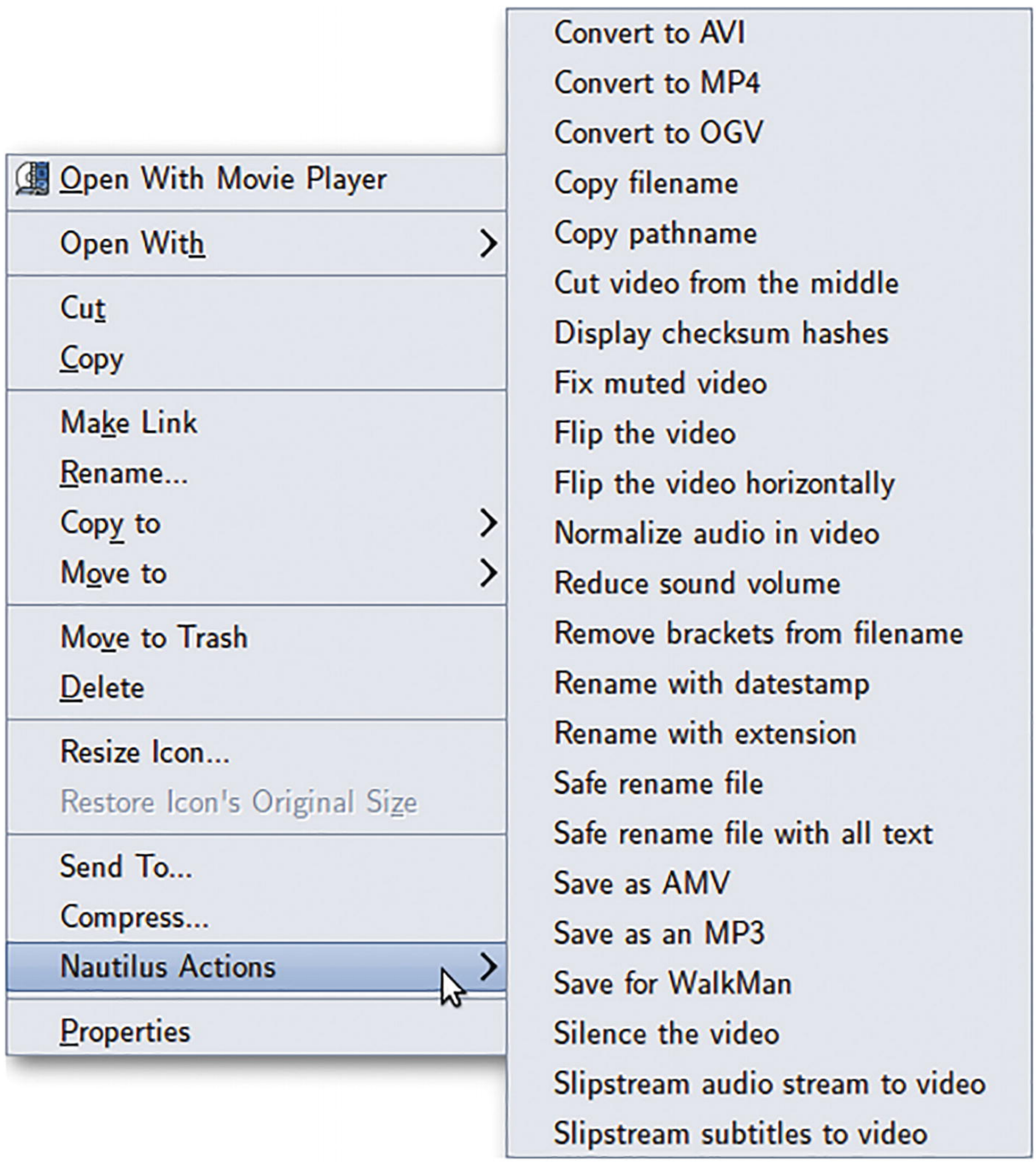


Figure 11-3 In the year 2020, the context menu options in the file manager of my desktop became so heavy with FFmpeg automation scripts that I decided to write this book

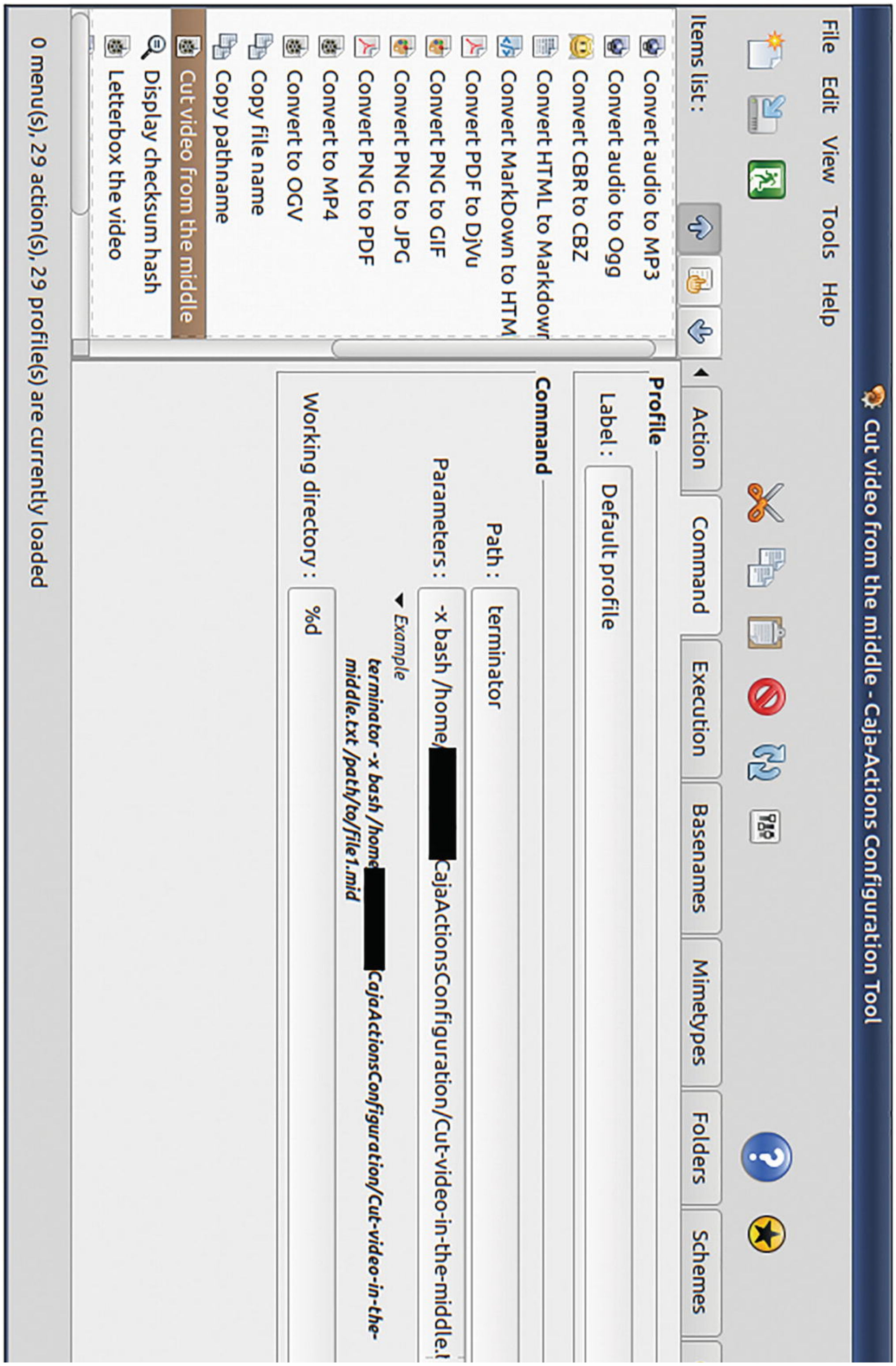


Figure 11-4 In the Mate desktop, the file manager is called Caja. You can use the app Caja Actions Configuration to add your own custom context-sensitive menu options inside Caja

In Gnome 2, you could install *Nautilus Actions Configuration* to add custom context menu options to *Nautilus*, the default file and desktop manager. In Gnome 3, Nautilus lost most of its features and became frustratingly useless. Thankfully, however, the *Mate desktop project* continued support for Nautilus and forked it as Caja. Caja has a fork of the Nautilus Actions Configuration called *Caja Actions Configuration*.

Now, stop fighting with your desktop and switch to Mate. Write your own context menus and automate routine FFmpeg tasks. Writing long FFmpeg poems should be for greater things.

Hide the Banner

In older versions of FFmpeg, you could hide the big banner that it displays by redirecting it to the null device (`2> /dev/null` or `2> NUL`). In new versions of FFmpeg, you can use the new –

`hide_banner` option. Typing this option is a hassle, so it is better if you create command aliases as described in Chapter 2.

The log output of FFmpeg is classified into several types of information. You can use the `-loglevel` option to specify what types you would like to see. You can also choose to see nothing. Check the documentation for what you would like.

`ffplay` can be prevented from displaying a window or console output using the option `-nodisp`. This is useful when playing audio files in shell scripts.

Add an `espeak` Intro to Your MP3 Files

I have lots of vintage radio shows as MP3 files. My DIY boombox does not display any tags or filenames - only file numbers.

Figure 11-5 I built this boombox. The MP3 player module's display is limited to song numbers

I use a script that iterates through the MP3 files in a directory and adds an `espeak` intro to the files. If a file is named "Fibber-n-Molly-Fibber-Makes-His-Own-Chili-Sauce.mp3," then `espeak` intelligently reads it out as "Fibber n Molly Fibber Makes His Own Chili Sauce." This audio is first saved to a wave file and then concatenated to the MP3 file.

```
cd "$1"    # Moves to a directory with MP3 files
if [ ! -d AnnD ]; then
  mkdir AnnD
fi
for sFile in *.mp3
```

```
do
  sFileName=${sFile%.*}
  espeak -w "${sFileName}.wav" "$sFileName"
  echo "Processing ${sFile}..."
  ffmpeg -i "${sFileName}.wav" -i "$sFile" \
         -filter_complex \
            "[0:a:0][1:a:0]concat=n=2:v=0:a=1[outa]"
         -map_metadata 1 -id3v2_version 3 \
         -map "[outa]" \
         -c:a libmp3lame  \
         "AnnD/${sFileName}-AnnD.mp3" 2> /dev/null
  echo -e "\tsaved to AnnD/${sFileName}-AnnD.mp3"
  rm "${sFileName}.wav"
done
```

Although FFmpeg can be used to tag MP3 files, I prefer to use *EasyTAG* instead. It has sophisticated options to mass-rename files and set MP3 tags. (I am not an FFmpeg fanatic and neither should you be one.) After I neatly tag and name the MP3 files, I let this FFmpeg script do its thing.

```
~/Desktop/FasDrive
$ bash add-intro-to-mp3s.txt ./vintage-radio-shows
Processing Duffy's-Tavern-Fred-Allen-Hosts-A-Pig-Roast.mp3...
        saved to AnnD/Duffy's-Tavern-Fred-Allen-Hosts-A-Pig-Roast-AnnD.mp3
Processing Duffy's-Tavern-The-Raffle-Joan-Bennet.mp3...
        saved to AnnD/Duffy's-Tavern-The-Raffle-Joan-Bennet-AnnD.mp3
Processing Fibber-n-Molly-Ceramics.mp3...
        saved to AnnD/Fibber-n-Molly-Ceramics-AnnD.mp3
Processing Fibber-n-Molly-Fibber-Get-His-Draft-Notice.mp3...
        saved to AnnD/Fibber-n-Molly-Fibber-Get-His-Draft-Notice-AnnD.mp3
Processing Fibber-n-Molly-Fibber-Makes-His-Own-Chili-Sauce.mp3...
        saved to AnnD/Fibber-n-Molly-Fibber-Makes-His-Own-Chili-Sauce-AnnD.


~/Desktop/FasDrive
$
```

Figure 11-6 If an MP3 file is informatively named, then this script can add a useful spoken introduction to it

I prefer `espeak` to `libflite`. However, unlike `espeak`, `libflite` has a female voice option.

```
ffmpeg -f lavfi -i "flite=textfile=speech.txt:voice=s
       speech.mp3
```

Best MP3 (MPEG 2 Audio Layer 3) Conversion Settings

MP3 is a lossy compression scheme for audio. When the bitrate is higher, the loss is minimized. This applies only when the source is of high quality. However, most people are unable to discern the difference between a song encoded at 64kbps and the same encoded at 320kbps. (It also depends on the equipment used to play the music.)

There are two popular methods of encoding MP3s - VBR (variable bitrate) and CBR (constant bitrate). With VBR, the bitrate rate changes over the length of playback and file size is optimized. CBR maintains the same bitrate throughout the length of the audio. When the same amount of data is used to encode data that is not much different, file size may be on the higher side.

MP3 processing (decoding and encoding) is a mature technology now and does not require a lot of processing power. There is no reason to use CBR. VBR is better because it focuses on quality.

To create a VBR MP3 file, use the `–qscale:a` option with the Lame MP3 encoder. The option's range is 0 to 9. For close resemblance to the original, use a value from 0 to 3. For most people, however, a `–qscale:a` value of 4 is good enough.

```
ffmpeg -i uncompressed.wav \
       -c:a libmp3lame \
       -qscale:a 4 \
       good.mp3
```

To create an old-school CBR MP3 file, use the `b:a` (bitrate) option.

```
ffmpeg -i uncompressed.wav \
       -c:a libmp3lame \
       -b:a 128k \
       goot.mp3
```

Colors in Hexadecimal

Any color can be represented as a combination of three color channels - red (R), green (G), and blue (B). Sometimes, a fourth value called alpha or transparency is also specified. When alpha is present, the colors can range from totally transparent to totally opaque. When alpha is not present, the color can range from black to the full color.

Colors are often represented in hexadecimal. This is a numbering system with a base of 16. It uses the numerals 0 to 9 and A to F.

- When one hexadecimal digit is used, the values can range from 0 to 15.
- With two digits (00 to FF), the range is 0 to 255.

Using these digit combinations,

- Red can be represented as F00 (RGB), F00F (RGBA), FF0000 (RRGGBB), and FF0000FF (RRGGBBAA).
- Blue can be represented as 00F, 00FF, 0000FF, and 0000FFFF.
- Black is represented as 000, 000F, 000000, and 000000FF.
- White is represented as FFF, FFFF, FFFFFF, and FFFFFFFF.
- Half-transparent red can be represented as F007 or FF000077.

The alpha channel affects all the other three channels. It needs to be at its maximum value (F, FF) for a color to be totally opaque. If it is any less, the entire color will have some transparency, and any object below the color will show through it. If there are not more than one layer of colors, then alpha value has no relevance and will be ignored.

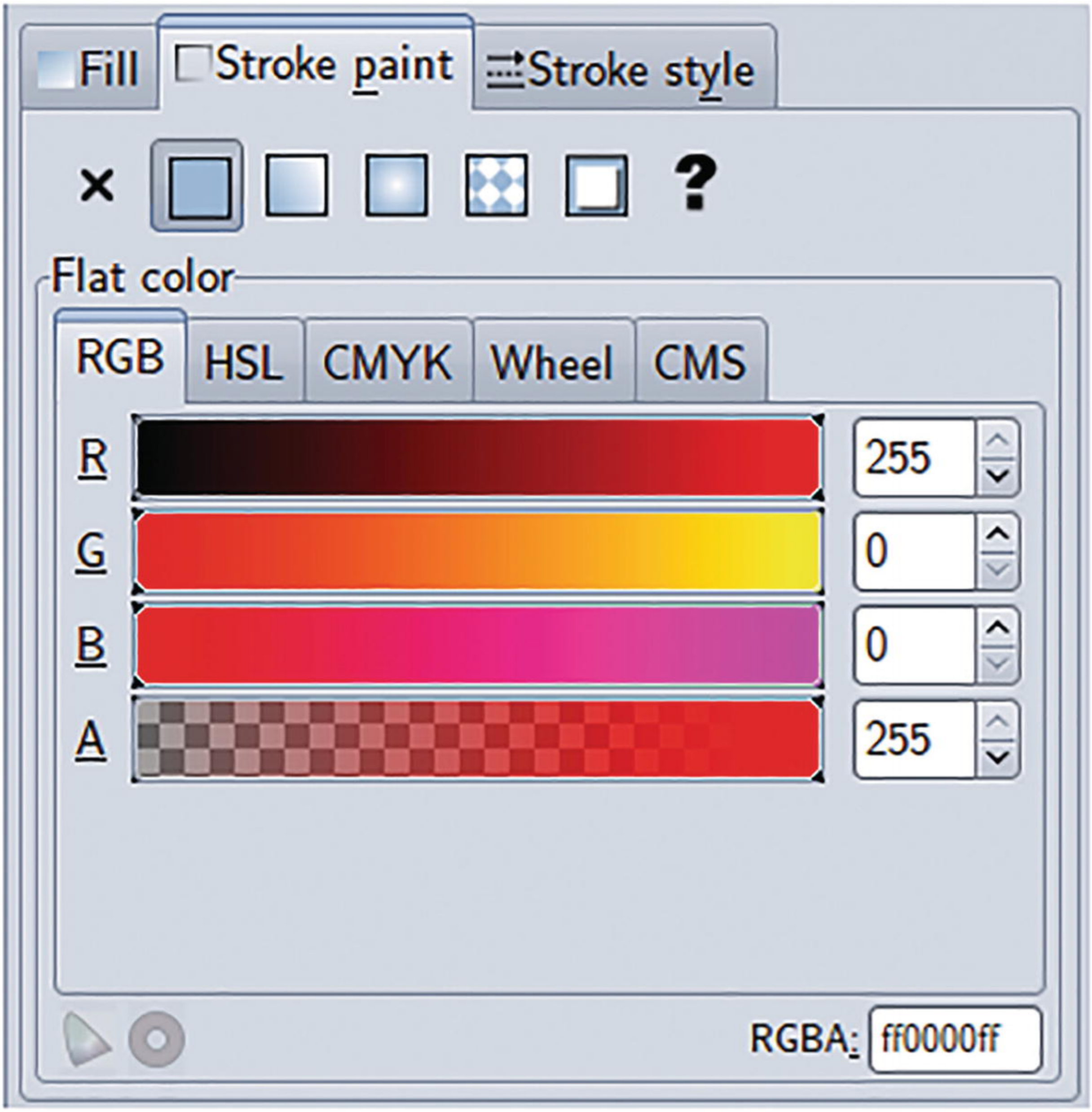


Figure 11-7 Any image-editing application will have a color palette. This one is from Inkscape

For `ffmpeg`, colors are specified in the form of 0xRRGGBBAA. The AA part, standing for the alpha channel, is optional.

Colors in Literal

While you can specify colors in hexadecimal, FFmpeg also supports some literal names, as listed in Table 11-1. These are the same nonstandard color names that Microsoft introduced into Internet Explorer and forced Firefox to adopt them to maintain compatibility. In addition to these color names, you can also use the literal `random` and let FFmpeg choose a color by random.

Table 11-1 Color names supported by FFmpeg

AliceBlue 0xF0F8FF	AntiqueWhite 0xFAEBD7	Aqua 0x00FFFF	Aquamarine 0x7FFFD4
Azure 0xF0FFFF	Beige 0xF5F5DC	Bisque 0xFFE4C4	Black 0x000000
BlanchedAlmond 0xFFEBCD	Blue 0x0000FF	BlueViolet 0x8A2BE2	Brown 0xA52A2A
BurlyWood 0xDEB887	CadetBlue 0x5F9EA0	Chartreuse 0x7FFF00	Chocolate 0xD2691E
Coral 0xFF7F50	CornflowerBlue 0x6495ED	Cornsilk 0xFFF8DC	Crimson 0xDC143C
Cyan 0x00FFFF	DarkBlue 0x00008B	DarkCyan 0x008B8B	DarkGoldenRod 0xB8860B
DarkGray 0xA9A9A9	DarkGreen 0x006400	DarkKhaki 0xBDB76B	DarkMagenta 0x8B008B
DarkOliveGreen 0x556B2F	Darkorange 0xFF8C00	DarkOrchid 0x9932CC	DarkRed 0x8B0000
DarkSalmon 0xE9967A	DarkSeaGreen 0x8FBC8F	DarkSlateBlue 0x483D8B	DarkSlateGray 0x2F4F4F
DarkTurquoise 0x00CED1	DarkViolet 0x9400D3	DeepPink 0xFF1493	DeepSkyBlue 0x00BFFF
DimGray 0x696969	DodgerBlue 0x1E90FF	FireBrick 0xB22222	FloralWhite 0xFFFAF0
ForestGreen 0x228B22	Fuchsia 0xFF00FF	Gainsboro 0xDCDCDC	GhostWhite 0xF8F8FF
Gold 0xFFD700	GoldenRod 0xDAA520	Gray 0x808080	Green 0x008000
GreenYellow 0xADFF2F	HoneyDew 0xF0FFF0	HotPink 0xFF69B4	IndianRed 0xCD5C5C
Indigo 0x4B0082	Ivory 0xFFFFF0	Khaki 0xF0E68C	Lavender 0xE6E6FA
LavenderBlush 0xFFF0F5	LawnGreen 0x7CFC00	LemonChiffon 0xFFFACD	LightBlue 0xADD8E6
LightCoral 0xF08080	LightCyan 0xE0FFFF	LightGoldenRodYellow 0xFAFAD2	LightGreen 0x90EE90
LightGrey 0xD3D3D3	LightPink 0xFFB6C1	LightSalmon 0xFFA07A	LightSeaGreen 0x20B2AA
LightSkyBlue 0x87CEFA	LightSlateGray 0x778899	LightSteelBlue 0xB0C4DE	LightYellow 0xFFFFE0
Lime 0x00FF00	LimeGreen 0x32CD32	Linen 0xFAF0E6	Magenta 0xFF00FF
Maroon 0x800000	MediumAquaMarine 0x66CDAA	MediumBlue 0x0000CD	MediumOrchid 0xBA55D3

MediumPurple 0x9370D8	MediumSeaGreen 0x3CB371	MediumSlateBlue 0x7B68EE	MediumSpringGreen 0x00FA9A
MediumTurquoise 0x48D1CC	MediumVioletRed 0xC71585	MidnightBlue 0x191970	MintCream 0xF5FFFA
MistyRose 0xFFE4E1	Moccasin 0xFFE4B5	NavajoWhite 0xFFDEAD	Navy 0x000080
OldLace 0xFDF5E6	Olive 0x808000	OliveDrab 0x6B8E23	Orange 0xFFA500
OrangeRed 0xFF4500	Orchid 0xDA70D6	PaleGoldenRod 0xEEE8AA	PaleGreen 0x98FB98
PaleTurquoise 0xAFEEEE	PaleVioletRed 0xD87093	PapayaWhip 0xFFEFD5	PeachPuff 0xFFDAB9
Peru 0xCD853F	Pink 0xFFC0CB	Plum 0xDDA0DD	PowderBlue 0xB0E0E6
Purple 0x800080	Red 0xFF0000	RosyBrown 0xBC8F8F	RoyalBlue 0x4169E1
SaddleBrown 0x8B4513	Salmon 0xFA8072	SandyBrown 0xF4A460	SeaGreen 0x2E8B57
SeaShell 0xFFF5EE	Sienna 0xA0522D	Silver 0xC0C0C0	SkyBlue 0x87CEEB
SlateBlue 0x6A5ACD	SlateGray 0x708090	Snow 0xFFFAFA	SpringGreen 0x00FF7F
SteelBlue 0x4682B4	Tan 0xD2B48C	Teal 0x008080	Thistle 0xD8BFD8
Tomato 0xFF6347	Turquoise 0x40E0D0	Violet 0xEE82EE	Wheat 0xF5DEB3
White 0xFFFFFF	WhiteSmoke 0xF5F5F5	Yellow 0xFFFF00	YellowGreen 0x9ACD32

Streams Information from `ffprobe`

`ffprobe` can display precise and structured information about a media file that can be filtered by your shell scripts or software programs for further processing.

```
ffprobe -show_streams -i somefile.mp4
```

The output of the preceding command is as printed in the following.

- [STREAM]

```
index=0
codec_name=h264
codec_long_name=H.264 / AVC / MPEG-4 AVC / MPEG-
4 part 10
profile=High
codec_type=video
codec_tag_string=avc1
codec_tag=0x31637661
width=640
height=480
coded_width=640
coded_height=480
closed_captions=0
film_grain=0
has_b_frames=2
sample_aspect_ratio=4:3
display_aspect_ratio=16:9
pix_fmt=yuv420p
```

```
level=30
color_range=unknown
color_space=unknown
color_transfer=unknown
color_primaries=unknown
chroma_location=left
field_order=progressive
refs=1
is_avc=true
nal_length_size=4
id=0x1
r_frame_rate=90000/2999
avg_frame_rate=90000/2999
time_base=1/90000
start_pts=0
start_time=0.000000
duration_ts=1802399
duration=20.026656
bit_rate=488521
max_bit_rate=N/A
bits_per_raw_sample=8
nb_frames=601
nb_read_frames=N/A
```

nb_read_packets=N/A

extradata_size=40

DISPOSITION:default=1

DISPOSITION:dub=0

DISPOSITION:original=0

DISPOSITION:comment=0

DISPOSITION:lyrics=0

DISPOSITION:karaoke=0

DISPOSITION:forced=0

DISPOSITION:hearing_impaired=0

DISPOSITION:visual_impaired=0

DISPOSITION:clean_effects=0

DISPOSITION:attached_pic=0

DISPOSITION:timed_thumbnails=0

DISPOSITION:captions=0

DISPOSITION:descriptions=0

DISPOSITION:metadata=0

DISPOSITION:dependent=0

DISPOSITION:still_image=0

TAG:language=eng

TAG:handler_name=VideoHandle

TAG:vendor_id=[0][0][0][0]

[/STREAM]

```
[STREAM]
index=1
codec_name=aac
codec_long_name=AAC (Advanced Audio Coding)
profile=LC
codec_type=audio
codec_tag_string=mp4a
codec_tag=0x6134706d
sample_fmt=fltp
sample_rate=48000
channels=2
channel_layout=stereo
bits_per_sample=0
id=0x2
r_frame_rate=0/0
avg_frame_rate=0/0
time_base=1/48000
start_pts=0
start_time=0.000000
duration_ts=960000
duration=20.000000
bit_rate=129267
max_bit_rate=N/A
```

```
bits_per_raw_sample=N/A
nb_frames=939
nb_read_frames=N/A
nb_read_packets=N/A
extradata_size=5
DISPOSITION:default=1
DISPOSITION:dub=0
DISPOSITION:original=0
DISPOSITION:comment=0
DISPOSITION:lyrics=0
DISPOSITION:karaoke=0
DISPOSITION:forced=0
DISPOSITION:hearing_impaired=0
DISPOSITION:visual_impaired=0
DISPOSITION:clean_effects=0
DISPOSITION:attached_pic=0
DISPOSITION:timed_thumbnails=0
DISPOSITION:captions=0
DISPOSITION:descriptions=0
DISPOSITION:metadata=0
DISPOSITION:dependent=0
DISPOSITION:still_image=0
TAG:language=eng
```

```
TAG:handler_name=SoundHandle
TAG:vendor_id=[0][0][0][0]
[/STREAM]
```

This output can be narrowed down to a particular stream using the `select_streams` option.

```
ffprobe -show_streams -select_streams v:0 \
        -i somefile.mp4 2> /dev/null
```

This option can also be output in several other formats such as ini and CSV. For more information, check the documentation that came with your version of FFmpeg.

```
ffprobe -show_streams -select_streams v:0 \
        -print_format csv \
        -i somefile.mp4 > somefile-videostream-info.c
```

With the `–sections` option, you can find out how the streams information is organized.

```
ffprobe -sections
```

This is the output:

- Sections:

```
W.. = Section is a wrapper (contains other
sections,⏎
no local entries)
.A. = Section contains an array of elements of
the⏎
same type
..V = Section may contain a variable number of
fields⏎
with variable keys
FLAGS NAME/UNIQUE_NAME
---
W..   root
.A.      chapters
...          chapter
..V              tags/chapter_tags
...      format
..V          tags/format_tags
.A.      frames
...          frame
..V              tags/frame_tags
.A.              side_data_list/frame_side_data_
list
```

```
...                     side_data/frame_side_data
.A.                         timecodes
...                             timecode
.A.                         components
...                             component
.A.                                 pieces
...                                     section
.A.                 logs
...                     log
...             subtitle
.A.     programs
...             program
..V                 tags/program_tags
.A.                 streams/program_streams
...                     stream/program_stream
...                         disposition/program_str
eam_disposition
..V                         tags/program_stream_tag
s
.A.     streams
...             stream
...                 disposition/stream_disposition
..V                 tags/stream_tags
```

```
.A.                side_data_list/stream_side_data
_list
...                    side_data/stream_side_data
.A.        packets
...            packet
..V                tags/packet_tags
.A.                side_data_list/packet_side_data
_list
...                    side_data/packet_side_data
...        error
...        program_version
.A.        library_versions
...            library_version
.A.        pixel_formats
...            pixel_format
...                flags/pixel_format_flags
.A.                components/pixel_format_compone
nts
...                    component
```

To display a particular key, say "duration," I can use the –`show_entries` option.

```
ffprobe -select_streams v:0  \
```

```
        -show_entries "stream=duration" \
        -i somefile.mp4 2> /dev/null
```

- [STREAM]

  duration=20.026656

  [/STREAM]

To eliminate section headers and key name, I use the –`print_format` option.

```
ffprobe -select_streams v:0  \
        -show_entries "stream=duration" \
        -print_format "default=nokey=1:noprint_wrappe
        -i somefile.mp4 2> /dev/null
```

Cue heavenly music!

- 20.026656

Now, the command output contains just the duration value. Similarly, other details about an input file can be atomized. Your shell script or some other program can capture these values for further processing.

```
~/Desktop/FasDrive
$ w=$(ffprobe -select_streams v:0 \
>             -show_entries "stream=width:" \
>             -print_format "default=nokey=1:noprint_wrappers=1" \
>             -i festival-fireworks.avi 2> /dev/null)


~/Desktop/FasDrive
$ h=$(ffprobe -select_streams v:0 \
>             -show_entries "stream=height" \
>             -print_format "default=nokey=1:noprint_wrappers=1" \
>             -i festival-fireworks.avi 2> /dev/null)


~/Desktop/FasDrive
$ echo "$w × $h"
1280 × 720
```

Figure 11-8 `ffprobe` output can be filtered for obtaining precise information about a multimedia file. This information can be stored in memory variables for further use in shell scripts

Extract Non-pixelated Images from a Video

When a video undergoes lossy compression, there are bound to be some artifacts in any still images that you extract from it. If the bitrate is low or there is a lot of fast-paced action, the artifacts can be impossible to ignore. You have a better chance at obtaining high-quality stills if you extract only the *I frames* in the video. I frames or key frames in a video stream have all the data to form a full image. There are other frames, known as *P frames*, that are immediately before and after an *I frame* that do not have all the data. Their data is limited to those regions of the frame that are different from the nearest I frame.

When you extract still images, FFmpeg tries to recreate a full frame using data from several frames. As not all of them are likely to be I frames, there may be some inevitable pixelation.

```
ffmpeg -y -i train.mp4 \
       -r 1 \
       -f image2 \
       nofilter-still%02d.jpg
ffmpeg -y -skip_frame nokey -i train.mp4 \
        -r 1 \
       -f image2 \
         filter-still%02d.jpg
```

The preceding first command tries to extract frames as usual without any discrimination. The second command picks only I frames, which are most likely to be without much pixelation.

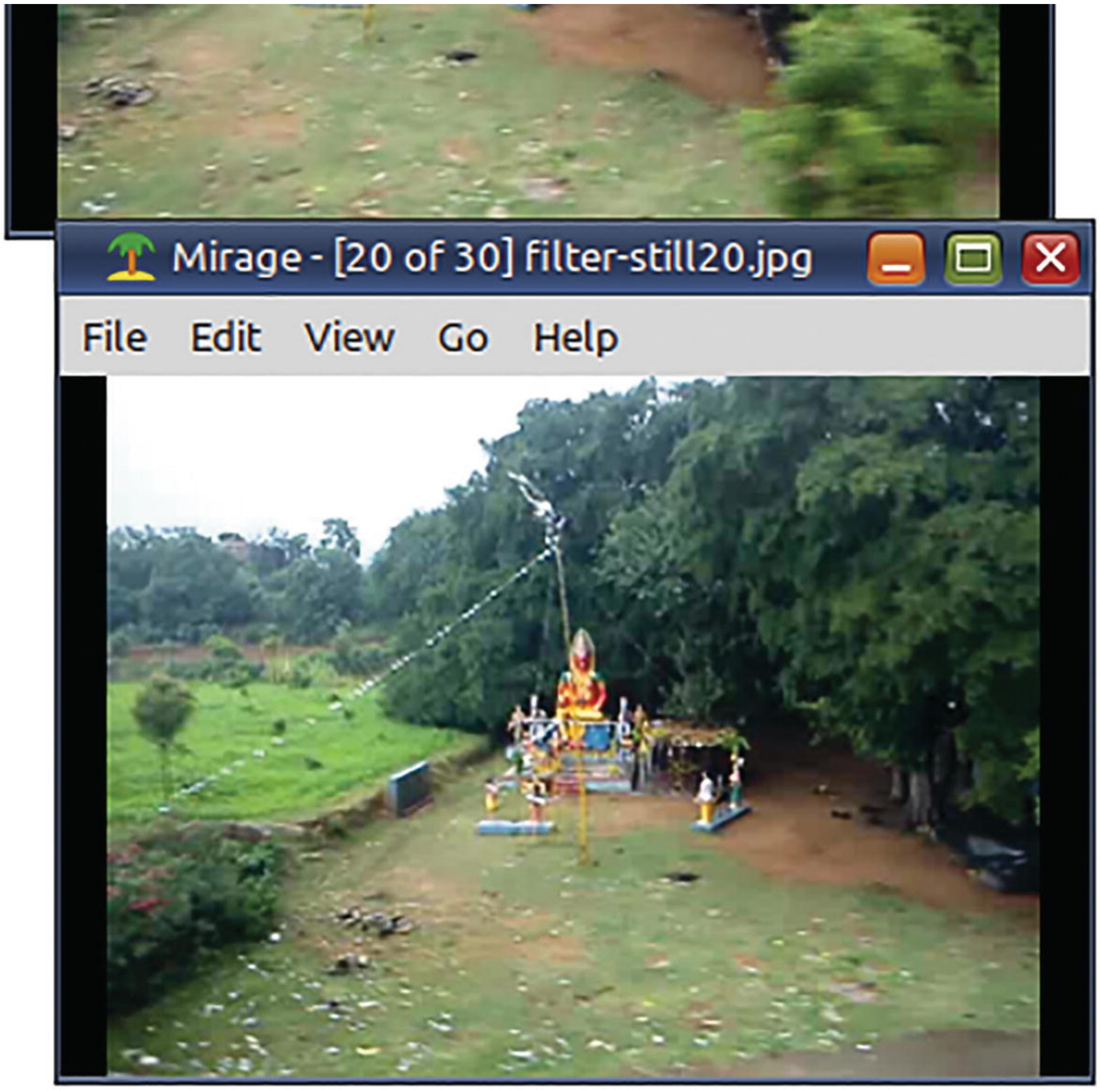


Figure 11-9 The source video was taken from a moving train. The first command took still images at regular intervals without consideration for image quality. The second command only took the I frames with maximal detail and less pixelation

If you want a good-quality still from a particular timestamp, try something like this:

```
ffmpeg -y -ss 0:0:20 -skip_frame nokey -i aero-india.
          -frames:v 1 -f image2 \
           still20.jpg
```

This command takes a still after the 20-second mark. When there is a lot of action at that timestamp, `ffmpeg` may not be able to find an I frame there, and this may result in some inevitable pixelation.

Create a Thumbnail Gallery for a Video

This shell script creates a 3x3 tiled gallery of thumbnails at one-third of the dimensions of the original video.

```
#!/bin/bash
# BASH script to create a 3x3 thumbnail gallery for a
# Accepts the pathname of the video as argument ($1)
########################################################
# Floating point number functions by Mitch Frazier
# Adapted from
# https://www.linuxjournal.com/content/floating-point
########################################################
# Default scale used by float functions
float_scale=2
# Evaluate a floating point number expression.
function float_eval() {
  local stat=0
  local result=0.0
  if [[ $# -gt 0 ]]; then
    result=$(echo "scale=$float_scale; $*" | bc -q 2>
```

```
    stat=$?
    if [[ $stat -eq 0  &&  -z "$result" ]]; then
      stat=1
    fi
  fi
  echo $result
  return $stat
}
# Evaluate a floating point number conditional expres
function float_cond() {
  local cond=0
  if [[ $# -gt 0 ]]; then
    cond=$(echo "$*" | bc -q 2>/dev/null)
    if [[ -z "$cond" ]]; then
      cond=0
    fi
    if [[ "$cond" != 0  &&  "$cond" != 1 ]]; then
      cond=0
    fi
  fi
  local stat=$((cond == 0))
  return $stat
}
#####################################################
# Floating point number functions end

# Prefix for images
FILE_NAME=${1%.*}
#echo $FILE_NAME
```

```
NUMBER_OF_THUMBNAILS=9
MOVIE="$1"
COUNTER=0
# Number of seconds
MOVIE_DURATION=$(ffprobe \
                   -show_entries "format=duration" \
                   -of "default=nokey=1:noprint_wrapp
                   -i $MOVIE 2> /dev/null)
#echo $MOVIE_DURATION
MOVIE_WIDTH=$(ffprobe -select_streams v:0 \
              -show_entries "stream=width:" \
              -print_format \
                "default=nokey=1:noprint_wrappers=1"
              -i $MOVIE 2> /dev/null)
MOVIE_HEIGHT=$(ffprobe -select_streams v:0 \
              -show_entries "stream=height" \
              -print_format \
                "default=nokey=1:noprint_wrappers=1"
              -i $MOVIE 2> /dev/null)
#echo "$MOVIE_WIDTH x $MOVIE_HEIGHT"
TW=$(float_eval "$MOVIE_WIDTH/3")
TH=$(float_eval "$MOVIE_HEIGHT/3")
THUMB_WIDTH=${TW%.*}
THUMB_HEIGHT=${TH%.*}
#echo "$THUMB_WIDTH x $THUMB_HEIGHT"

for i in $(seq $NUMBER_OF_THUMBNAILS)
do
  let COUNTER=COUNTER+1
```

```
    #echo $COUNTER
    LOCATION_FLOAT=$(float_eval \
              "($i-0.5)*$MOVIE_DURATION/$NUMBER_OF_THUM
    #echo $LOCATION_FLOAT
    LOCATION_INT=${LOCATION_FLOAT%.*}
    #echo $LOCATION_INT
    # Create the thumbnails
    ffmpeg -y -skip_frame nokey -ss $LOCATION_INT -i $M
           -frames:v 1 \
           -s ${THUMB_WIDTH}x${THUMB_HEIGHT} \
           "${FILE_NAME}_${COUNTER}.jpg"
  done
  # Create the gallery
  montage -density 96 -tile 3x3 -geometry +4+4 \
          -border 1 "${FILE_NAME}*.jpg" \
          "${FILE_NAME}-thumbnail.jpg"
```

☞ This script is my implementation of a pseudocode found at https://superuser.com/a/821680.

The last command in the shell script uses *ImageMagick*, which is a powerful open source program for processing images.

This script can be easily modified for greater grid sizes. It is also very fast, as it quickly skips to different locations in the file to take the thumbnail snapshots. It does not parse through the entire file.

The script only picks I-frame images from the file. Totem media player creates a thumbnail gallery similar to this. It is very fast but its thumbnails are just equidistant in time. They are not necessarily high-quality images.

When you run this script on a video file, pass its pathname as the first argument:

```
bash create-thumbnail-gallery.txt festival-fireworks.
```

Figure 11-10 The Totem media player creates a thumbnail gallery much faster than this script. However, it does not find I frames like this script does. With I frames, you get more detail

Record from Microphone

A PC may have more than one sound device - built-in sound card, the webcam, HDMI output audio, and sometimes even a USB microphone. In Linux, these sound cards are identified as `hw:0`, `hw:1`.... You have to find which one you are using or what can record audio through its microphone. **Check your desktop sound configuration utility, and ensure that it is responding to noises in your room.** After this,

- Type `alsamixer` in Terminal.
- Press F6 key to display the list of cards. Make a note of the number of the card, as you will need it later.
- After selecting the card, press the F2 to display the list of devices on that card. Select `/proc/sound/devices` to check if you have an *audio capture* device on that card.
- Exit `alsamixer` by pressing the Esc key.
- If you are then able to record from the device using the number of the card with this command, then you are all set to record from the microphone.

```
ffmpeg -f alsa -i hw:1 -t 10 microphone-test.mp3
```

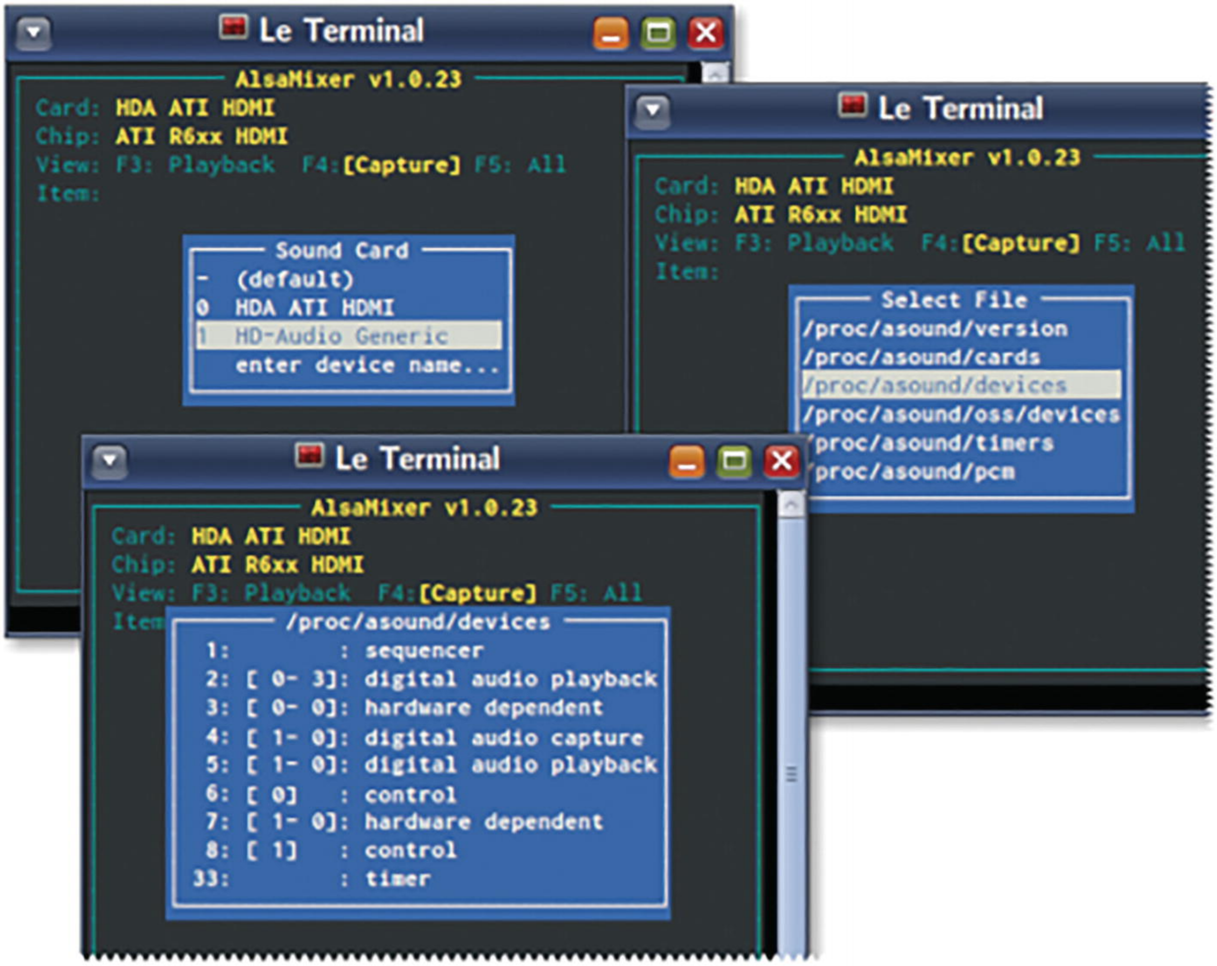


Figure 11-11 A console-based volume control utility for the ALSA sound system

If you are still unable to record, then audio capture may have been disabled.

- Type the command `amixer -c` followed by the number of the sound card.
- Note the name of the device for the microphone. Usually, it is named `Mic` or `Internal Mic`.
- Type a command like `amixer -c 1 sset Mic,0 mute cap`. This ensures that the sound captured from the second sound

card (1) is not played back (`mute`) but is available for recording (`cap`).

If you have made changes to your audio configuration, it is best if you restart the OS and try again. If nothing works, then try the PulseAudio `(-i pulse)` hack.

```
ffmpeg -f alsa -i pulse -t 10 microphone-pulse-test.m
```

Record from Webcam

Recording from a webcam or grabbing the screen output in Windows is not easy. There is a FOSS tool called *CamStudio* that internally uses FFmpeg. If you are able to use it, then follow the FFmpeg Wiki on the topic.

In Linux, things are very easy. Even then, install *Cheese* or a similar webcam application before you use `ffmpeg`. Ensure that the device is working properly. Check the preferences and leave it at the best settings. Then, close it and try this `ffmpeg` command:

```
ffmpeg -y -f v4l2 \
       -i /dev/video0 \
       -s vga -r 12 -b:v 466k \
       -t 0:0:10 \
```

```
        webcam.ogv
```

☞ Where did I get this `/dev/video0` thingy? Install `v4l-ctl` or `v4l-utils` and type the command `v4l2-ctl --list-devices`.

☞ To tell you the truth, I do not use webcams anymore. This command was tested on an ancient Logitech cam that still works fine. Check the settings supported by your hi-res Hasselblad, and update the size and bitrate options accordingly.

You can simultaneously capture from your webcam and microphone.

```
ffmpeg -f v4l2 -r 12 -s qvga -i /dev/video0 \
       -f alsa -i hw:1 \
       -t 0:0:6 \
       webcam2.ogv
```

On my old laptop (with a new OS), this command struggles to record the audio. With the PulseAudio hack, it magically starts working fine.

```
ffmpeg -f v4l2 -r 12 -s qvga -i /dev/video0 \
       -f alsa -i pulse \
       -t 0:0:6 \
```

```
        webcam3.ogv
```

Screen Capture

The `-f x11grab` format option can be used to capture the video display (`-i :0.0`, known as *X* in Linux). You need to specify the capture settings in the order given here, that is, `-f`, `-s`, `-i`, and `-b`. The frame rate can be 12 at the minimum. Otherwise, the output capture file will be very big.

```
ffmpeg -y -f x11grab -s 1366x768 -r 12 \
       -i :0.0 \
       -b:v 1024k \
       -t 0:0:10 \
       screen.ogv
```

☞ Replace the value for the `-s` option with the pixel resolution of the screen you are trying to grab.

While screen capturing, use a high bitrate so that as much data is captured. The capture will be lag-free if the CPU is not tied up with real-time compression (encoding). You can compress the file to your heart's content after the capture but not during it.

To capture a part of the screen, add the x- and y-offsets of the region in the `-i` option.

```
# Records a 600×600 region at 100,100 pixels
# from the top-left corner.
ffmpeg -y -f x11grab -s 600x600 -r 12 \
       -i :0.0+100,100 \
       -b:v 1024k \
       -t 0:0:10 \
       screen-region.ogv
```

You can capture sound playing on the speakers while you grab the screen. The input to capture (sound mixer) is not easy to nail down on my computer, so this command uses the PulseAudio hack (`–i pulse`) again.

```
ffmpeg -f x11grab -s 1366x768 -r 12 -i :0.0 \
       -f alsa -i pulse \
       -b:v 2024K -b:a 128K \
       -ac 2 \
       -t 0:0:10 \
       -y screen2.ogv
```

Render an Animated GIF on a Video

Humble as it is, an animated GIF can be more dramatic than a static JPEG or PNG. For this example, I rendered a GIF animation that I use on my website over a demo video that I created for my Android browser.

```
ffmpeg -y -i subhash-browser-rss-demo.mp4  \
       -ignore_loop 0 -i animation-download.gif \
       -filter_complex \
       "[0:v:0]overlay=(W-w-10):(H-h)/2:shortest=1[v]
       -map '[v]' -map 0:a:0  \
       -c:v libx264 -c:a copy \
       subhash-browser-rss-demo-with-download-button.
```

If I were to upload this demo to a video-hosting site, I could add an interactive download link to the region where the animated GIF is playing on the video. When I used the overlay filter with a GIF on a video, the animation played once and then stopped. I found a solution to this problem, that is, `-ignore_loop 0`, hidden in the help output of the GIF demuxer (`ffmpeg -h demuxer=gif`). This however had a limitation in that the looping is limited to whatever value the GIF image is set to. This could be infinite or 1 to 65535 times. If it was set to a finite number, then the looping would have stopped eventually.

A better approach is to use the `-stream_loop` option so that you can specify the looping instead of the GIF image. You can set this option to the number of loops, 0 for no looping or -1 for indefinite looping.

```
ffmpeg -y -i subhash-browser-rss-demo.mp4  \
       -stream_loop -1 -i animation-download.gif \
       -filter_complex \
```

```
          -filter_complex \
           "[0:v:0]overlay=(W-w-10):(H-h)/2:shortest=1[
          -map '[v]' -map 0:a:0  \
          -c:v libx264 -c:a copy \
           subhash-browser-rss-demo-with-download-button
```

The -shortest option in the overlay filter ensures that the filter processing ends when the output from the video file has been completed. Otherwise, the endlessly looping GIF animation will continue the processing forever.

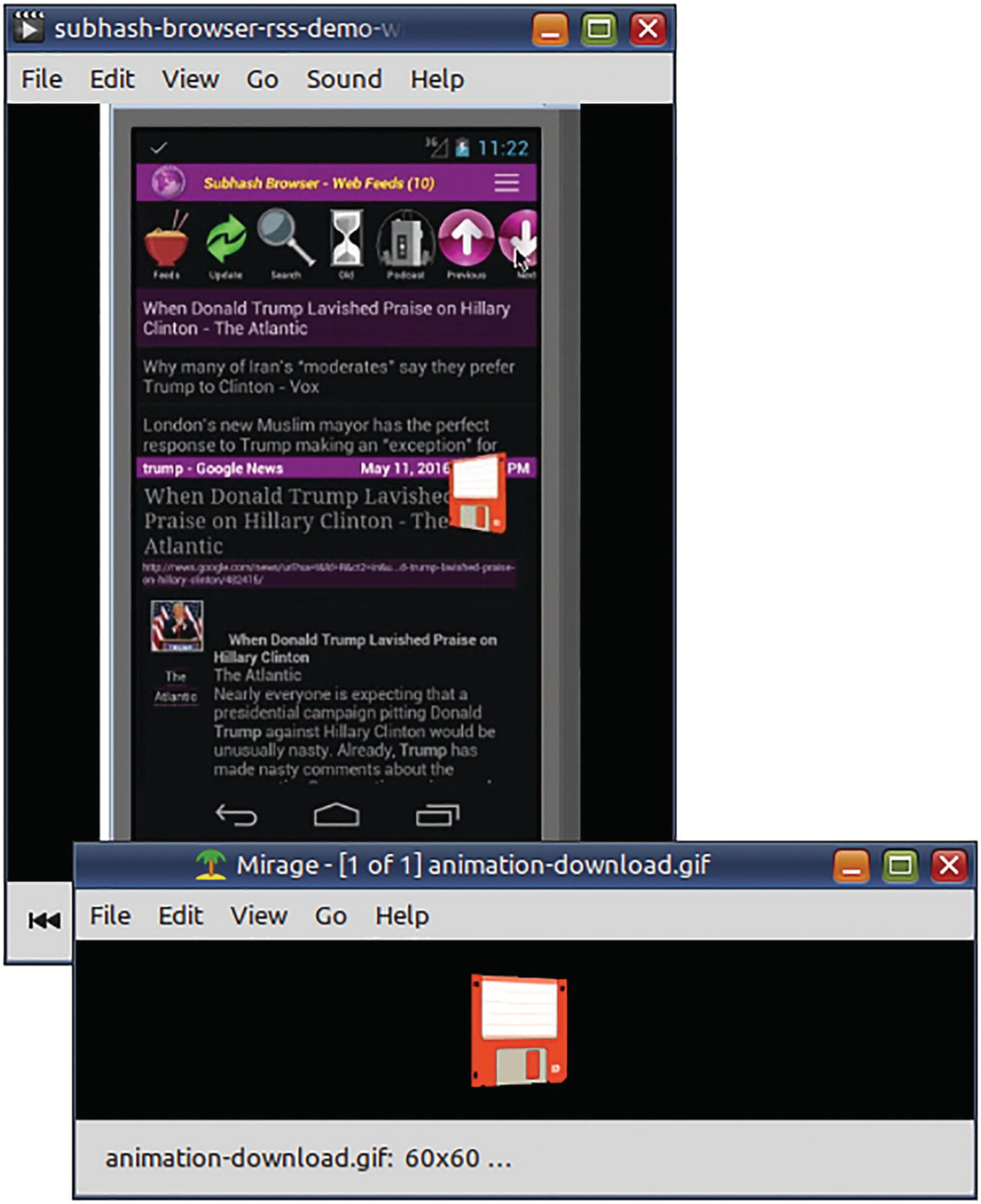


Figure 11-12 This GIF is also animated over the video in the background window

Show a Timer on the Video

The `drawtext` filter has a `timecode` option that can be used in place of the `text` option. To ensure that the timer is accurate, the `timecode_rate` should be the same as the frame rate of the video. (Use `ffprobe` for obtaining the exact value.)

```
ffmpeg -y -i rollcage-video.mp4 \
       -filter:v \
          "drawtext=:x=100:y=h-lh-100:
             shadowcolor=FFFFFF66:shadowx=1:shadowy=2
             fontfile=Time.ttf:fontcolor=00000066:fon
             timecode=\'00\:00\:00\:00\':timecode_rat
       race-timer.mp4
```

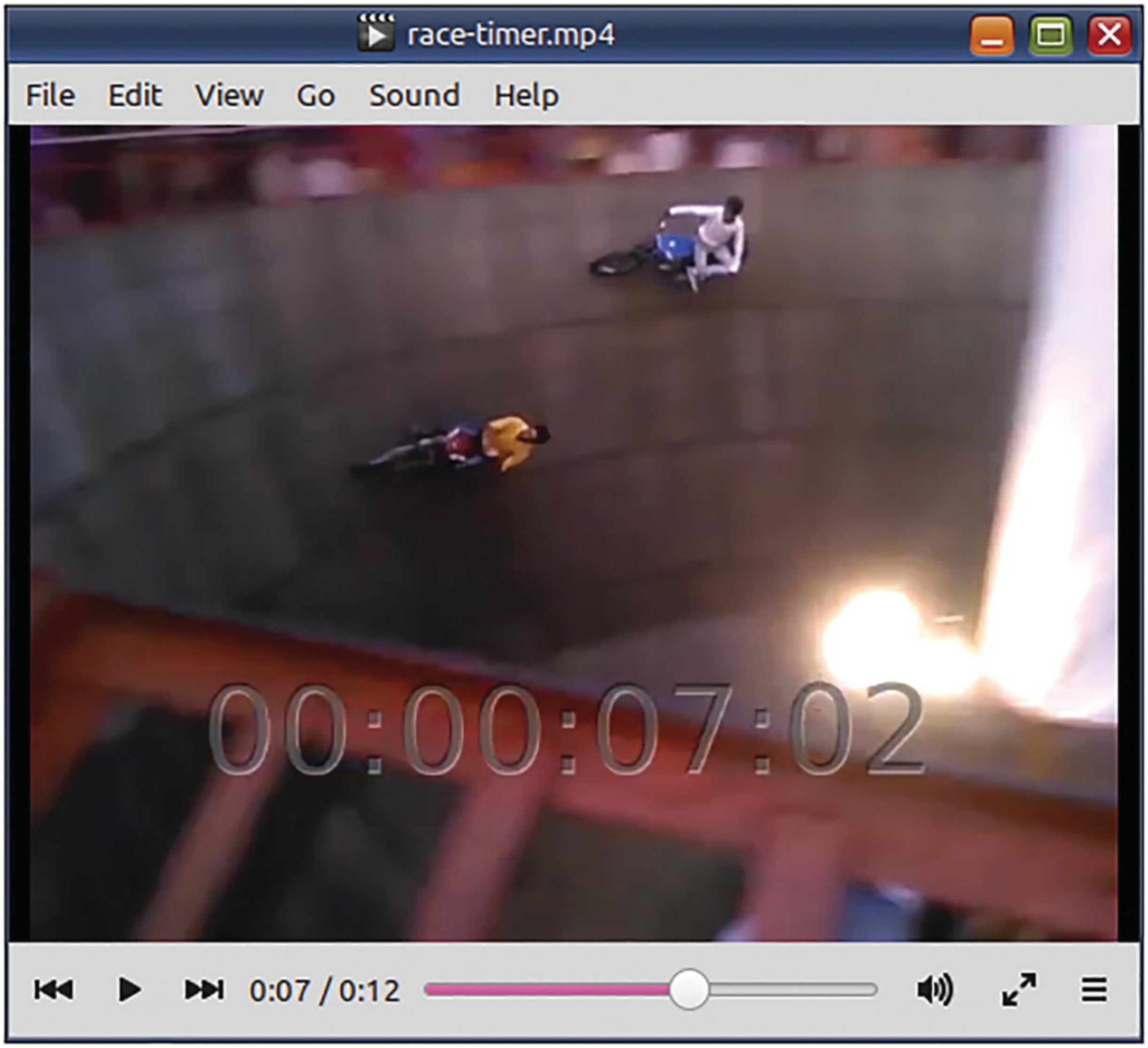


Figure 11-13 This command uses an option of the `drawtext` filter to render a timer on the video

Create a Silent Ringtone

Some mobile phones do not have a silent ringtone. This can prevent you from silencing certain obnoxious contacts. You can use the `anullsrc` filter to create a silent ringtone.

```
ffmpeg -f lavfi \
       -i anullsrc \
       -vn -t 0:0:12 -b:a 128k -c:a libmp3lame \
       silent.mp3
```

This command uses the filter as a virtual input file. The `anullsrc` filter does not require an input file. By default, it generates a 44100 Hz wave as output. This one will have no sound though.

Create a Countdown Beep Audio

Television quiz shows usually play a timer-countdown audio with a beep every second. Can you create it using FFmpeg?

```
ffplay -f lavfi \-i "sine=frequency=220:beep_factor=3
ffmpeg -f lavfi  \
       -i "sine=frequency=220:beep_factor=3:duration=
```

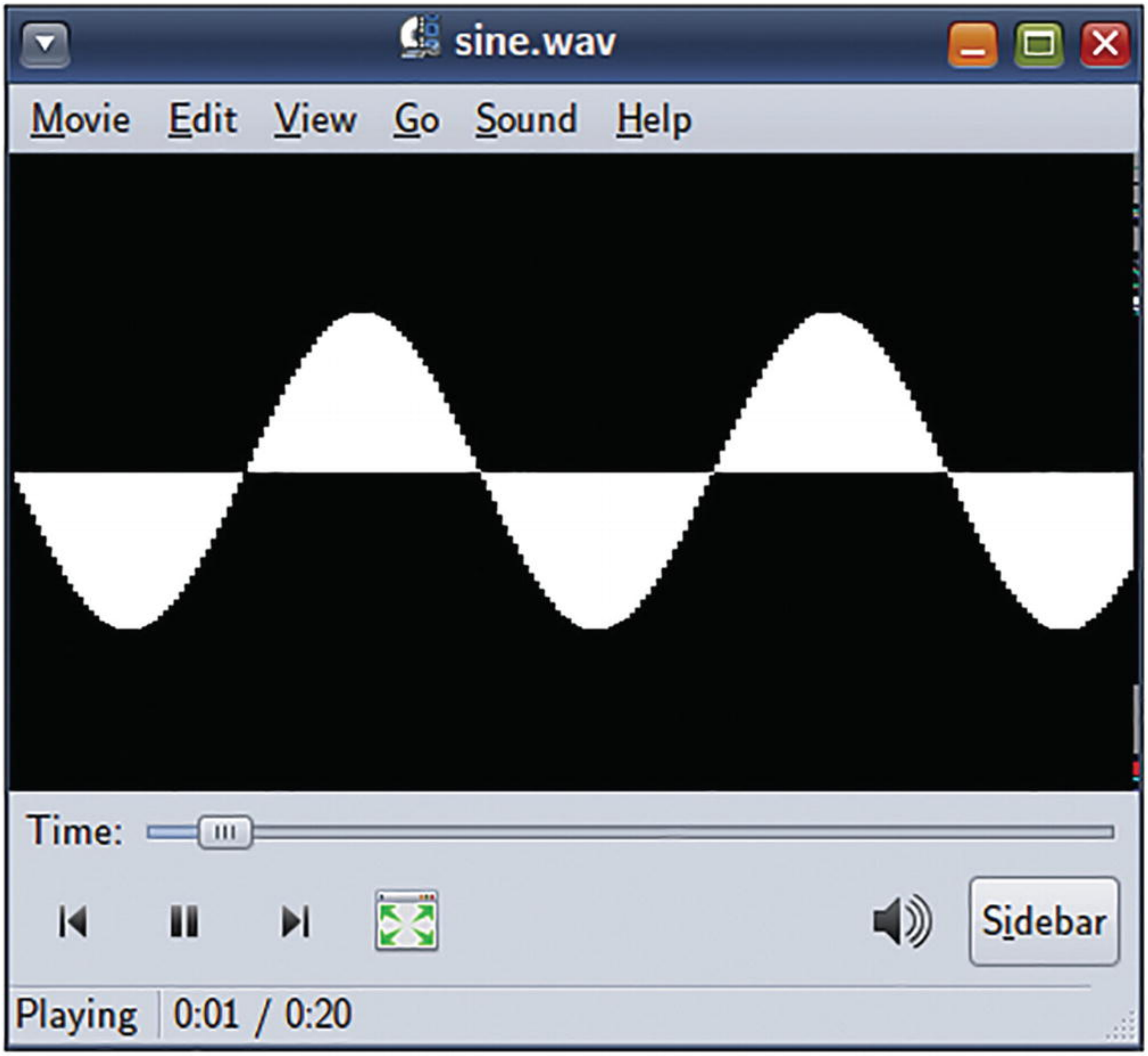


Figure 11-14 The visualization feature of this media player confirms that the audio is a sine wave

For more customized waveforms, the `aevalsrc` filter can be used.

```
ffmpeg -f lavfi \
       -i aevalsrc='sin(1000*PI*t*lt(t-trunc(t)\,0.1)
       -t 0:0:20 sine.wav
```

Generate Noise of a Certain “Color”

FFmpeg can generate noise in several “colors” - white, pink, brown, blue, violet, and velvet.

```
ffplay -f lavfi -showmode 0 -i 'anoisesrc=color=brown
```

The “brown” noise is closer to the sound that a TV generates when its CATV signal cable is unplugged.

```
ffmpeg -y -i barbara.mp4 \
  -filter_complex \
     "[0:v:0]noise=alls=100:allf=a+t:enable='between(
      [0:a:0]atrim=start=0:end=6, asetpts=N/SAMPLE_RA
      anoisesrc=color=brown:d=6[ma];
      [0:a:0]atrim=start=12:end=20, asetpts=N/SAMPLE_
      [fa][ma][la]concat=n=3:v=0:a=1[a]" \
  -map "[v]" -map "[a]" \
  -t 0:0:20 \
  barb-intermission.mp4
```

This command uses a video `noise` filter between seconds 6 and 12. In the same interval, the aforementioned brown noise is used in place of the original audio.

Create a Bleep Audio

A few months ago, I created a video where I needed to bleep out some segments of a speaker's audio. I did not have an audio file containing the bleep sound. I then found that there were several programs including FFmpeg that could be used to create the bleep sound. This example uses a 1000 Hz wave of a continuous bleep sound instead of the original audio for seconds 6 and 7.

```
ffmpeg -y -i barbara.mp4 \
  -filter_complex \
    "[0:a:0]atrim=start=0:end=5, asetpts=N/SAMPLE_RAT
     sine=frequency=1000:duration=2[a2];
     [0:a:0]atrim=start=7:end=10, asetpts=N/SAMPLE_RA
     [a1][a2][a3]concat=n=3:v=0:a=1[a]" \
  -map 0:v:0 -map '[a]' \
  -t 0:0:10 \
  barb-bleep.mp4
```

Add an Echo to Part of a Video

This command adds a six-second echo in the middle of playback using the `aecho` filter.

```
ffmpeg -y -i barbara.mp4 \
  -filter_complex \
   "[0:a:0]atrim=start=0:end=5, asetpts=N/SR/TB[a1];
    [0:a:0]atrim=start=6:end=12, asetpts=N/SR/TB,
      aecho=0.8:0.9:1000:0.3[a2];
    [0:a:0]atrim=start=13:end=16, asetpts=N/SR/TB[a3]
    [a1][a2][a3]concat=n=3:v=0:a=1[a]" \
  -map 0:v:0 -map '[a]' \
  -t 0:0:16 \
  barb-echo.mp4
```

> ☞ The `atrim` and `concat` filters were used because `aecho` does not support timeline editing.

Reverse a Video

In some of his movies, Jim Carrey does a live rewind of a shot. Does he sound intelligible if you rewind that footage?

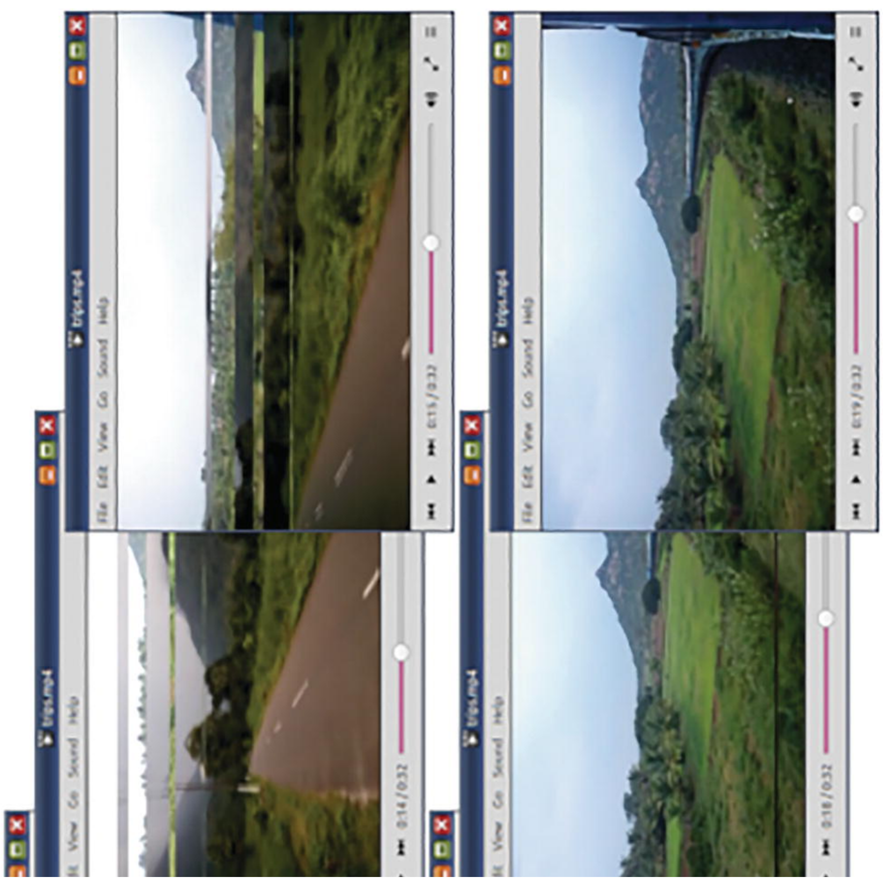
☞ This routine is actually copied from another movie (whose name I forget), and it involves a mentally disturbed prisoner who thinks he is trapped in a film camera!

```
ffmpeg -y -i ace-ventura-reverse.mp4 \
  -filter_complex \
     "[0:v:0]reverse[v]; [0:a:0]areverse[a]" \
  -map '[v]' -map '[a]' \
  ace-ventura-reverse-reversed.mp4
# Place the videos side-by-side
ffmpeg -y -i ace-ventura-reverse.mp4 \
       -i ace-ventura-reverse-reversed.mp4 \
  -filter_complex  \
    "[0:v:0]pad=1280:360:0:0[frame];
     [frame][1:v:0]overlay=640:0[fullvideo];
     [fullvideo]drawtext=x=30:y=60:fontcolor=yellow:
        text='Original audio on left speaker':fontsiz
        fontfile=Florentia.ttf[lefttext];
     [lefttext]drawtext=x=670:y=60:fontcolor=yellow:
        text='Reversed audio on right speaker':
        fontsize=30:fontfile=Florentia.ttf[v];
     [0:a:0]channelsplit=channel_layout=mono[leftaudi
     [1:a:0]channelsplit=channel_layout=mono[rightauc
     [leftaudio][rightaudio]join=inputs=2: \
       channel_layout=stereo[a]" \
  -map '[v]' -map '[a]' ace-ventura-reversal-truth.mp
```

The documentation warns that the `reverse` filter consumes a lot of memory, so use small clips.

Fade into Another Video Using a Transition Effect

The `xfade` filter can be used to transition between two video files. By default, it starts at the beginning of the file, so you need to offset it to the end of the first video. Check the documentation for the different kinds of transitions that are supported. The audio filter `acrossfade` works as expected at the end of the first file. You just need to set it to the same duration as the `xfade` video filter.



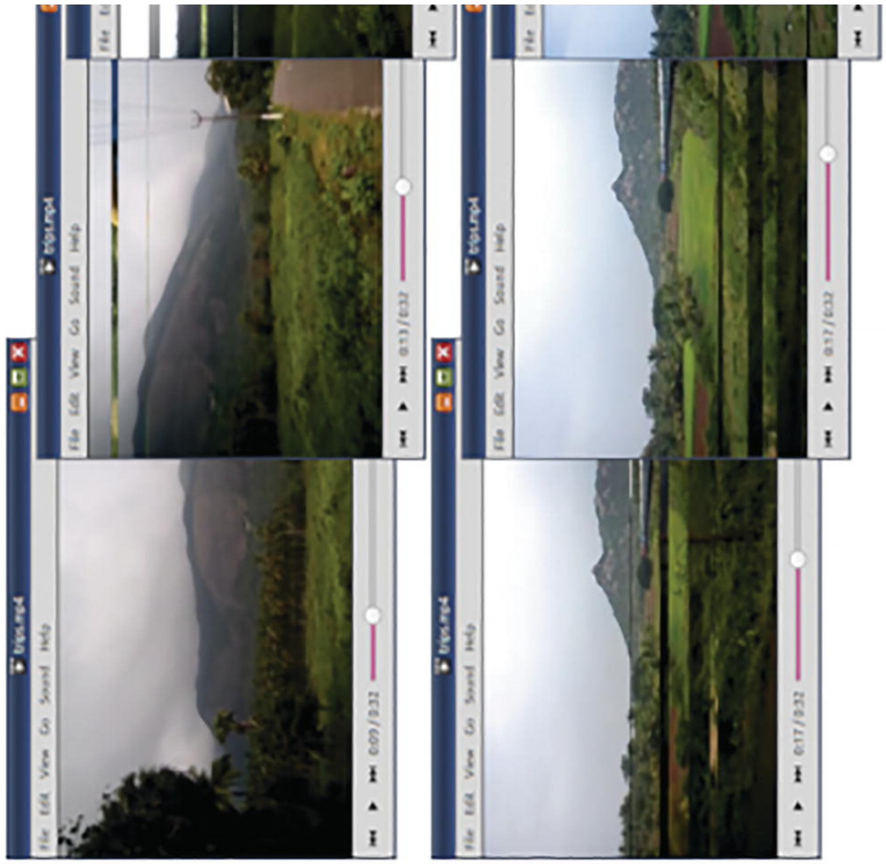


Figure 11-15 Use `xfade` filter transition from one video to another. Use `crossfade` to do the same for audio

```
ffmpeg -y -i bike-trip.mp4 -i train-trip.mp4 \
 -filter_complex \
  "[0:v:0][1:v:0]xfade=transition=vdslice:
                duration=8:offset=12[v];
   [0:a:0][1:a:0]acrossfade=d=8[a]" \
 -c:v libx264 -crf 21 -tune film -pix_fmt yuv420p \
 -map '[v]' -map '[a]' \
 trips.mp4
```

If you get any time base or frame rate errors because of differences in the videos, try this instead:

```
ffmpeg -y -i bike-trip.mp4 -i train-trip.mp4 \
  -filter_complex \
    "[0:v:0]settb=AVTB, framerate=24[v1];
     [1:v:0]settb=AVTB, framerate=24[v2];
     [v1][v2]xfade=transition=vdslice:duration=8:offs
     [0:a:0][1:a:0]acrossfade=d=8[a]" \
  -c:v libx264 -crf 21 -tune film -pix_fmt yuv420p \
  -map '[v]' -map '[a]' \
  trips.mp4
```

Create Waveform Video of Audio

In an earlier section, you learned how to create a sine wave tone. In my old OS, the media player's visualization confirmed that it is indeed a sine wave. In my new OS, the media player has no audio visualization support. How do I know that it is indeed a sine wave? Use the `showwaves` filter! This filter can read an audio stream and generate a video stream containing visual waveform data.

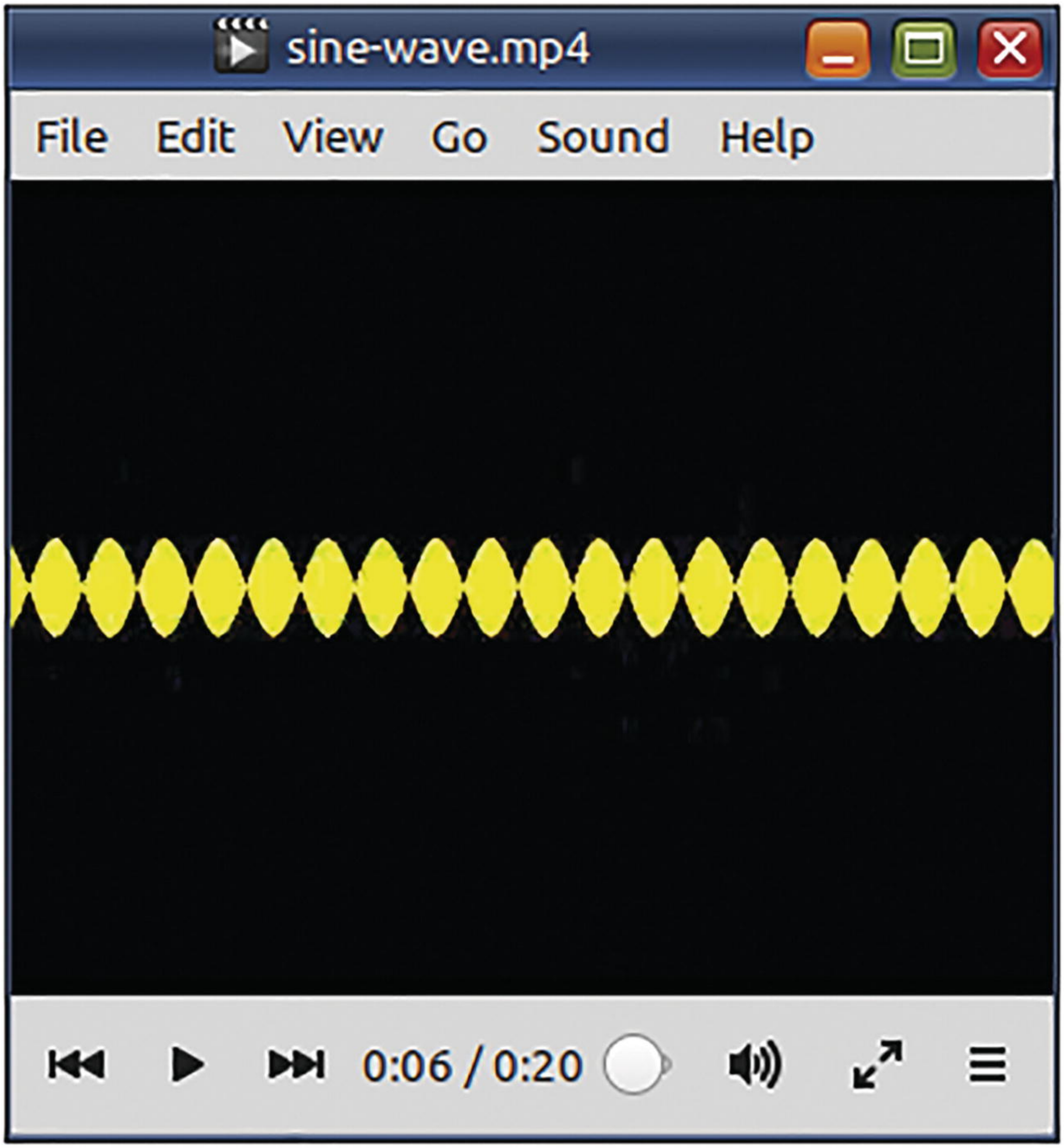


Figure 11-16 The `showwaves` filter confirms that the audio is a sine wave

```
ffmpeg -i sine.wav \
       -filter_complex \
         "showwaves=s=vga:mode=cline:draw=full:
```

```
            colors=yellow[v]" \
        -map '[v]' -map 0:a:0 \
        -c:v mpeg4 -b:v 300K -r 24 \
        sine-wave.mp4
```

Create a Waveform Image of Audio

Some audio-hosting sites use waveform images as the background for their audio player controls. How can you create similar images? Use the `showwavespic` filter.

```
ffmpeg -y -i ace-ventura-reverse.mp4 \
       -lavfi "showwavespic=s=600x120:split_channels=
                                  colors=yellow|red:scale=s
       ace-waveform.png
```

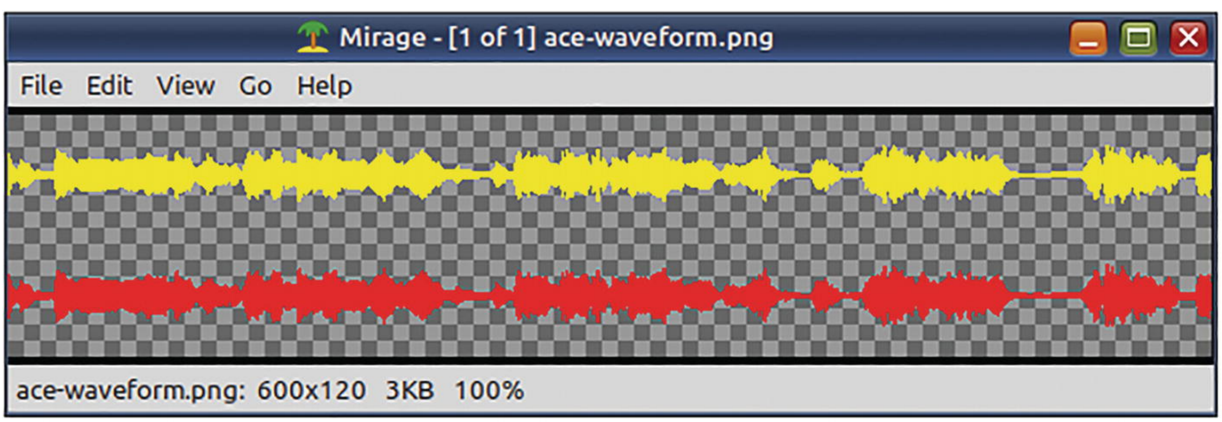


Figure 11-17 The `showwavespic` filter can generate an image containing the waveform of an audio stream

Forensic Examination of Audio (Not Really)

Browsing through the FFmpeg documentation, I found several filters that generate visual waveform data from audio streams. I used them on the audio stream of a music recording and then rendered the generated visuals on the input video stream.

```
ffmpeg -y -i chenda-music.mp4 \
  -filter_complex \
    "[0:a:0]showfreqs=s=250x100:mode=bar:cmode=separa
    colors=orange|red[chartf];
    [0:a:0]showvolume=w=250:h=50:p=0.6:dm=2:dmc=red[c
    [0:a:0]showwaves=s=250x100:mode=cline:draw=full:
    colors=yellow|orange:split_channels=1[chartw];
    color=color=black@0:size=vga[bg];
    [bg][chartf]overlay=x=20:y=20[v1];
    [v1][chartv]overlay=x=20:y=150[v2];
    [v2][chartw]overlay=x=20:y=280[v3];
    [0:v:0][v3]overlay[v]" \
    -map '[v]' -map 0:a:0 -shortest \
  chenda-music-sound-levels.mp4
```

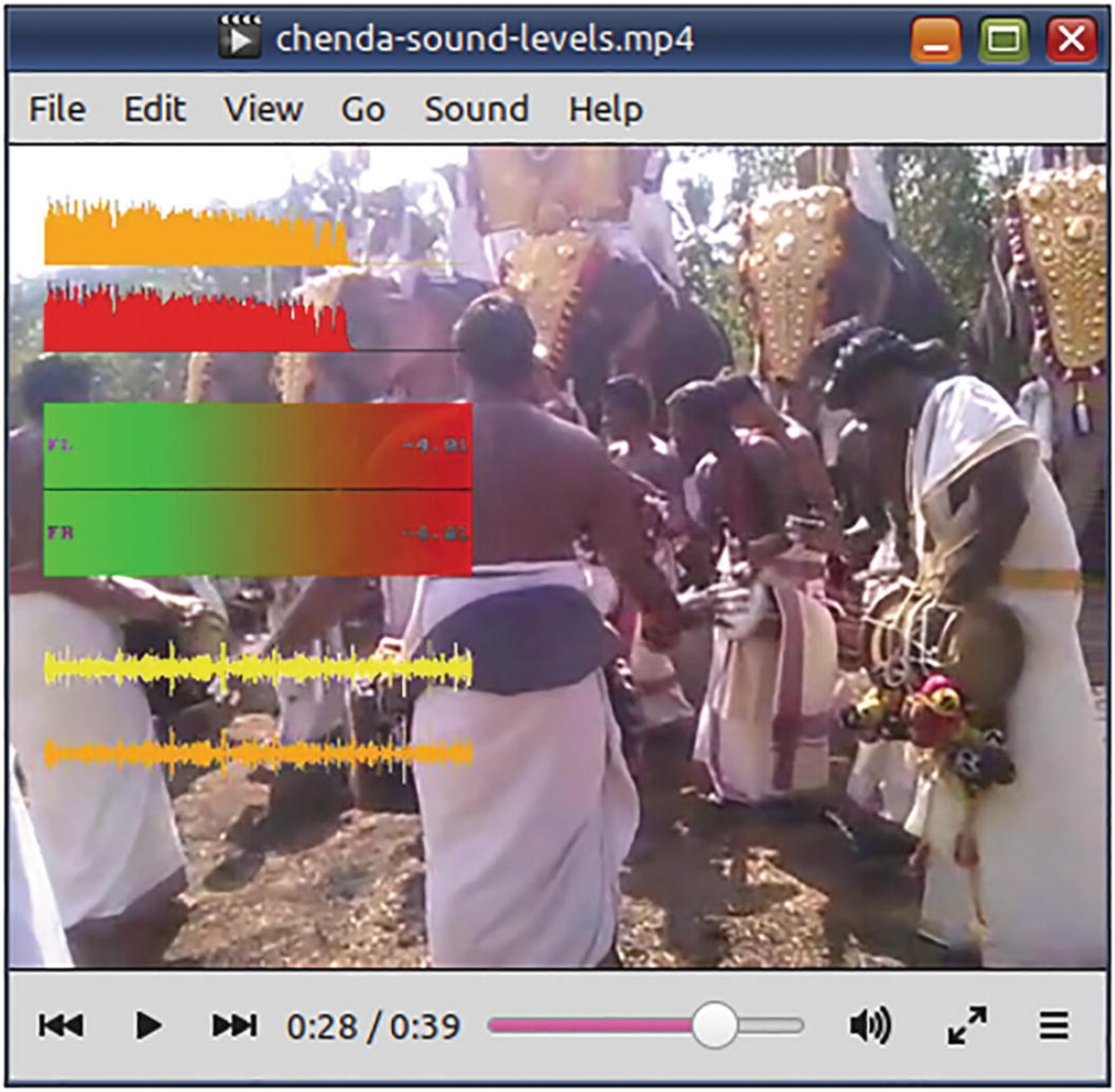


Figure 11-18 Several filters were used to generate visual waveform data from the audio stream and render it on the video stream

Replace a Green-Screen Background with Another Video

Do you have a green-screen video? Do you wish to place some other video in place of the green background? The `colorkey` filter is your friend. It replaces a color of your choice with transparency.

```
ffmpeg -y -i festival-fireworks.avi -i van-damme.mp4
       -filter_complex \
         "[1:v]colorkey=0x008000:0.2:0.2[v1];
          [0:v:0][v1]overlay=(W-w)/2:(H-h)[v];
          [0:a:0][1:a:0]amerge=inputs=2[a]" \
       -map "[v]" -map '[a]' \
       -s nhd -ac 2 -t 0:2:0 \
       green-screen-eliminated.mp4
```

The `colorkey` filter requires three keys - the color, how strictly shades of colors closer to the one specified are also made transparent, and by how much the transparent pixels should blend with the background.

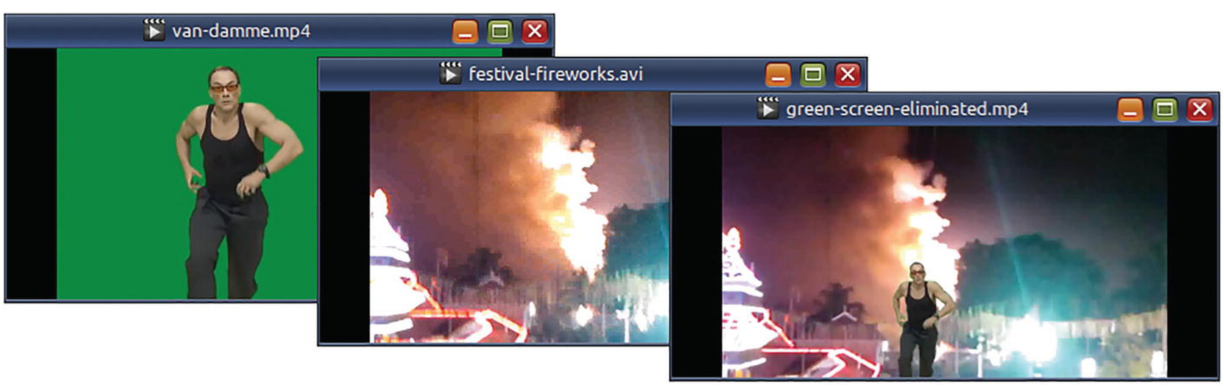


Figure 11-19 The green-screen video has been rendered on the fireworks video

☞ Jean-Claude Van Damme produced and donated this green-screen video to the public.

Turn All Colors Gray Except One

How do some commercials and music videos eliminate all colors except a few? With the `colorhold` filter!

```
ffmpeg -i color-test.mp4 \
       -filter:v "colorhold=yellow:similarity=0.2" \
       hold-yellow.mp4
```

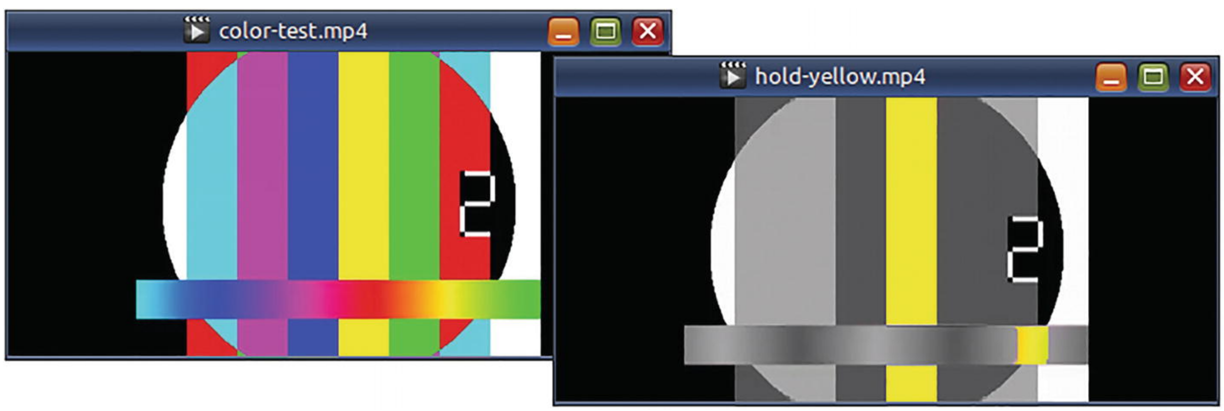


Figure 11-20 Using the `colorhold` filter, all colors in the original video have been removed except yellow

How to Pan Across a Video

Can you create the effect of a camera panning from top-left corner across to a particular region on the video? The next command tries to pan to a region that is 332x332 with the top-left coordinates at 150,12. The effect starts from the 20th second and lasts just 5 seconds. After the panning effect, this video continues with the rest of the cropped video without any panning.

```
ffmpeg -y -ss 20 -i how-to-vote.mp4 \
  -filter_complex \
      "[0:v:0]crop=w=332:h=332:
       x=(150*min(t\,5)/5):y=(12*min(t\,5)/5)" \
  -codec:a copy \
  how-to-vote-panned.mp4
```

In this command, the filter constant `t` representing the seconds is used to move the x-y coordinates of the crop region to its ultimate location at 150,12. For this, the coordinate is multiplied by `t` and divided by the total duration of the effect (five seconds). The `min` function expires the offsets of the crop filter after it has reached the destination at the end of five seconds.

Using FFmpeg with Timeline-Based Video-Editing Software

This tip comes from Apress author Seth Kenlon who mentioned it in his podcast some years ago. A lot of content creators record their videos in high definition. Editing these videos is quite a hassle in timeline-based video editing software. His trick was to downsize the video to say qvga (320x240) and then import that smaller video into his video-editing software. Because the video was so small, the editing software was more responsive, and he could finish the editing quickly. After he saved the project, he would close the editor. He would then manually overwrite the smaller video file with the original video. He would then start the editor again, open the project file, and only render (export) the video.

Your video editor must have built-in support for this kind of proxy editing. If not, it is likely to suffer from synchronization and scaling issues. Alternatively, you could reduce the frame rate to 12. This can make quite a difference if the source was recorded at say 60.

Make `ffmpeg -version` More Meaningful

If you had installed the pre-built ffmpeg executable and checked the –`version` option, `ffmpeg` displays the version like any other command-line program. If you build from source, then `ffmpeg` will display the label of the source code snapshot on the FFmpeg `git` repository.

```
~/Desktop
$ ffmpeg -version | head -1
ffmpeg version N-107964-g7de9c0e9d7 Copyright (c) 2000-2022
the FFmpeg developers
```

Figure 11-21 This `git` label is likely to be meaningless to most users. Is `ffmpeg` trying to be anonymous?

I studied the build script and made a few changes to one of the files extracted from the tarball (the downloaded compressed source code).

```
# Backup the file containing the git label
cp VERSION VERSION.bak
# Suffix the current date and release version number
echo  -e \
 "$(cat VERSION.bak) [$(date +%Y-%m-%d)] [$(cat RELEA
```

Then, I ran the `make` and `make install` commands to build the binaries. Now, the version number is more meaningful. If I have to deal with multiple ffmpeg binaries sometime in the future, this information will be useful.

```
~/ffmpeg_sources/ffmpeg
$ ~/bin/ffmpeg -version | head -1
ffmpeg version N-108219-g129cbbd7be [2022-09-20] [5.1.git]
Copyright (c) 2000-2022 the FFmpeg developers
```

Figure 11-22 The `-version` option displays the `git` label for whatever it is worth, YOUR build date, and the number of the last release version

This of course assumes that you will build the binaries on the same day you downloaded the source.

Hardware Acceleration

Computer video cards have encoders and decoders of some popular codecs in their chips. These hardware encoders and decoders are faster than the CPU running software-based encoders and decoders. You can offload the encoding and decoding operations of supported codecs from the processor (CPU) on your computer's motherboard to the processor chip (GPU) on your graphics card. (AMD calls 'em GPUs as APUs.)

What the heck is all that? Well, instead of encoding the video using your CPU with a software encoder like this,

```
ffmpeg -i raw-video.avi -codec:v libx264 compressed-v
```

... you can offload the processing to your video card like this:

```
# If you are on the red team
ffmpeg -i raw-video.avi -codec:v h264_amf compressed-
# or
# if you are green with nv
ffmpeg -i raw-video.avi -codec:v h264_nvenc \compress
```

Is that not cool? Well, to use such an exotic option, you need to build the FFmpeg source code forked by one of the participating video card manufacturers. You can find more information on this topic from the following:

- https://docs.nvidia.com/video-technologies/video-codec-sdk/ffmpeg-with-nvidia-gpu/
- https://trac.ffmpeg.org/wiki/HWAccelIntro

Beware that not all GPU models are supported. In some cases, performance may be inferior or have additional restrictions. nVidia seems to have shown more interest and openness in this field than AMD or Intel. I have AMD hardware and could not find enough documentation to build from source.

It is better if you can get statically linked builds created by someone else. For Windows users, the builds provided by the reviewer on his website (www.gyan.dev) had support for hardware-accelerated encoders and decoders in AMD and nVidia GPUs.

```
~/Desktop
$ wine [redacted]/ffmpeg-dos/bin/ffmpeg.exe \
>   -encoders -hide_banner | grep 'amf\|nv'
 V....D h264_amf             AMD AMF H.264 Encoder (codec h264)
 V....D h264_nvenc           NVIDIA NVENC H.264 encoder (codec h264
 V....D hevc_amf             AMD AMF HEVC encoder (codec hevc)
 V....D hevc_nvenc           NVIDIA NVENC hevc encoder (codec hevc)


~/Desktop
$ ffmpeg -encoders | grep vaapi
 V....D h264_vaapi           H.264/AVC (VAAPI) (codec h264)
 V....D hevc_vaapi           H.265/HEVC (VAAPI) (codec hevc)
 V....D mjpeg_vaapi          MJPEG (VAAPI) (codec mjpeg)
 V....D mpeg2_vaapi          MPEG-2 (VAAPI) (codec mpeg2video)
 V....D vp8_vaapi            VP8 (VAAPI) (codec vp8)
 V....D vp9_vaapi            VP9 (VAAPI) (codec vp9)
```

Figure 11-23 Some hardware-accelerated encoders available in a Windows build and a Linux build have been listed

> ☞ No, `wine` will not work. I used it only to take this screenshot of the encoder listing.

> ☞ The `hevc` encoders are for the newer H265 codec. Try `ffmpeg -hwaccels` to see what hardware-accelerated options you have.

> ☞ The `libva` library (Video Acceleration API) is supported in some Intel and AMD GPUs.

Apart from encoders and decoders, you can install some hardware-accelerated filters when you build from source.

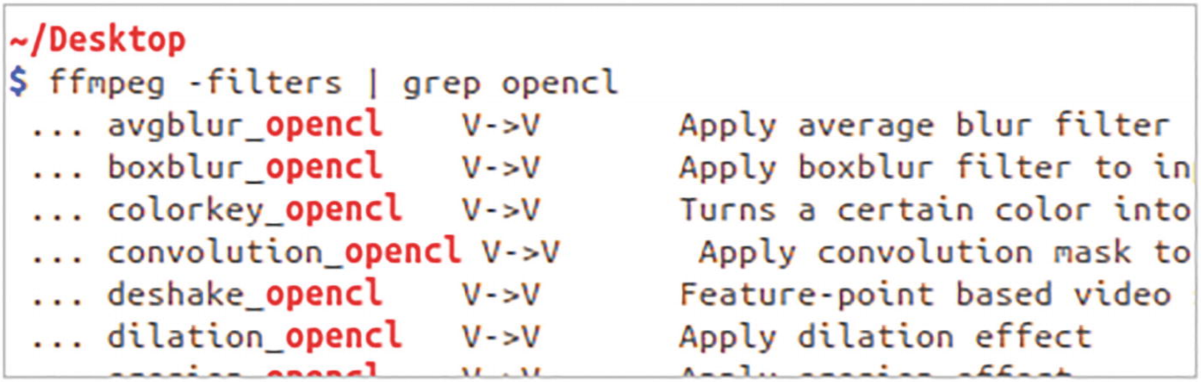


Figure 11-24 Several OpenCL-enabled filters were installed after adding the `--enable-opencl` option in the `configure` script when I built FFmpeg version 5.1 from source

Finis

All right! What does this command do?

```
ffmpeg \
  -f image2 -loop 1 -i BG-Collage.png \
  -f mp4 -i idiot-box-2.mp4 -i chenda-music-sound-lev
          -i Delphine-with-accessibility.mp4 \
          -i race-timer.mp4 -i slide.mp4 \
          -i watermarked-solar.mp4 \
   -filter_complex \
     "[0:v:0]drawtext=x=(w-tw)/2:y=15:
        fontcolor=red:alpha=0.6:shadowx=1:shadowy=2:
        text='Quick Start Guide To FFmpeg by V. Subha
        fontsize=30:fontfile=Oswald.ttf[banner1];

      [banner1]drawtext=x=(w-tw)/2:y=270:
        fontcolor=white:alpha=0.6:shadowx=1:shadowy=2
```

```
        text='www.Apress.com':fontsize=30:
        fontfile=Merriweather.ttf[banner];
      [1:v:0]scale=160:90[scale1];
          [banner][scale1]overlay=40:60[over1];
      [2:v:0]scale=160:90[scale2];
          [over1][scale2]overlay=240:60[over2];
      [3:v:0]scale=160:90[scale3];
          [over2][scale3]overlay=440:60[over3];
      [4:v:0]scale=160:90[scale4];
          [over3][scale4]overlay=40:170[over4];
      [5:v:0]scale=160:90[scale5];
          [over4][scale5]overlay=240:170[over5];
      [6:v:0]scale=160:90[scale6];
          [over5][scale6]overlay=440:170[video];
      [1:a:0][2:a:0][3:a:0][4:a:0][6:a:0]amerge=input
    -map '[video]' -map '[audio]' \
    -ac 2 \
    -t 0:0:10 \
    thank-you.mp4
```

This command creates a video that has six downscaled videos playing simultaneously on a background image. The audio from the five input files were downmixed to stereo. (The slideshow had no audio.) Even the texts on the background were rendered by `ffmpeg`.

Figure 11-25 This video collage was created using several FFmpeg techniques described in this book

This video and several others used in this book are available in an online video playlist. You can find its link on these sites:

- www.apress.com/9781484287002
- www.vsubhash.in/ffmpeg-book.html

What Next…

Well, you have finished the book. What else can you do?

- Check the extra resources provided for this book.
- Spend some time reading the relevant sections of the FFmpeg documentation and online wiki when you are trying out the commands.
- If you have an FFmpeg-related problem, you may be able to find answers by simply doing an online search of its error message (within quotation marks). When you post FFmpeg-related questions on a forum, post the error messages as text rather than as screenshots. The recommended forums are as follows:
  - https://superuser.com/questions/tagged/ffmpeg
  - https://video.stackexchange.com/questions/tagged/ffmpeg
- If FFmpeg made a valuable contribution to you or your organization, you could show your appreciation of the favor: http://ffmpeg.org/donations.html
- If you give this book a good rating or review online, that will also be appreciated… by me… and other current/future FFmpeg users.
- If you have any corrections or suggestions, write to info@vsubhash.com.

V. Subhash, *Quick Start Guide to FFmpeg*
https://doi.org/10.1007/978-1-4842-8701-9_12

12. Annexures

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Annexure 1: Sample List of Codecs

This annexure contains sample output for the command `ffmpeg -codecs`.

```
Codecs:
D..... = Decoding supported
.E.... = Encoding supported
..V... = Video codec
..A... = Audio codec
..S... = Subtitle codec
..D... = Data codec
..T... = Attachment codec
...I.. = Intra frame-only codec
....L. = Lossy compression
.....S = Lossless compression
-------
D.VI.S 012v                 Uncompressed 4:2:2 10-bit
```

```
 D.V.L. 4xm                  4X Movie
 D.VI.S 8bps                 QuickTime 8BPS video
 .EVIL. a64_multi            Multicolor charset for Co
 .EVIL. a64_multi5           Multicolor charset for Co
 D.V..S aasc                 Autodesk RLE
 D.V.L. agm                  Amuse Graphics Movie
 D.VIL. aic                  Apple Intermediate Codec
 DEVI.S alias_pix            Alias/Wavefront PIX image
 DEVIL. amv                  AMV Video
 D.V.L. anm                  Deluxe Paint Animation
 D.V.L. ansi                 ASCII/ANSI art
 DEV..S apng                 APNG (Animated Portable N
 D.V.L. arbc                 Gryphon's Anim Compressor
 D.V.L. argo                 Argonaut Games Video
 DEVIL. asv1                 ASUS V1
 DEVIL. asv2                 ASUS V2
 D.VIL. aura                 Auravision AURA
 D.VIL. aura2                Auravision Aura 2
 DEV.L. av1                  Alliance for Open Media A
 D.V... avrn                 Avid AVI Codec
 DEVI.S avrp                 Avid 1:1 10-bit RGB Packe
 D.V.L. avs                  AVS (Audio Video Standard
 ..V.L. avs2                 AVS2-P2/IEEE1857.4
 ..V.L. avs3                 AVS3-P2/IEEE1857.10
 DEVI.S avui                 Avid Meridien Uncompresse

 DEVI.S ayuv                 Uncompressed packed MS 4:
 D.V.L. bethsoftvid          Bethesda VID video
 D.V.L. bfi                  Brute Force & Ignorance
```

```
D.V.L. binkvideo            Bink video
D.VI.. bintext              Binary text
DEVI.S bitpacked            Bitpacked
DEVI.S bmp                  BMP (Windows and OS/2 bit
D.V..S bmv_video            Discworld II BMV video
D.VI.S brender_pix          BRender PIX image
D.V.L. c93                  Interplay C93
D.V.L. cavs                 Chinese AVS (Audio Video
D.V.L. cdgraphics           CD Graphics video
D.V..S cdtoons              CDToons video
D.VIL. cdxl                 Commodore CDXL video
DEV.L. cfhd                 GoPro CineForm HD
DEV.L. cinepak              Cinepak
D.V.L. clearvideo           Iterated Systems ClearVid
DEVIL. cljr                 Cirrus Logic AccuPak
D.VI.S cllc                 Canopus Lossless Codec
D.V.L. cmv                  Electronic Arts CMV video
D.V... cpia                 CPiA video format
D.VILS cri                  Cintel RAW
D.V..S cscd                 CamStudio (decoders: cams
D.VIL. cyuv                 Creative YUV (CYUV)
..V.LS daala                Daala
D.VILS dds                  DirectDraw Surface image
D.V.L. dfa                  Chronomaster DFA
DEV.LS dirac                Dirac (encoders: vc2)

DEVIL. dnxhd                VC3/DNxHD
DEVI.S dpx                  DPX (Digital Picture Exch
D.V.L. dsicinvideo          Delphine Software Interna
```

```
DEVIL. dvvideo          DV (Digital Video)
D.V..S dxa              Feeble Files/ScummVM DXA
D.VI.S dxtory           Dxtory
D.VIL. dxv              Resolume DXV
D.V.L. escape124        Escape 124
D.V.L. escape130        Escape 130
DEVILS exr              OpenEXR image
DEV..S ffv1             FFmpeg video codec #1
DEVI.S ffvhuff          Huffyuv FFmpeg variant
D.V.L. fic              Mirillis FIC
DEVI.S fits             FITS (Flexible Image Tran
DEV..S flashsv          Flash Screen Video v1
DEV.L. flashsv2         Flash Screen Video v2
D.V..S flic             Autodesk Animator Flic vi
DEV.L. flv1             FLV / Sorenson Spark / So
D.V..S fmvc             FM Screen Capture Codec
D.VI.S fraps            Fraps
D.VI.S frwu             Forward Uncompressed
D.V.L. g2m              Go2Meeting
D.V.L. gdv              Gremlin Digital Video
D.V.L. gem              GEM Raster image
DEV..S gif              CompuServe GIF (Graphics
DEV.L. h261             H.261
DEV.L. h263             H.263 / H.263-1996, H.263
                        ↳ version 2 (decoders: h2

                        ↳ (encoders: h263 h263_v4
D.V.L. h263i            Intel H.263
DEV.L. h263p            H.263+ / H.263-1998 / H.2
```

```
DEV.LS h264                 H.264 / AVC / MPEG-4 AVC
                            ↳ (decoders: h264 h264_v4
                            ↳ libx264rgb h264_v4l2m2m
DEVIL. hap                  Vidvox Hap
DEVIL. hdr                  HDR (Radiance RGBE format
DEV.L. hevc                 H.265 / HEVC (High Effici
                            ↳ (decoders: hevc hevc_v4
                            ↳ libx265 hevc_v4l2m2m he
D.V.L. hnm4video            HNM 4 video
D.VIL. hq_hqa               Canopus HQ/HQA
D.VIL. hqx                  Canopus HQX
DEVI.S huffyuv              HuffYUV
D.VI.S hymt                 HuffYUV MT
D.V.L. idcin                id Quake II CIN video (de
D.VI.. idf                  iCEDraw text
D.V.L. iff_ilbm             IFF ACBM/ANIM/DEEP/ILBM/P
D.V.L. imm4                 Infinity IMM4
D.V.L. imm5                 Infinity IMM5
D.V.L. indeo2               Intel Indeo 2
D.V.L. indeo3               Intel Indeo 3
D.V.L. indeo4               Intel Indeo Video Interac
D.V.L. indeo5               Intel Indeo Video Interac
D.V.L. interplayvideo       Interplay MVE video
D.VIL. ipu                  IPU Video
DEVILS jpeg2000             JPEG 2000 (decoders: jpeg

                            ↳ jpeg2000 libopenjpeg)
DEVILS jpegls               JPEG-LS
DEVILS jpegxl               JPEG XL (decoders: libjxl
```

```
D.VIL. jv                   Bitmap Brothers JV video
D.V.L. kgv1                 Kega Game Video
D.V.L. kmvc                 Karl Morton's video codec
D.VI.S lagarith             Lagarith lossless
.EVI.S ljpeg                Lossless JPEG
D.VI.S loco                 LOCO
D.V.L. lscr                 LEAD Screen Capture
D.VI.S m101                 Matrox Uncompressed SD
D.V.L. mad                  Electronic Arts Madcow Vi
DEVI.S magicyuv             MagicYUV video
D.VIL. mdec                 Sony PlayStation MDEC (Mo
D.V.L. mimic                Mimic
DEVIL. mjpeg                Motion JPEG (encoders: mj
D.VIL. mjpegb               Apple MJPEG-B
D.V.L. mmvideo              American Laser Games MM V
D.V.L. mobiclip             MobiClip Video
D.V.L. motionpixels         Motion Pixels video
DEV.L. mpeg1video           MPEG-1 video (decoders: m
DEV.L. mpeg2video           MPEG-2 video (decoders: m
                            ↳ mpeg2_v4l2m2m) (encoder
DEV.L. mpeg4                MPEG-4 part 2 (decoders: 
D.V.L. msa1                 MS ATC Screen
D.VI.S mscc                 Mandsoft Screen Capture C
D.V.L. msmpeg4v1            MPEG-4 part 2 Microsoft v
DEV.L. msmpeg4v2            MPEG-4 part 2 Microsoft v

DEV.L. msmpeg4v3            MPEG-4 part 2 Microsoft v
                            ↳ (encoders: msmpeg4) (de
D.VI.S msp2                 Microsoft Paint (MSP) ver
```

```
D.V..S msrle                Microsoft RLE
D.V.L. mss1                 MS Screen 1
D.VIL. mss2                 MS Windows Media Video V9
DEV.L. msvideo1             Microsoft Video 1
D.VI.S mszh                 LCL (LossLess Codec Libra
D.V.L. mts2                 MS Expression Encoder Scr
D.V.L. mv30                 MidiVid 3.0
D.VIL. mvc1                 Silicon Graphics Motion V
D.VIL. mvc2                 Silicon Graphics Motion V
D.V.L. mvdv                 MidiVid VQ
D.VIL. mvha                 MidiVid Archive Codec
D.V..S mwsc                 MatchWare Screen Capture
D.V.L. mxpeg                Mobotix MxPEG video
D.VIL. notchlc              NotchLC
D.V.L. nuv                  NuppelVideo/RTJPEG
D.V.L. paf_video            Amazing Studio Packed Ani
DEVI.S pam                  PAM (Portable AnyMap) ima
DEVI.S pbm                  PBM (Portable BitMap) ima
DEVI.S pcx                  PC Paintbrush PCX image
DEVI.S pfm                  PFM (Portable FloatMap) i
DEVI.S pgm                  PGM (Portable GrayMap) im
DEVI.S pgmyuv               PGMYUV (Portable GrayMap
D.VI.S pgx                  PGX (JPEG2000 Test Format
DEVI.S phm                  PHM (Portable HalfFloatMa
D.V.L. photocd              Kodak Photo CD

D.VIL. pictor               Pictor/PC Paint
D.VIL. pixlet               Apple Pixlet
DEV..S png                  PNG (Portable Network Gra
```

```
 DEVI.S ppm                  PPM (Portable PixelMap) i
 DEVIL. prores               Apple ProRes (iCodec Pro)
                             ↳ prores_aw prores_ks)
 D.VIL. prosumer             Brooktree ProSumer Video
 D.VI.S psd                  Photoshop PSD file
 D.VIL. ptx                  V.Flash PTX image
 D.VI.S qdraw                Apple QuickDraw
 DEVI.S qoi                  QOI (Quite OK Image)
 D.V.L. qpeg                 Q-team QPEG
 DEV..S qtrle                QuickTime Animation (RLE)
 DEVI.S r10k                 AJA Kona 10-bit RGB Codec
 DEVI.S r210                 Uncompressed RGB 10-bit
 D.V.L. rasc                 RemotelyAnywhere Screen C
 DEVI.S rawvideo             raw video
 D.VIL. rl2                  RL2 video
 DEV.L. roq                  id RoQ video (decoders: r
 DEV.L. rpza                 QuickTime video (RPZA)
 D.V..S rscc                 innoHeim/Rsupport Screen
 DEV.L. rv10                 RealVideo 1.0
 DEV.L. rv20                 RealVideo 2.0
 D.V.L. rv30                 RealVideo 3.0
 D.V.L. rv40                 RealVideo 4.0
 D.V.L. sanm                 LucasArts SANM/SMUSH vide
 D.V.LS scpr                 ScreenPressor
 D.V..S screenpresso         Screenpresso

 D.V.L. sga                  Digital Pictures SGA Vide
 DEVI.S sgi                  SGI image
 D.VI.S sgirle               SGI RLE 8-bit
```

```
 D.VI.S sheervideo           BitJazz SheerVideo
 D.V.L. simbiosis_imx        Simbiosis Interactive IMX
 D.V.L. smackvideo           Smacker video (decoders:
 DEV.L. smc                  QuickTime Graphics (SMC)
 D.VIL. smvjpeg              Sigmatel Motion Video
 DEV.LS snow                 Snow
 D.VIL. sp5x                 Sunplus JPEG (SP5X)
 DEVIL. speedhq              NewTek SpeedHQ
 D.VI.S srgc                 Screen Recorder Gold Code
 DEVI.S sunrast              Sun Rasterfile image
 ..V..S svg                  Scalable Vector Graphics
 DEV.L. svq1                 Sorenson Vector Quantizer
 D.V.L. svq3                 Sorenson Vector Quantizer
 DEVI.S targa                Truevision Targa image
 D.VI.S targa_y216           Pinnacle TARGA CineWave Y
 D.V.L. tdsc                 TDSC
 D.V.L. tgq                  Electronic Arts TGQ video
 D.V.L. tgv                  Electronic Arts TGV video
 DEV.L. theora               Theora (encoders: libtheo
 D.VIL. thp                  Nintendo Gamecube THP vid
 D.V.L. tiertexseqvideo      Tiertex Limited SEQ video
 DEVI.S tiff                 TIFF image
 D.VIL. tmv                  8088flex TMV
 D.V.L. tqi                  Electronic Arts TQI video
 D.V.L. truemotion1          Duck TrueMotion 1.0

 D.V.L. truemotion2          Duck TrueMotion 2.0
 D.VIL. truemotion2rt        Duck TrueMotion 2.0 Real
 D.V..S tscc                 TechSmith Screen Capture
```

```
D.V.L. tscc2                TechSmith Screen Codec 2
D.VIL. txd                  Renderware TXD (TeXture D
D.V.L. ulti                 IBM UltiMotion (decoders:
DEVI.S utvideo              Ut Video
DEVI.S v210                 Uncompressed 4:2:2 10-bit
D.VI.S v210x                Uncompressed 4:2:2 10-bit
DEVI.S v308                 Uncompressed packed 4:4:4
DEVI.S v408                 Uncompressed packed QT 4:
DEVI.S v410                 Uncompressed 4:4:4 10-bit
D.V.L. vb                   Beam Software VB
D.VI.S vble                 VBLE Lossless Codec
DEV.L. vbn                  Vizrt Binary Image
D.V.L. vc1                  SMPTE VC-1 (decoders: vc1
D.V.L. vc1image             Windows Media Video 9 Ima
D.VIL. vcr1                 ATI VCR1
D.VIL. vixl                 Miro VideoXL (decoders: x
D.V.L. vmdvideo             Sierra VMD video
D.V..S vmnc                 VMware Screen Codec / VMw
D.V.L. vp3                  On2 VP3
D.V.L. vp4                  On2 VP4
D.V.L. vp5                  On2 VP5
D.V.L. vp6                  On2 VP6
D.V.L. vp6a                 On2 VP6 (Flash version, w
D.V.L. vp6f                 On2 VP6 (Flash version)
D.V.L. vp7                  On2 VP7

DEV.L. vp8                  On2 VP8 (decoders: vp8 vp
                            ↳ (encoders: libvpx vp8_v
DEV.L. vp9                  Google VP9 (decoders: vp9
```

```
                          ↳ (encoders: libvpx-vp9 v
..V.L. vvc                H.266 / VVC (Versatile Vi
DEVI.S wbmp               WBMP (Wireless Applicatio
D.V..S wcmv               WinCAM Motion Video
DEVILS webp               WebP (encoders: libwebp_a
DEV.L. wmv1               Windows Media Video 7
DEV.L. wmv2               Windows Media Video 8
D.V.L. wmv3               Windows Media Video 9
D.V.L. wmv3image          Windows Media Video 9 Ima
D.VIL. wnv1               Winnov WNV1
DEV..S wrapped_avframe    AVFrame to AVPacket passt
D.V.L. ws_vqa             Westwood Studios VQA (Vec
                          ↳ (decoders: vqavideo)
D.V.L. xan_wc3            Wing Commander III / Xan
D.V.L. xan_wc4            Wing Commander IV / Xxan
D.VI.. xbin               eXtended BINary text
DEVI.S xbm                XBM (X BitMap) image
DEVIL. xface              X-face image
D.VI.S xpm                XPM (X PixMap) image
DEVI.S xwd                XWD (X Window Dump) image
DEVI.S y41p               Uncompressed YUV 4:1:1 12
D.VI.S ylc                YUY2 Lossless Codec
D.V.L. yop                Psygnosis YOP Video
DEVI.S yuv4               Uncompressed packed 4:2:0
D.V..S zerocodec          ZeroCodec Lossless Video

DEVI.S zlib               LCL (LossLess Codec Libra
DEV..S zmbv               Zip Motion Blocks Video
..AIL. 4gv                4GV (Fourth Generation Vo
```

```
D.AIL. 8svx_exp             8SVX exponential
D.AIL. 8svx_fib             8SVX fibonacci
DEAIL. aac                  AAC (Advanced Audio Codin
                            ↳ libfdk_aac) (encoders:
D.AIL. aac_latm             AAC LATM (Advanced Audio
DEAIL. ac3                  ATSC A/52A (AC-3) (decode
                            ↳ (encoders: ac3 ac3_fixe
D.AIL. acelp.kelvin         Sipro ACELP.KELVIN
D.AIL. adpcm_4xm            ADPCM 4X Movie
DEAIL. adpcm_adx            SEGA CRI ADX ADPCM
D.AIL. adpcm_afc            ADPCM Nintendo Gamecube A
D.AIL. adpcm_agm            ADPCM AmuseGraphics Movie
D.AIL. adpcm_aica           ADPCM Yamaha AICA
DEAIL. adpcm_argo           ADPCM Argonaut Games
D.AIL. adpcm_ct             ADPCM Creative Technology
D.AIL. adpcm_dtk            ADPCM Nintendo Gamecube D
D.AIL. adpcm_ea             ADPCM Electronic Arts
D.AIL. adpcm_ea_maxis_xa    ADPCM Electronic Arts Max
D.AIL. adpcm_ea_r1          ADPCM Electronic Arts R1
D.AIL. adpcm_ea_r2          ADPCM Electronic Arts R2
D.AIL. adpcm_ea_r3          ADPCM Electronic Arts R3
D.AIL. adpcm_ea_xas         ADPCM Electronic Arts XAS
DEAIL. adpcm_g722           G.722 ADPCM (decoders: g7
DEAIL. adpcm_g726           G.726 ADPCM (decoders: g7
DEAIL. adpcm_g726le         G.726 ADPCM little-endian

                            ↳ (encoders: g726le)
D.AIL. adpcm_ima_acorn      ADPCM IMA Acorn Replay
DEAIL. adpcm_ima_alp        ADPCM IMA High Voltage So
```

```
DEAIL. adpcm_ima_amv        ADPCM IMA AMV
D.AIL. adpcm_ima_apc        ADPCM IMA CRYO APC
DEAIL. adpcm_ima_apm        ADPCM IMA Ubisoft APM
D.AIL. adpcm_ima_cunning    ADPCM IMA Cunning Develop
D.AIL. adpcm_ima_dat4       ADPCM IMA Eurocom DAT4
D.AIL. adpcm_ima_dk3        ADPCM IMA Duck DK3
D.AIL. adpcm_ima_dk4        ADPCM IMA Duck DK4
D.AIL. adpcm_ima_ea_eacs    ADPCM IMA Electronic Arts
D.AIL. adpcm_ima_ea_sead    ADPCM IMA Electronic Arts
D.AIL. adpcm_ima_iss        ADPCM IMA Funcom ISS
D.AIL. adpcm_ima_moflex     ADPCM IMA MobiClip MOFLEX
D.AIL. adpcm_ima_mtf        ADPCM IMA Capcom's MT Fra
D.AIL. adpcm_ima_oki        ADPCM IMA Dialogic OKI
DEAIL. adpcm_ima_qt         ADPCM IMA QuickTime
D.AIL. adpcm_ima_rad        ADPCM IMA Radical
D.AIL. adpcm_ima_smjpeg     ADPCM IMA Loki SDL MJPEG
DEAIL. adpcm_ima_ssi        ADPCM IMA Simon & Schuste
DEAIL. adpcm_ima_wav        ADPCM IMA WAV
DEAIL. adpcm_ima_ws         ADPCM IMA Westwood
DEAIL. adpcm_ms             ADPCM Microsoft
D.AIL. adpcm_mtaf           ADPCM MTAF
D.AIL. adpcm_psx            ADPCM Playstation
D.AIL. adpcm_sbpro_2        ADPCM Sound Blaster Pro 2
D.AIL. adpcm_sbpro_3        ADPCM Sound Blaster Pro 2
D.AIL. adpcm_sbpro_4        ADPCM Sound Blaster Pro 4

DEAIL. adpcm_swf            ADPCM Shockwave Flash
D.AIL. adpcm_thp            ADPCM Nintendo THP
D.AIL. adpcm_thp_le         ADPCM Nintendo THP (Littl
```

```
D.AIL. adpcm_vima           LucasArts VIMA audio
D.AIL. adpcm_xa             ADPCM CDROM XA
DEAIL. adpcm_yamaha         ADPCM Yamaha
D.AIL. adpcm_zork           ADPCM Zork
DEAI.S alac                 ALAC (Apple Lossless Audi
DEAIL. amr_nb               AMR-NB (Adaptive Multi-Ra
                            ↳ libopencore_amrnb) (enc
DEAIL. amr_wb               AMR-WB (Adaptive Multi-Ra
                            ↳ libopencore_amrwb) (enc
D.AI.S ape                  Monkey's Audio
DEAIL. aptx                 aptX (Audio Processing Te
DEAIL. aptx_hd              aptX HD (Audio Processing
D.AIL. atrac1               ATRAC1 (Adaptive TRansfor
D.AIL. atrac3               ATRAC3 (Adaptive TRansfor
D.AI.S atrac3al             ATRAC3 AL (Adaptive TRans
                            ↳ Advanced Lossless)
D.AIL. atrac3p              ATRAC3+ (Adaptive TRansfo
                            ↳ (decoders: atrac3plus)
D.AI.S atrac3pal            ATRAC3+ AL (Adaptive TRan
                            ↳  Advanced Lossless) (de
D.AIL. atrac9               ATRAC9 (Adaptive TRansfor
D.AIL. avc                  On2 Audio for Video Codec
D.AIL. binkaudio_dct        Bink Audio (DCT)
D.AIL. binkaudio_rdft       Bink Audio (RDFT)
D.AIL. bmv_audio            Discworld II BMV audio

..AIL. celt                 Constrained Energy Lapped
..AIL. codec2               codec2 (very low bitrate
DEAIL. comfortnoise         RFC 3389 Comfort Noise
```

```
D.AIL. cook                 Cook / Cooker / Gecko (Re
D.AIL. derf_dpcm            DPCM Xilam DERF
DEA.L. dfpwm                DFPWM (Dynamic Filter Pul
D.AIL. dolby_e              Dolby E
D.AIL. dsd_lsbf             DSD (Direct Stream Digita
D.AIL. dsd_lsbf_planar      DSD (Direct Stream Digita
                            ↳ first, planar
D.AIL. dsd_msbf             DSD (Direct Stream Digita
D.AIL. dsd_msbf_planar      DSD (Direct Stream Digita
                            ↳ first, planar
D.AIL. dsicinaudio          Delphine Software Interna
D.AIL. dss_sp               Digital Speech Standard -
D.AI.S dst                  DST (Direct Stream Transf
DEAILS dts                  DCA (DTS Coherent Acousti
                            ↳ (encoders: dca)
D.AIL. dvaudio              DV audio
DEAIL. eac3                 ATSC A/52B (AC-3, E-AC-3)
D.AIL. evrc                 EVRC (Enhanced Variable R
D.AIL. fastaudio            MobiClip FastAudio
DEAI.S flac                 FLAC (Free Lossless Audio
DEAIL. g723_1               G.723.1
D.AIL. g729                 G.729
D.AIL. gremlin_dpcm         DPCM Gremlin
D.AIL. gsm                  GSM
D.AIL. gsm_ms               GSM Microsoft variant

D.AIL. hca                  CRI HCA
D.AIL. hcom                 HCOM Audio
D.AIL. iac                  IAC (Indeo Audio Coder)
```

```
 D.AIL. ilbc                 iLBC (Internet Low Bitrat
 D.AIL. imc                  IMC (Intel Music Coder)
 D.AIL. interplay_dpcm       DPCM Interplay
 D.AIL. interplayacm         Interplay ACM
 D.AIL. mace3                MACE (Macintosh Audio Com
 D.AIL. mace6                MACE (Macintosh Audio Com
 D.AIL. metasound            Voxware MetaSound
 DEA..S mlp                  MLP (Meridian Lossless Pa
 D.AIL. mp1                  MP1 (MPEG audio layer 1)
 DEAIL. mp2                  MP2 (MPEG audio layer 2)
                             ↳ (encoders: mp2 mp2fixed
 DEAIL. mp3                  MP3 (MPEG audio layer 3)
                             ↳ (encoders: libmp3lame l
 D.AIL. mp3adu               ADU (Application Data Uni
                             ↳ (decoders: mp3adufloat
 D.AIL. mp3on4               MP3onMP4 (decoders: mp3on
 D.AI.S mp4als               MPEG-4 Audio Lossless Cod
 ..A.L. mpegh_3d_audio       MPEG-H 3D Audio
 D.AIL. msnsiren             MSN Siren
 D.AIL. musepack7            Musepack SV7 (decoders: m
 D.AIL. musepack8            Musepack SV8 (decoders: m
 DEAIL. nellymoser           Nellymoser Asao
 DEAIL. opus                 Opus (Opus Interactive Au
                             ↳ libopus) (encoders: opu
 D.AIL. paf_audio            Amazing Studio Packed Ani

 DEAIL. pcm_alaw             PCM A-law / G.711 A-law
 DEAI.S pcm_bluray           PCM signed 16|20|24-bit b
 DEAI.S pcm_dvd              PCM signed 20|24-bit big-
```

```
 D.AI.S pcm_f16le            PCM 16.8 floating point l
 D.AI.S pcm_f24le            PCM 24.0 floating point l
 DEAI.S pcm_f32be            PCM 32-bit floating point
 DEAI.S pcm_f32le            PCM 32-bit floating point
 DEAI.S pcm_f64be            PCM 64-bit floating point
 DEAI.S pcm_f64le            PCM 64-bit floating point
 D.AI.S pcm_lxf              PCM signed 20-bit little-
 DEAIL. pcm_mulaw            PCM mu-law / G.711 mu-law
 DEAI.S pcm_s16be            PCM signed 16-bit big-end
 DEAI.S pcm_s16be_planar     PCM signed 16-bit big-end
 DEAI.S pcm_s16le            PCM signed 16-bit little-
 DEAI.S pcm_s16le_planar     PCM signed 16-bit little-
 DEAI.S pcm_s24be            PCM signed 24-bit big-end
 DEAI.S pcm_s24daud          PCM D-Cinema audio signed
 DEAI.S pcm_s24le            PCM signed 24-bit little-
 DEAI.S pcm_s24le_planar     PCM signed 24-bit little-
 DEAI.S pcm_s32be            PCM signed 32-bit big-end
 DEAI.S pcm_s32le            PCM signed 32-bit little-
 DEAI.S pcm_s32le_planar     PCM signed 32-bit little-
 DEAI.S pcm_s64be            PCM signed 64-bit big-end
 DEAI.S pcm_s64le            PCM signed 64-bit little-
 DEAI.S pcm_s8               PCM signed 8-bit
 DEAI.S pcm_s8_planar        PCM signed 8-bit planar
 D.AI.S pcm_sga              PCM SGA
 DEAI.S pcm_u16be            PCM unsigned 16-bit big-e

 DEAI.S pcm_u16le            PCM unsigned 16-bit littl
 DEAI.S pcm_u24be            PCM unsigned 24-bit big-e
 DEAI.S pcm_u24le            PCM unsigned 24-bit littl
```

```
 DEAI.S pcm_u32be            PCM unsigned 32-bit big-e
 DEAI.S pcm_u32le            PCM unsigned 32-bit littl
 DEAI.S pcm_u8               PCM unsigned 8-bit
 DEAIL. pcm_vidc             PCM Archimedes VIDC
 D.AIL. qcelp                QCELP / PureVoice
 D.AIL. qdm2                 QDesign Music Codec 2
 D.AIL. qdmc                 QDesign Music
 DEAIL. ra_144               RealAudio 1.0 (14.4K) (de
                             ↳ (encoders: real_144)
 D.AIL. ra_288               RealAudio 2.0 (28.8K) (de
 D.AI.S ralf                 RealAudio Lossless
 DEAIL. roq_dpcm             DPCM id RoQ
 DEAI.S s302m                SMPTE 302M
 DEAIL. sbc                  SBC (low-complexity subba
 D.AIL. sdx2_dpcm            DPCM Squareroot-Delta-Exa
 D.AI.S shorten              Shorten
 D.AIL. sipr                 RealAudio SIPR / ACELP.NE
 D.AIL. siren                Siren
 D.AIL. smackaudio           Smacker audio (decoders:
 ..AIL. smv                  SMV (Selectable Mode Voco
 D.AIL. sol_dpcm             DPCM Sol
 DEAI.. sonic                Sonic
 .EAI.. sonicls              Sonic lossless
 DEAIL. speex                Speex (decoders: speex li
 D.A..S tak                  TAK (Tom's lossless Audio

 DEA..S truehd               TrueHD
 D.AIL. truespeech           DSP Group TrueSpeech
 DEAI.S tta                  TTA (True Audio)
```

```
 D.AIL. twinvq               VQF TwinVQ
 D.AIL. vmdaudio             Sierra VMD audio
 DEAIL. vorbis               Vorbis (decoders: vorbis
                             ↳ (encoders: vorbis libvo
 D.AI.. wavesynth            Wave synthesis pseudo-cod
 DEAILS wavpack              WavPack
 D.AIL. westwood_snd1        Westwood Audio (SND1) (de
 D.AI.S wmalossless          Windows Media Audio Lossl
 D.AIL. wmapro               Windows Media Audio 9 Pro
 DEAIL. wmav1                Windows Media Audio 1
 DEAIL. wmav2                Windows Media Audio 2
 D.AIL. wmavoice             Windows Media Audio Voice
 D.AIL. xan_dpcm             DPCM Xan
 D.AIL. xma1                 Xbox Media Audio 1
 D.AIL. xma2                 Xbox Media Audio 2
 ..D... bin_data             binary data
 ..D... dvd_nav_packet       DVD Nav packet
 ..D... epg                  Electronic Program Guide
 ..D... klv                  SMPTE 336M Key-Length-Val
 ..D... mpegts               raw MPEG-TS stream
 ..D... otf                  OpenType font
 ..D... scte_35              SCTE 35 Message Queue
 ..D... timed_id3            timed ID3 metadata
 ..D... ttf                  TrueType font
 ..S... arib_caption         ARIB STD-B24 caption

 DES... ass                  ASS (Advanced SSA) subtit
                             ↳ (encoders: ssa ass)
 DES... dvb_subtitle         DVB subtitles (decoders:
```

```
 D.S... dvb_teletext         DVB teletext (decoders: l
 DES... dvd_subtitle         DVD subtitles (decoders:
 D.S... eia_608              EIA-608 closed captions (
 D.S... hdmv_pgs_subtitle    HDMV Presentation Graphic
                             ↳ subtitles (decoders: pg
 ..S... hdmv_text_subtitle   HDMV Text subtitle
 D.S... jacosub              JACOsub subtitle
 D.S... microdvd             MicroDVD subtitle
 DES... mov_text             MOV text
 D.S... mpl2                 MPL2 subtitle
 D.S... pjs                  PJS (Phoenix Japanimation
 D.S... realtext             RealText subtitle
 D.S... sami                 SAMI subtitle
 ..S... srt                  SubRip subtitle with embe
 ..S... ssa                  SSA (SubStation Alpha) su
 D.S... stl                  Spruce subtitle format
 DES... subrip               SubRip subtitle (decoders
                             ↳ subrip) (enc oders: srt
 D.S... subviewer            SubViewer subtitle
 D.S... subviewer1           SubViewer v1 subtitle
 DES... text                 raw UTF-8 text
 .ES... ttml                 Timed Text Markup Languag
 D.S... vplayer              VPlayer subtitle
 DES... webvtt               WebVTT subtitle
 DES... xsub                 XSUB
```

Annexure 2: Sample List of Decoders

This annexure contains sample output for the command `ffmpeg –decoders`.

```
Decoders:
V..... = Video
A..... = Audio
S..... = Subtitle
.F.... = Frame-level multithreading
..S... = Slice-level multithreading
...X.. = Codec is experimental
....B. = Supports draw_horiz_band
.....D = Supports direct rendering method 1
------
V....D 012v                 Uncompressed 4:2:2 10-bit
V....D 4xm                  4X Movie
V....D 8bps                 QuickTime 8BPS video
V....D aasc                 Autodesk RLE
V....D agm                  Amuse Graphics Movie
VF...D aic                  Apple Intermediate Codec
V....D alias_pix            Alias/Wavefront PIX image
V....D amv                  AMV Video
V....D anm                  Deluxe Paint Animation
V....D ansi                 ASCII/ANSI art
VF...D apng                 APNG (Animated Portable N
V....D arbc                 Gryphon's Anim Compressor
V....D argo                 Argonaut Games Video
V....D asv1                 ASUS V1
V....D asv2                 ASUS V2
```

```
V....D aura                Auravision AURA
V....D aura2               Auravision Aura 2
V..... libdav1d            dav1d AV1 decoder by Vide
V....D libaom-av1          libaom AV1 (codec av1)
V....D av1                 Alliance for Open Media A
V..... av1_cuvid           Nvidia CUVID AV1 decoder
V....D av1_qsv             AV1 video (Intel Quick Sy
                           ↳ acceleration) (codec av
V....D avrn                Avid AVI Codec
V....D avrp                Avid 1:1 10-bit RGB Packe
V....D avs                 AVS (Audio Video Standard
V..... libdavs2            libdavs2 AVS2-P2/IEEE1857
V....D libuavs3d           libuavs3d AVS3-P2/IEEE185
V....D avui                Avid Meridien Uncompresse
V....D ayuv                Uncompressed packed MS 4:
V....D bethsoftvid         Bethesda VID video
V....D bfi                 Brute Force & Ignorance
V....D binkvideo           Bink video
V....D bintext             Binary text
VF.... bitpacked           Bitpacked
V....D bmp                 BMP (Windows and OS/2 bit
V....D bmv_video           Discworld II BMV video
V....D brender_pix         BRender PIX image
V....D c93                 Interplay C93
V....D cavs                Chinese AVS (Audio Video

                           ↳ (AVS1-P2, JiZhun profil
V....D cdgraphics          CD Graphics video
V....D cdtoons             CDToons video
```

```
 V....D cdxl                 Commodore CDXL video
 VF...D cfhd                 GoPro CineForm HD
 V....D cinepak              Cinepak
 V....D clearvideo           Iterated Systems ClearVid
 V....D cljr                 Cirrus Logic AccuPak
 VF...D cllc                 Canopus Lossless Codec
 V....D eacmv                Electronic Arts CMV video
 V....D cpia                 CPiA video format
 VF...D cri                  Cintel RAW
 V....D camstudio            CamStudio (codec cscd)
 V....D cyuv                 Creative YUV (CYUV)
 V.S..D dds                  DirectDraw Surface image
 V....D dfa                  Chronomaster DFA
 V.S..D dirac                BBC Dirac VC-2
 VFS..D dnxhd                VC3/DNxHD
 V....D dpx                  DPX (Digital Picture Exch
 V....D dsicinvideo          Delphine Software Interna
 VFS..D dvvideo              DV (Digital Video)
 V....D dxa                  Feeble Files/ScummVM DXA
 VF...D dxtory               Dxtory
 VFS..D dxv                  Resolume DXV
 V....D escape124            Escape 124
 V....D escape130            Escape 130
 VFS..D exr                  OpenEXR image
 VFS..D ffv1                 FFmpeg video codec #1

 VF..BD ffvhuff              Huffyuv FFmpeg variant
 V.S..D fic                  Mirillis FIC
 V....D fits                 Flexible Image Transport
```

```
V....D flashsv              Flash Screen Video v1
V....D flashsv2             Flash Screen Video v2
V....D flic                 Autodesk Animator Flic vi
V...BD flv                  FLV / Sorenson Spark / So
                            ↳ H.263 (Flash Video) (co
V....D fmvc                 FM Screen Capture Codec
VF...D fraps                Fraps
V....D frwu                 Forward Uncompressed
V....D g2m                  Go2Meeting
V....D gdv                  Gremlin Digital Video
V....D gem                  GEM Raster image
V....D gif                  GIF (Graphics Interchange
V....D h261                 H.261
V...BD h263                 H.263 / H.263-1996, H.263
                            ↳ H.263-1998 / H.263 vers
V..... h263_v4l2m2m         V4L2 mem2mem H.263 decode
V...BD h263i                Intel H.263
V...BD h263p                H.263 / H.263-1996, H.263
                            ↳ H.263-1998 / H.263 vers
VFS..D h264                 H.264 / AVC / MPEG-4 AVC
V..... h264_v4l2m2m         V4L2 mem2mem H.264 decode
V....D h264_qsv             H264 video (Intel Quick S
                            ↳ acceleration) (codec h2
V..... h264_cuvid           Nvidia CUVID H264 decoder
VFS..D hap                  Vidvox Hap

VF...D hdr                  HDR (Radiance RGBE format
VFS..D hevc                 HEVC (High Efficiency Vid
V..... hevc_v4l2m2m         V4L2 mem2mem HEVC decoder
```

```
V....D hevc_qsv            HEVC video (Intel Quick S
                           ↳ acceleration) (codec he
V..... hevc_cuvid          Nvidia CUVID HEVC decoder
V....D hnm4video           HNM 4 video
V....D hq_hqa              Canopus HQ/HQA
VFS..D hqx                 Canopus HQX
VF..BD huffyuv             Huffyuv / HuffYUV
VF..BD hymt                HuffYUV MT
V....D idcinvideo          id Quake II CIN video (co
V....D idf                 iCEDraw text
V....D iff                 IFF ACBM/ANIM/DEEP/ILBM/P
                           ↳ RGBN (codeciff_ilbm)
V....D imm4                Infinity IMM4
V..... imm5                Infinity IMM5
V....D indeo2              Intel Indeo 2
V....D indeo3              Intel Indeo 3
V....D indeo4              Intel Indeo Video Interac
V....D indeo5              Intel Indeo Video Interac
V....D interplayvideo      Interplay MVE video
V....D ipu                 IPU Video
VFS..D jpeg2000            JPEG 2000
VF...D libopenjpeg         OpenJPEG JPEG 2000 (codec
V....D jpegls              JPEG-LS
V....D libjxl              libjxl JPEG XL (codec jpe
V....D jv                  Bitmap Brothers JV video

V....D kgv1                Kega Game Video
V....D kmvc                Karl Morton's video codec
VF...D lagarith            Lagarith lossless
```

```
V....D loco                     LOCO
V....D lscr                     LEAD Screen Capture
V....D m101                     Matrox Uncompressed SD
V....D eamad                    Electronic Arts Madcow Vi
VFS..D magicyuv                 MagicYUV video
VF...D mdec                     Sony PlayStation MDEC (Mo
VF...D mimic                    Mimic
V....D mjpeg                    MJPEG (Motion JPEG)
V..... mjpeg_cuvid              Nvidia CUVID MJPEG decode
V....D mjpeg_qsv                MJPEG video (Intel Quick
                                ↳ (codec mjpeg)
V....D mjpegb                   Apple MJPEG-B
V....D mmvideo                  American Laser Games MM V
V....D mobiclip                 MobiClip Video
V....D motionpixels             Motion Pixels video
V.S.BD mpeg1video               MPEG-1 video
V..... mpeg1_v4l2m2m            V4L2 mem2mem MPEG1 decode
V..... mpeg1_cuvid              Nvidia CUVID MPEG1VIDEO d
V.S.BD mpeg2video               MPEG-2 video
V.S.BD mpegvideo                MPEG-1 video (codec mpeg2
V..... mpeg2_v4l2m2m            V4L2 mem2mem MPEG2 decode
V....D mpeg2_qsv                MPEG2VIDEO video (Intel Q
                                ↳ (codec mpeg2video)
V..... mpeg2_cuvid              Nvidia CUVID MPEG2VIDEO d
VF..BD mpeg4                    MPEG-4 part 2

V..... mpeg4_v4l2m2m            V4L2 mem2mem MPEG4 decode
V..... mpeg4_cuvid              Nvidia CUVID MPEG4 decode
V....D msa1                     MS ATC Screen
```

```
 V....D mscc                 Mandsoft Screen Capture C
 V...BD msmpeg4v1            MPEG-4 part 2 Microsoft v
 V...BD msmpeg4v2            MPEG-4 part 2 Microsoft v
 V...BD msmpeg4              MPEG-4 part 2 Microsoft v
                             ↳ (codec msmpeg4v3)
 V....D msp2                 Microsoft Paint (MSP) ver
 V....D msrle                Microsoft RLE
 V....D mss1                 MS Screen 1
 V....D mss2                 MS Windows Media Video V9
 V....D msvideo1             Microsoft Video 1
 VF...D mszh                 LCL (LossLess Codec Libra
 V....D mts2                 MS Expression Encoder Scr
 V....D mv30                 MidiVid 3.0
 V....D mvc1                 Silicon Graphics Motion V
 V....D mvc2                 Silicon Graphics Motion V
 V....D mvdv                 MidiVid VQ
 V....D mvha                 MidiVid Archive Codec
 V....D mwsc                 MatchWare Screen Capture
 V....D mxpeg                Mobotix MxPEG video
 VF...D notchlc              NotchLC
 V....D nuv                  NuppelVideo/RTJPEG
 V....D paf_video            Amazing Studio Packed Ani
 V....D pam                  PAM (Portable AnyMap) ima
 V....D pbm                  PBM (Portable BitMap) ima
 V....D pcx                  PC Paintbrush PCX image

 V....D pfm                  PFM (Portable FloatMap) i
 V....D pgm                  PGM (Portable GrayMap) im
 V....D pgmyuv               PGMYUV (Portable GrayMap
```

```
 V....D pgx                  PGX (JPEG2000 Test Format
 V....D phm                  PHM (Portable HalfFloatMa
 VF...D photocd              Kodak Photo CD
 V....D pictor               Pictor/PC Paint
 VF...D pixlet               Apple Pixlet
 VF...D png                  PNG (Portable Network Gra
 V....D ppm                  PPM (Portable PixelMap) i
 VFS..D prores               Apple ProRes (iCodec Pro)
 V....D prosumer             Brooktree ProSumer Video
 VF...D psd                  Photoshop PSD file
 V....D ptx                  V.Flash PTX image
 V....D qdraw                Apple QuickDraw
 VF...D qoi                  QOI (Quite OK Image forma
 V....D qpeg                 Q-team QPEG
 V....D qtrle                QuickTime Animation (RLE)
 V....D r10k                 AJA Kona 10-bit RGB Codec
 V....D r210                 Uncompressed RGB 10-bit
 V....D rasc                 RemotelyAnywhere Screen C
 V..... rawvideo             raw video
 V....D rl2                  RL2 video
 V....D roqvideo             id RoQ video (codec roq)
 V....D rpza                 QuickTime video (RPZA)
 V....D rscc                 innoHeim/Rsupport Screen
 V....D rv10                 RealVideo 1.0
 V....D rv20                 RealVideo 2.0

 VF...D rv30                 RealVideo 3.0
 VF...D rv40                 RealVideo 4.0
 V....D sanm                 LucasArts SANM/Smush vide
```

```
V....D scpr                 ScreenPressor
V....D screenpresso         Screenpresso
V....D sga                  Digital Pictures SGA Vide
V....D sgi                  SGI image
V....D sgirle               Silicon Graphics RLE 8-bi
VF...D sheervideo           BitJazz SheerVideo
V....D simbiosis_imx        Simbiosis Interactive IMX
V....D smackvid             Smacker video (codec smac
V....D smc                  QuickTime Graphics (SMC)
V....D smvjpeg              SMV JPEG
V....D snow                 Snow
V....D sp5x                 Sunplus JPEG (SP5X)
V....D speedhq              NewTek SpeedHQ
V....D srgc                 Screen Recorder Gold Code
V....D sunrast              Sun Rasterfile image
V....D svq1                 Sorenson Vector Quantizer
V...BD svq3                 Sorenson Vector Quantizer
V....D targa                Truevision Targa image
V....D targa_y216           Pinnacle TARGA CineWave Y
V....D tdsc                 TDSC
V....D eatgq                Electronic Arts TGQ video
V....D eatgv                Electronic Arts TGV video
VF..BD theora               Theora
V....D thp                  Nintendo Gamecube THP vid
V....D tiertexseqvideo      Tiertex Limited SEQ video

VF...D tiff                 TIFF image
V....D tmv                  8088flex TMV
V....D eatqi                Electronic Arts TQI Video
```

```
V....D truemotion1          Duck TrueMotion 1.0
V....D truemotion2          Duck TrueMotion 2.0
V....D truemotion2rt        Duck TrueMotion 2.0 Real
V....D camtasia             TechSmith Screen Capture
V....D tscc2                TechSmith Screen Codec 2
V....D txd                  Renderware TXD (TeXture D
V....D ultimotion           IBM UltiMotion (codec ult
VF...D utvideo              Ut Video
VFS..D v210                 Uncompressed 4:2:2 10-bit
V....D v210x                Uncompressed 4:2:2 10-bit
V....D v308                 Uncompressed packed 4:4:4
V....D v408                 Uncompressed packed QT 4:
VFS..D v410                 Uncompressed 4:4:4 10-bit
V....D vb                   Beam Software VB
VF...D vble                 VBLE Lossless Codec
V.S..D vbn                  Vizrt Binary Image
V....D vc1                  SMPTE VC-1
V..... vc1_v4l2m2m          V4L2 mem2mem VC1 decoder
V....D vc1_qsv              VC1 video (Intel Quick Sy
                            ↳ acceleration) (codec vc
V..... vc1_cuvid            Nvidia CUVID VC1 decoder
V....D vc1image             Windows Media Video 9 Ima
V....D vcr1                 ATI VCR1
V....D xl                   Miro VideoXL (codec vixl)
V....D vmdvideo             Sierra VMD video

V....D vmnc                 VMware Screen Codec / VMw
VF..BD vp3                  On2 VP3
VF..BD vp4                  On2 VP4
```

```
V....D vp5                  On2 VP5
V....D vp6                  On2 VP6
V.S..D vp6a                 On2 VP6 (Flash version, w
V....D vp6f                 On2 VP6 (Flash version)
V....D vp7                  On2 VP7
VFS..D vp8                  On2 VP8
V..... vp8_v4l2m2m          V4L2 mem2mem VP8 decoder
V....D libvpx               libvpx VP8 (codec vp8)
V..... vp8_cuvid            Nvidia CUVID VP8 decoder
V....D vp8_qsv              VP8 video (Intel Quick Sy
                            ↳ acceleration) (codec vp
VFS..D vp9                  Google VP9
V..... vp9_v4l2m2m          V4L2 mem2mem VP9 decoder
V..... libvpx-vp9           libvpx VP9 (codec vp9)
V..... vp9_cuvid            Nvidia CUVID VP9 decoder
V....D vp9_qsv              VP9 video (Intel Quick Sy
                            ↳ (codec vp9)
VF...D wbmp                 WBMP (Wireless Applicatio
V....D wcmv                 WinCAM Motion Video
VF...D webp                 WebP image
V...BD wmv1                 Windows Media Video 7
V...BD wmv2                 Windows Media Video 8
V....D wmv3                 Windows Media Video 9
V....D wmv3image            Windows Media Video 9 Ima
V....D wnv1                 Winnov WNV1

V..... wrapped_avframe      AVPacket to AVFrame passt
V....D vqavideo             Westwood Studios VQA (Vec
                            ↳ (codec ws_vqa)
```

```
V....D xan_wc3              Wing Commander III / Xan
V....D xan_wc4              Wing Commander IV / Xxan
V....D xbin                 eXtended BINary text
V....D xbm                  XBM (X BitMap) image
V....D xface                X-face image
V....D xpm                  XPM (X PixMap) image
V....D xwd                  XWD (X Window Dump) image
V....D y41p                 Uncompressed YUV 4:1:1 12
VF...D ylc                  YUY2 Lossless Codec
V..... yop                  Psygnosis YOP Video
V....D yuv4                 Uncompressed packed 4:2:0
V....D zerocodec            ZeroCodec Lossless Video
VF...D zlib                 LCL (LossLess Codec Libra
V....D zmbv                 Zip Motion Blocks Video
A....D 8svx_exp             8SVX exponential
A....D 8svx_fib             8SVX fibonacci
A....D aac                  AAC (Advanced Audio Codin
A....D aac_fixed            AAC (Advanced Audio Codin
A....D libfdk_aac           Fraunhofer FDK AAC (codec
A....D aac_latm             AAC LATM (Advanced Audio
A....D ac3                  ATSC A/52A (AC-3)
A....D ac3_fixed            ATSC A/52A (AC-3) (codec
A....D acelp.kelvin         Sipro ACELP.KELVIN
A....D adpcm_4xm            ADPCM 4X Movie
A....D adpcm_adx            SEGA CRI ADX ADPCM

A....D adpcm_afc            ADPCM Nintendo Gamecube A
A....D adpcm_agm            ADPCM AmuseGraphics Movie
A....D adpcm_aica           ADPCM Yamaha AICA
```

```
 A....D adpcm_argo           ADPCM Argonaut Games
 A....D adpcm_ct             ADPCM Creative Technology
 A....D adpcm_dtk            ADPCM Nintendo Gamecube D
 A....D adpcm_ea             ADPCM Electronic Arts
 A....D adpcm_ea_maxis_xa    ADPCM Electronic Arts Max
 A....D adpcm_ea_r1          ADPCM Electronic Arts R1
 A....D adpcm_ea_r2          ADPCM Electronic Arts R2
 A....D adpcm_ea_r3          ADPCM Electronic Arts R3
 A....D adpcm_ea_xas         ADPCM Electronic Arts XAS
 A....D g722                 G.722 ADPCM (codec adpcm_
 A....D g726                 G.726 ADPCM (codec adpcm_
 A....D g726le               G.726 ADPCM little-endian
 A....D adpcm_ima_acorn      ADPCM IMA Acorn Replay
 A....D adpcm_ima_alp        ADPCM IMA High Voltage So
 A....D adpcm_ima_amv        ADPCM IMA AMV
 A....D adpcm_ima_apc        ADPCM IMA CRYO APC
 A....D adpcm_ima_apm        ADPCM IMA Ubisoft APM
 A....D adpcm_ima_cunning    ADPCM IMA Cunning Develop
 A....D adpcm_ima_dat4       ADPCM IMA Eurocom DAT4
 A....D adpcm_ima_dk3        ADPCM IMA Duck DK3
 A....D adpcm_ima_dk4        ADPCM IMA Duck DK4
 A....D adpcm_ima_ea_eacs    ADPCM IMA Electronic Arts
 A....D adpcm_ima_ea_sead    ADPCM IMA Electronic Arts
 A....D adpcm_ima_iss        ADPCM IMA Funcom ISS
 A....D adpcm_ima_moflex     ADPCM IMA MobiClip MOFLEX

 A....D adpcm_ima_mtf        ADPCM IMA Capcom's MT Fra
 A....D adpcm_ima_oki        ADPCM IMA Dialogic OKI
 A....D adpcm_ima_qt         ADPCM IMA QuickTime
```

```
 A....D adpcm_ima_rad        ADPCM IMA Radical
 A....D adpcm_ima_smjpeg     ADPCM IMA Loki SDL MJPEG
 A....D adpcm_ima_ssi        ADPCM IMA Simon & Schuste
 A....D adpcm_ima_wav        ADPCM IMA WAV
 A....D adpcm_ima_ws         ADPCM IMA Westwood
 A....D adpcm_ms             ADPCM Microsoft
 A....D adpcm_mtaf           ADPCM MTAF
 A....D adpcm_psx            ADPCM Playstation
 A....D adpcm_sbpro_2        ADPCM Sound Blaster Pro 2
 A....D adpcm_sbpro_3        ADPCM Sound Blaster Pro 2
 A....D adpcm_sbpro_4        ADPCM Sound Blaster Pro 4
 A....D adpcm_swf            ADPCM Shockwave Flash
 A....D adpcm_thp            ADPCM Nintendo THP
 A....D adpcm_thp_le         ADPCM Nintendo THP (littl
 A....D adpcm_vima           LucasArts VIMA audio
 A....D adpcm_xa             ADPCM CDROM XA
 A....D adpcm_yamaha         ADPCM Yamaha
 A....D adpcm_zork           ADPCM Zork
 AF...D alac                 ALAC (Apple Lossless Audi
 A....D amrnb                AMR-NB (Adaptive Multi-Ra
 A....D libopencore_amrnb    OpenCORE AMR-NB (Adaptive
                             ↳ (codec amr_nb)
 A....D amrwb                AMR-WB (Adaptive Multi-Ra
 A....D libopencore_amrwb    OpenCORE AMR-WB (Adaptive
                             ↳ (codec amr_wb)

 A....D ape                  Monkey's Audio
 A....D aptx                 aptX (Audio Processing Te
 A....D aptx_hd              aptX HD (Audio Processing
```

```
A....D atrac1               ATRAC1 (Adaptive TRansfor
A....D atrac3               ATRAC3 (Adaptive TRansfor
A....D atrac3al             ATRAC3 AL (Adaptive TRans
                            ↳ Advanced Lossless)
A....D atrac3plus           ATRAC3+ (Adaptive TRansfo
                            ↳ (codec atrac3p)
A....D atrac3plusal         ATRAC3+ AL (Adaptive TRan
                            ↳ Advanced Lossless) (cod
A....D atrac9               ATRAC9 (Adaptive TRansfor
A....D on2avc               On2 Audio for Video Codec
A....D binkaudio_dct        Bink Audio (DCT)
A....D binkaudio_rdft       Bink Audio (RDFT)
A....D bmv_audio            Discworld II BMV audio
A....D comfortnoise         RFC 3389 comfort noise ge
A....D cook                 Cook / Cooker / Gecko (Re
A....D derf_dpcm            DPCM Xilam DERF
A....D dfpwm                DFPWM1a audio
A....D dolby_e              Dolby E
A.S..D dsd_lsbf             DSD (Direct Stream Digita
                            ↳ significant bit first
A.S..D dsd_lsbf_planar      DSD (Direct Stream Digita
                            ↳ significant bit first,
A.S..D dsd_msbf             DSD (Direct Stream Digita
                            ↳ significant bit first
A.S..D dsd_msbf_planar      DSD (Direct Stream Digita

                            ↳ significant bit first,
A....D dsicinaudio          Delphine Software Interna
A....D dss_sp               Digital Speech Standard -
```

```
A....D dst                  DST (Digital Stream Trans
A....D dca                  DCA (DTS Coherent Acousti
A....D dvaudio              Ulead DV Audio
A....D eac3                 ATSC A/52B (AC-3, E-AC-3)
A....D evrc                 EVRC (Enhanced Variable R
A....D fastaudio            MobiClip FastAudio
AF...D flac                 FLAC (Free Lossless Audio
A....D g723_1               G.723.1
A....D g729                 G.729
A....D gremlin_dpcm         DPCM Gremlin
A....D gsm                  GSM
A....D libgsm               libgsm GSM (codec gsm)
A....D gsm_ms               GSM Microsoft variant
A....D libgsm_ms            libgsm GSM Microsoft vari
A....D hca                  CRI HCA
A....D hcom                 HCOM Audio
A....D iac                  IAC (Indeo Audio Coder)
A....D ilbc                 iLBC (Internet Low Bitrat
A....D libilbc              iLBC (Internet Low Bitrat
A....D imc                  IMC (Intel Music Coder)
A....D interplay_dpcm       DPCM Interplay
A....D interplayacm         Interplay ACM
A....D mace3                MACE (Macintosh Audio Com
A....D mace6                MACE (Macintosh Audio Com
A....D metasound            Voxware MetaSound

A....D mlp                  MLP (Meridian Lossless Pa
A....D mp1                  MP1 (MPEG audio layer 1)
A....D mp1float             MP1 (MPEG audio layer 1)
```

```
A....D mp2                  MP2 (MPEG audio layer 2)
A....D mp2float             MP2 (MPEG audio layer 2)
A....D mp3float             MP3 (MPEG audio layer 3)
A....D mp3                  MP3 (MPEG audio layer 3)
A....D mp3adufloat          ADU (Application Data Uni
                            ↳ (codec mp3adu)
A....D mp3adu               ADU (Application Data Uni
A....D mp3on4float          MP3onMP4 (codec mp3on4)
A....D mp3on4               MP3onMP4
A....D als                  MPEG-4 Audio Lossless Cod
A....D msnsiren             MSN Siren
A....D mpc7                 Musepack SV7 (codec musep
A....D mpc8                 Musepack SV8 (codec musep
A....D nellymoser           Nellymoser Asao
A....D opus                 Opus
A....D libopus              libopus Opus (codec opus)
A....D paf_audio            Amazing Studio Packed Ani
A....D pcm_alaw             PCM A-law / G.711 A-law
A....D pcm_bluray           PCM signed 16|20|24-bit b
A....D pcm_dvd              PCM signed 16|20|24-bit b
A....D pcm_f16le            PCM 16.8 floating point l
A....D pcm_f24le            PCM 24.0 floating point l
A....D pcm_f32be            PCM 32-bit floating point
A....D pcm_f32le            PCM 32-bit floating point
A....D pcm_f64be            PCM 64-bit floating point

A....D pcm_f64le            PCM 64-bit floating point
A....D pcm_lxf              PCM signed 20-bit little-
A....D pcm_mulaw            PCM mu-law / G.711 mu-law
```

```
  A....D pcm_s16be            PCM signed 16-bit big-end
  A....D pcm_s16be_planar     PCM signed 16-bit big-end
  A....D pcm_s16le            PCM signed 16-bit little-
  A....D pcm_s16le_planar     PCM signed 16-bit little-
  A....D pcm_s24be            PCM signed 24-bit big-end
  A....D pcm_s24daud          PCM D-Cinema audio signed
  A....D pcm_s24le            PCM signed 24-bit little-
  A....D pcm_s24le_planar     PCM signed 24-bit little-
  A....D pcm_s32be            PCM signed 32-bit big-end
  A....D pcm_s32le            PCM signed 32-bit little-
  A....D pcm_s32le_planar     PCM signed 32-bit little-
  A....D pcm_s64be            PCM signed 64-bit big-end
  A....D pcm_s64le            PCM signed 64-bit little-
  A....D pcm_s8               PCM signed 8-bit
  A....D pcm_s8_planar        PCM signed 8-bit planar
  A....D pcm_sga              PCM SGA
  A....D pcm_u16be            PCM unsigned 16-bit big-e
  A....D pcm_u16le            PCM unsigned 16-bit littl
  A....D pcm_u24be            PCM unsigned 24-bit big-e
  A....D pcm_u24le            PCM unsigned 24-bit littl
  A....D pcm_u32be            PCM unsigned 32-bit big-e
  A....D pcm_u32le            PCM unsigned 32-bit littl
  A....D pcm_u8               PCM unsigned 8-bit
  A....D pcm_vidc             PCM Archimedes VIDC
  A....D qcelp                QCELP / PureVoice

  A....D qdm2                 QDesign Music Codec 2
  A....D qdmc                 QDesign Music Codec 1
  A....D real_144             RealAudio 1.0 (14.4K) (co
```

```
A....D real_288             RealAudio 2.0 (28.8K) (co
A....D ralf                 RealAudio Lossless
A....D roq_dpcm             DPCM id RoQ
A....D s302m                SMPTE 302M
A....D sbc                  SBC (low-complexity subba
A....D sdx2_dpcm            DPCM Squareroot-Delta-Exa
A....D shorten              Shorten
A....D sipr                 RealAudio SIPR / ACELP.NE
A....D siren                Siren
A....D smackaud             Smacker audio (codec smac
A....D sol_dpcm             DPCM Sol
A..X.D sonic                Sonic
A....D speex                Speex
A....D libspeex             libspeex Speex (codec spe
AF...D tak                  TAK (Tom's lossless Audio
A....D truehd               TrueHD
A....D truespeech           DSP Group TrueSpeech
AF...D tta                  TTA (True Audio)
A....D twinvq               VQF TwinVQ
A....D vmdaudio             Sierra VMD audio
A....D vorbis               Vorbis
A..... libvorbis            libvorbis (codec vorbis)
A....D wavesynth            Wave synthesis pseudo-cod
AFS..D wavpack              WavPack
A....D ws_snd1              Westwood Audio (SND1) (co

A....D wmalossless          Windows Media Audio Lossl
A....D wmapro               Windows Media Audio 9 Pro
A....D wmav1                Windows Media Audio 1
```

```
 A....D wmav2                Windows Media Audio 2
 A....D wmavoice             Windows Media Audio Voice
 A....D xan_dpcm             DPCM Xan
 A....D xma1                 Xbox Media Audio 1
 A....D xma2                 Xbox Media Audio 2
 S..... ssa                  ASS (Advanced SubStation
 S..... ass                  ASS (Advanced SubStation
 S..... dvbsub               DVB subtitles (codec dvb_
 S..... libzvbi_teletextdec  Libzvbi DVB teletext deco
 S..... dvdsub               DVD subtitles (codec dvd_
 S..... cc_dec               Closed Caption (EIA-608 /
 S..... pgssub               HDMV Presentation Graphic
                             ↳ hdmv_pgs_subtitle)
 S..... jacosub              JACOsub subtitle
 S..... microdvd             MicroDVD subtitle
 S..... mov_text             3GPP Timed Text subtitle
 S..... mpl2                 MPL2 subtitle
 S..... pjs                  PJS subtitle
 S..... realtext             RealText subtitle
 S..... sami                 SAMI subtitle
 S..... stl                  Spruce subtitle format
 S..... srt                  SubRip subtitle (codec su
 S..... subrip               SubRip subtitle
 S..... subviewer            SubViewer subtitle
 S..... subviewer1           SubViewer1 subtitle

 S..... text                 Raw text subtitle
 S..... vplayer              VPlayer subtitle
 S..... webvtt               WebVTT subtitle
```

```
S..... xsub                    XSUB
```

Annexure 3: Sample List of Encoders

This annexure contains sample output for the command `ffmpeg -encoders`.

```
Encoders:
V..... = Video
A..... = Audio
S..... = Subtitle
.F.... = Frame-level multithreading
..S... = Slice-level multithreading
...X.. = Codec is experimental
....B. = Supports draw_horiz_band
.....D = Supports direct rendering method 1
------
V....D a64multi                Multicolor charset for Co
V....D a64multi5               Multicolor charset for Co
                               ↳ 5th color (colram) (cod
V....D alias_pix               Alias/Wavefront PIX image
V..... amv                     AMV Video
V....D apng                    APNG (Animated Portable N

V....D asv1                    ASUS V1
V....D asv2                    ASUS V2
V....D libaom-av1              libaom AV1 (codec av1)
```

```
 V....D librav1e             librav1e AV1 (codec av1)
 V..... libsvtav1            SVT-AV1(Scalable Video Te
                             ↳ encoder (codec av1)
 V....D avrp                 Avid 1:1 10-bit RGB Packe
 V....D libxavs2             libxavs2 AVS2-P2/IEEE1857
 V..X.D avui                 Avid Meridien Uncompresse
 V....D ayuv                 Uncompressed packed MS 4:
 VF...D bitpacked            Bitpacked
 V....D bmp                  BMP (Windows and OS/2 bit
 VF...D cfhd                 GoPro CineForm HD
 V....D cinepak              Cinepak
 V....D cljr                 Cirrus Logic AccuPak
 V.S..D vc2                  SMPTE VC-2 (codec dirac)
 VFS..D dnxhd                VC3/DNxHD
 V....D dpx                  DPX (Digital Picture Exch
 VFS..D dvvideo              DV (Digital Video)
 VF...D exr                  OpenEXR image
 V.S..D ffv1                 FFmpeg video codec #1
 VF...D ffvhuff              Huffyuv FFmpeg variant
 V....D fits                 Flexible Image Transport
 V....D flashsv              Flash Screen Video
 V....D flashsv2             Flash Screen Video Versio
 V..... flv                  FLV / Sorenson Spark / So
                             ↳ (codec flv1)
 V....D gif                  GIF (Graphics Interchange

 V..... h261                 H.261
 V..... h263                 H.263 / H.263-1996
 V..... h263_v4l2m2m         V4L2 mem2mem H.263 encode
```

```
 V.S... h263p                H.263+ / H.263-1998 / H.2
 V....D libx264              libx264 H.264 / AVC / MPE
                             ↳ / MPEG-4 part 10 (codec
 V....D libx264rgb           libx264 H.264 / AVC / MPE
                             ↳ / MPEG-4 part 10 RGB (c
 V..... h264_v4l2m2m         V4L2 mem2mem H.264 encode
 V....D h264_vaapi           H.264/AVC (VAAPI) (codec 
 V....D h264_amf             AMD AMF H.264 Encoder (co
 V....D h264_mf              H264 via MediaFoundation 
 V....D h264_nvenc           NVIDIA NVENC H.264 encode
 V..... h264_qsv             H.264 / AVC / MPEG-4 AVC 
                             ↳ Sync Video acceleration
 V.S..D hap                  Vidvox Hap
 VF...D hdr                  HDR (Radiance RGBE format
 V....D libx265              libx265 H.265 / HEVC (cod
 V..... hevc_v4l2m2m         V4L2 mem2mem HEVC encoder
 V....D hevc_vaapi           H.265/HEVC (VAAPI) (codec
 V....D hevc_amf             AMD AMF HEVC encoder (cod
 V....D hevc_mf              HEVC via MediaFoundation 
 V....D hevc_nvenc           NVIDIA NVENC hevc encoder
 V..... hevc_qsv             HEVC (Intel Quick Sync Vi
                             ↳ acceleration) (codec he
 VF...D huffyuv              Huffyuv / HuffYUV
 V....D jpeg2000             JPEG 2000
 VF.... libopenjpeg          OpenJPEG JPEG 2000 (codec

 VF...D jpegls               JPEG-LS
 V..... libjxl               libjxl JPEG XL (codec jpe
 VF...D ljpeg                Lossless JPEG
```

```
VF...D magicyuv             MagicYUV video
VFS... mjpeg                MJPEG (Motion JPEG)
V....D mjpeg_vaapi          MJPEG (VAAPI) (codec mjpe
V..... mjpeg_qsv            MJPEG (Intel Quick Sync V
V.S... mpeg1video           MPEG-1 video
V.S... mpeg2video           MPEG-2 video
V....D mpeg2_vaapi          MPEG-2 (VAAPI) (codec mpe
V..... mpeg2_qsv            MPEG-2 video (Intel Quick
                            ↳ (codec mpeg2video)
V.S... mpeg4                MPEG-4 part 2
V....D libxvid              libxvidcore MPEG-4 part 2
V..... mpeg4_v4l2m2m        V4L2 mem2mem MPEG4 encode
V..... msmpeg4v2            MPEG-4 part 2 Microsoft v
V..... msmpeg4              MPEG-4 part 2 Microsoft v
V..... msvideo1             Microsoft Video-1
V....D pam                  PAM (Portable AnyMap) ima
V....D pbm                  PBM (Portable BitMap) ima
V....D pcx                  PC Paintbrush PCX image
V....D pfm                  PFM (Portable FloatMap) i
V....D pgm                  PGM (Portable GrayMap) im
V....D pgmyuv               PGMYUV (Portable GrayMap
V....D phm                  PHM (Portable HalfFloatMa
VF...D png                  PNG (Portable Network Gra
V....D ppm                  PPM (Portable PixelMap) i
VF...D prores               Apple ProRes

VF...D prores_aw            Apple ProRes (codec prore
VFS... prores_ks            Apple ProRes (iCodec Pro)
VF...D qoi                  QOI (Quite OK Image forma
```

```
 V....D qtrle                QuickTime Animation (RLE)
 V....D r10k                 AJA Kona 10-bit RGB Codec
 V....D r210                 Uncompressed RGB 10-bit
 VF...D rawvideo             raw video
 V....D roqvideo             id RoQ video (codec roq)
 V....D rpza                 QuickTime video (RPZA)
 V..... rv10                 RealVideo 1.0
 V..... rv20                 RealVideo 2.0
 V....D sgi                  SGI image
 V....D smc                  QuickTime Graphics (SMC)
 V....D snow                 Snow
 V..... speedhq              NewTek SpeedHQ
 V....D sunrast              Sun Rasterfile image
 V....D svq1                 Sorenson Vector Quantizer
 V....D targa                Truevision Targa image
 V....D libtheora            libtheora Theora (codec t
 VF...D tiff                 TIFF image
 VF...D utvideo              Ut Video
 VF...D v210                 Uncompressed 4:2:2 10-bit
 V....D v308                 Uncompressed packed 4:4:4
 V....D v408                 Uncompressed packed QT 4:
 V....D v410                 Uncompressed 4:4:4 10-bit
 V.S..D vbn                  Vizrt Binary Image
 V....D libvpx               libvpx VP8 (codec vp8)
 V..... vp8_v4l2m2m          V4L2 mem2mem VP8 encoder

 V....D vp8_vaapi            VP8 (VAAPI) (codec vp8)
 V....D libvpx-vp9           libvpx VP9 (codec vp9)
 V....D vp9_vaapi            VP9 (VAAPI) (codec vp9)
```

```
V..... vp9_qsv              VP9 video (Intel Quick Sy
                            ↳ acceleration) (codec vp
VF...D wbmp                 WBMP (Wireless Applicatio
V....D libwebp_anim         libwebp WebP image (codec
V....D libwebp              libwebp WebP image (codec
V..... wmv1                 Windows Media Video 7
V..... wmv2                 Windows Media Video 8
V..... wrapped_avframe      AVFrame to AVPacket passt
V....D xbm                  XBM (X BitMap) image
V....D xface                X-face image
V....D xwd                  XWD (X Window Dump) image
V....D y41p                 Uncompressed YUV 4:1:1 12
V....D yuv4                 Uncompressed packed 4:2:0
VF...D zlib                 LCL (LossLess Codec Libra
V....D zmbv                 Zip Motion Blocks Video
A....D aac                  AAC (Advanced Audio Codin
A....D libfdk_aac           Fraunhofer FDK AAC (codec
A....D aac_mf               AAC via MediaFoundation (
A....D ac3                  ATSC A/52A (AC-3)
A....D ac3_fixed            ATSC A/52A (AC-3) (codec
A....D ac3_mf               AC3 via MediaFoundation (
A....D adpcm_adx            SEGA CRI ADX ADPCM
A....D adpcm_argo           ADPCM Argonaut Games
A....D g722                 G.722 ADPCM (codec adpcm_
A....D g726                 G.726 ADPCM (codec adpcm_

A....D g726le               G.726 little endian ADPCM
                            ↳ (codec adpcm_g726le)
A....D adpcm_ima_alp        ADPCM IMA High Voltage So
```

```
A....D adpcm_ima_amv        ADPCM IMA AMV
A....D adpcm_ima_apm        ADPCM IMA Ubisoft APM
A....D adpcm_ima_qt         ADPCM IMA QuickTime
A....D adpcm_ima_ssi        ADPCM IMA Simon & Schuste
A....D adpcm_ima_wav        ADPCM IMA WAV
A....D adpcm_ima_ws         ADPCM IMA Westwood
A....D adpcm_ms             ADPCM Microsoft
A....D adpcm_swf            ADPCM Shockwave Flash
A....D adpcm_yamaha         ADPCM Yamaha
A....D alac                 ALAC (Apple Lossless Audi
A....D libopencore_amrnb    OpenCORE AMR-NB (Adaptive
                            ↳ (codec amr_nb)
A....D libvo_amrwbenc       Android VisualOn AMR-WB (
                            ↳ (codec amr_wb)
A....D aptx                 aptX (Audio Processing Te
A....D aptx_hd              aptX HD (Audio Processing
A....D comfortnoise         RFC 3389 comfort noise ge
A....D dfpwm                DFPWM1a audio
A..X.D dca                  DCA (DTS Coherent Acousti
A....D eac3                 ATSC A/52 E-AC-3
A....D flac                 FLAC (Free Lossless Audio
A....D g723_1               G.723.1
A....D libgsm               libgsm GSM (codec gsm)
A....D libgsm_ms            libgsm GSM Microsoft vari
A....D libilbc              iLBC (Internet Low Bitrat

A..X.D mlp                  MLP (Meridian Lossless Pa
A....D mp2                  MP2 (MPEG audio layer 2)
A....D mp2fixed             MP2 fixed point (MPEG aud
```

```
 A....D libtwolame           libtwolame MP2 (MPEG audi
 A....D libmp3lame           libmp3lame MP3 (MPEG audi
 A....D libshine             libshine MP3 (MPEG audio 
 A....D mp3_mf               MP3 via MediaFoundation (
 A....D nellymoser           Nellymoser Asao
 A..X.D opus                 Opus
 A....D libopus              libopus Opus (codec opus)
 A....D pcm_alaw             PCM A-law / G.711 A-law
 A....D pcm_bluray           PCM signed 16|20|24-bit b
 A....D pcm_dvd              PCM signed 16|20|24-bit b
 A....D pcm_f32be            PCM 32-bit floating point
 A....D pcm_f32le            PCM 32-bit floating point
 A....D pcm_f64be            PCM 64-bit floating point
 A....D pcm_f64le            PCM 64-bit floating point
 A....D pcm_mulaw            PCM mu-law / G.711 mu-law
 A....D pcm_s16be            PCM signed 16-bit big-end
 A....D pcm_s16be_planar     PCM signed 16-bit big-end
 A....D pcm_s16le            PCM signed 16-bit little-
 A....D pcm_s16le_planar     PCM signed 16-bit little-
 A....D pcm_s24be            PCM signed 24-bit big-end
 A....D pcm_s24daud          PCM D-Cinema audio signed
 A....D pcm_s24le            PCM signed 24-bit little-
 A....D pcm_s24le_planar     PCM signed 24-bit little-
 A....D pcm_s32be            PCM signed 32-bit big-end
 A....D pcm_s32le            PCM signed 32-bit little-

 A....D pcm_s32le_planar     PCM signed 32-bit little-
 A....D pcm_s64be            PCM signed 64-bit big-end
 A....D pcm_s64le            PCM signed 64-bit little-
```

```
  A....D pcm_s8               PCM signed 8-bit
  A....D pcm_s8_planar        PCM signed 8-bit planar
  A....D pcm_u16be            PCM unsigned 16-bit big-e
  A....D pcm_u16le            PCM unsigned 16-bit littl
  A....D pcm_u24be            PCM unsigned 24-bit big-e
  A....D pcm_u24le            PCM unsigned 24-bit littl
  A....D pcm_u32be            PCM unsigned 32-bit big-e
  A....D pcm_u32le            PCM unsigned 32-bit littl
  A....D pcm_u8               PCM unsigned 8-bit
  A....D pcm_vidc             PCM Archimedes VIDC
  A....D real_144             RealAudio 1.0 (14.4K) (co
  A....D roq_dpcm             id RoQ DPCM
  A..X.D s302m                SMPTE 302M
  A....D sbc                  SBC (low-complexity subba
  A..X.D sonic                Sonic
  A..X.D sonicls              Sonic lossless
  A....D libspeex             libspeex Speex (codec spe
  A..X.D truehd               TrueHD
  A....D tta                  TTA (True Audio)
  A..X.D vorbis               Vorbis
  A....D libvorbis            libvorbis (codec vorbis)
  A....D wavpack              WavPack
  A....D wmav1                Windows Media Audio 1
  A....D wmav2                Windows Media Audio 2
  S..... ssa                  ASS (Advanced SubStation

  S..... ass                  ASS (Advanced SubStation
  S..... dvbsub               DVB subtitles (codec dvb_
  S..... dvdsub               DVD subtitles (codec dvd_
```

```
S..... mov_text             3GPP Timed Text subtitle
S..... srt                  SubRip subtitle (codec su
S..... subrip               SubRip subtitle
S..... text                 Raw text subtitle
S..... ttml                 TTML subtitle
S..... webvtt               WebVTT subtitle
S..... xsub                 DivX subtitles (XSUB)
```

Annexure 4: Sample List of Filters

This annexure contains sample output for the command `ffmpeg -filters`.

```
Filters:
T.. = Timeline support
.S. = Slice threading
..C = Command support
A = Audio input/output
V = Video input/output
N = Dynamic number and/or type of input/output
| = Source or sink filter
... abench            A->A       Benchmark part of a
..C acompressor       A->A       Audio compressor

... acontrast         A->A       Simple audio dynamic
                                 ↳ expansion filter
... acopy             A->A       Copy the input audio
```

```
... acue              A->A      Delay filtering to m
... acrossfade        AA->A     Cross fade two input
.S. acrossover        A->N      Split audio into per
T.C acrusher          A->A      Reduce audio bit res
TS. adeclick          A->A      Remove impulsive noi
TS. adeclip           A->A      Remove clipping from
TS. adecorrelate      A->A      Apply decorrelation 
T.C adelay            A->A      Delay one or more au
TSC adenorm           A->A      Remedy denormals by 
T.. aderivative       A->A      Compute derivative o
TSC adynamicequalizer A->A      Apply Dynamic Equali
T.C adynamicsmooth    A->A      Apply Dynamic Smooth
... aecho             A->A      Add echoing to the a
TSC aemphasis         A->A      Audio emphasis
T.. aeval             A->A      Filter audio signal 
                                ↳ expression
T.C aexciter          A->A      Enhance high frequen
T.C afade             A->A      Fade in/out input au
TSC afftdn            A->A      Denoise audio sample
TS. afftfilt          A->A      Apply arbitrary expr
                                ↳ frequency domain
.SC afir              N->N      Apply Finite Impulse
                                ↳ coefficients in ad
... aformat           A->A      Convert the input au
                                ↳ specified formats

TSC afreqshift        A->A      Apply frequency shif
TSC afwtdn            A->A      Denoise audio stream
T.C agate             A->A      Audio gate
```

```
.S. aiir              A->N      Apply Infinite Impul
                                ↳ with supplied coef
T.. aintegral         A->A      Compute integral of 
... ainterleave       N->A      Temporally interleav
T.. alatency          A->A      Report audio filteri
T.C alimiter          A->A      Audio lookahead limi
TSC allpass           A->A      Apply a two-pole all
... aloop             A->A      Loop audio samples
... amerge            N->A      Merge two or more au
                                ↳ single multi-chann
T.. ametadata         A->A      Manipulate audio fra
..C amix              N->A      Audio mixing
... amultiply         AA->A     Multiply two audio s
TSC anequalizer       A->N      Apply high-order aud
                                ↳ equalizer
TSC anlmdn            A->A      Reduce broadband noi
                                ↳ stream using Non-L
TSC anlmf             AA->A     Apply Normalized Lea
                                ↳ first audio stream
TSC anlms             AA->A     Apply Normalized Lea
                                ↳ first audio stream
... anull             A->A      Pass the source unch
T.. apad              A->A      Pad audio with silen
T.C aperms            A->A      Set permissions for 
... aphaser           A->A      Add a phasing effect

TSC aphaseshift       A->A      Apply phase shifting
TSC apsyclip          A->A      Audio Psychoacoustic
... apulsator         A->A      Audio pulsator
```

```
..C arealtime        A->A       Slow down filtering
... aresample        A->A       Resample audio data
... areverse         A->A       Reverse an audio cli
TSC arnndn           A->A       Reduce noise from sp
                                ↳ Networks
... asdr             AA->A      Measure Audio Signal
... asegment         A->N       Segment audio stream
... aselect          A->N       Select audio frames
... asendcmd         A->A       Send commands to fil
... asetnsamples     A->A       Set the number of sa
                                ↳ frames
... asetpts          A->A       Set PTS for the outp
... asetrate         A->A       Change the sample ra
... asettb           A->A       Set timebase for the
... ashowinfo        A->A       Show textual informa
T.. asidedata        A->A       Manipulate audio fra
TSC asoftclip        A->A       Audio Soft Clipper
.S. aspectralstats   A->A       Show frequency domai
... asplit           A->N       Pass on the audio in
.S. astats           A->A       Show time domain sta
..C astreamselect    N->N       Select audio streams
TSC asubboost        A->A       Boost subwoofer freq
TSC asubcut          A->A       Cut subwoofer freque
TSC asupercut        A->A       Cut super frequencie
TSC asuperpass       A->A       Apply high order But

TSC asuperstop       A->A       Apply high order But
..C atempo           A->A       Adjust audio tempo
TSC atilt            A->A       Apply spectral tilt
```

```
... atrim              A->A       Pick one continuous
                                  ↳ drop the rest
... axcorrelate        AA->A      Cross-correlate two
... azmq               A->A       Receive commands thr
                                  ↳ them to filters
TSC bandpass           A->A       Apply a two-pole But
TSC bandreject         A->A       Apply a two-pole But
TSC bass               A->A       Boost or cut lower f
TSC biquad             A->A       Apply a biquad IIR f
                                  ↳ coefficients
... bs2b               A->A        Bauer stereo-to-bin
... channelmap         A->A       Remap audio channels
... channelsplit       A->N       Split audio into per
... chorus             A->A       Add a chorus effect
... compand            A->A       Compress or expand a
T.C compensationdelay A->A       Audio Compensation D
T.C crossfeed          A->A       Apply headphone cros
TSC crystalizer        A->A       Simple audio noise s
T.. dcshift            A->A       Apply a DC shift to
T.. deesser            A->A       Apply de-essing to t
T.C dialoguenhance     A->A       Audio Dialogue Enhan
... drmeter            A->A       Measure audio dynami
T.C dynaudnorm         A->A       Dynamic Audio Normal
... earwax             A->A       Widen the stereo ima
... ebur128            A->N       EBU R128 scanner

TSC equalizer          A->A       Apply two-pole peaki
T.C extrastereo        A->A       Increase difference
..C firequalizer       A->A       Finite Impulse Respo
```

```
 ... flanger          A->A       Apply a flanging eff
 ... haas             A->A       Apply Haas Stereo En
 ... hdcd             A->A       Apply High Definitio
                                 ↳ decoding
 .S. headphone        N->A       Apply headphone bina
                                 ↳ in additional stre
 TSC highpass         A->A       Apply a high-pass fi
 TSC highshelf        A->A       Apply a high shelf f
 ... join             N->A       Join multiple audio 
                                 ↳ output
 ..C ladspa           N->A       Apply LADSPA effect 
 ... loudnorm         A->A       EBU R128 loudness no
 TSC lowpass          A->A       Apply a low-pass fil
 TSC lowshelf         A->A       Apply a low shelf fi
 ... mcompand         A->A       Multiband Compress o
 ... pan              A->A       Remix channels with 
 ... replaygain       A->A       ReplayGain scanner
 ..C rubberband       A->A       Apply time-stretchin
 ..C sidechaincompress AA->A     Sidechain compressor
 T.C sidechaingate    AA->A      Audio sidechain gate
 ... silencedetect    A->A       Detect silence
 ... silenceremove    A->A       Remove silence
 .S. sofalizer        A->A       SOFAlizer (Spatially
 T.C speechnorm       A->A       Speech Normalizer
 T.C stereotools      A->A       Apply various stereo

 T.C stereowiden      A->A       Apply stereo widenin
 ... superequalizer   A->A       Apply 18 band equali
 .S. surround         A->A       Apply audio surround
```

```
 TSC tiltshelf         A->A       Apply a tilt shelf f
 TSC treble            A->A       Boost or cut upper f
 T.. tremolo           A->A       Apply tremolo effect
 T.. vibrato           A->A       Apply vibrato effect
 T.C virtualbass       A->A       Audio Virtual Bass
 T.C volume            A->A       Change input volume
 ... volumedetect      A->A       Detect audio volume
 ... aevalsrc          |->A       Generate an audio si
 ... afirsrc           |->A       Generate a FIR coeff
 ... anoisesrc         |->A       Generate a noise aud
 ... anullsrc          |->A       Null audio source, r
 ... flite             |->A       Synthesize voice fro
 ... hilbert           |->A       Generate a Hilbert t
 ... sinc              |->A       Generate a sinc kais
                                  ↳ band-pass, or band
 ... sine              |->A       Generate sine wave a
 ... anullsink         A->|       Do absolutely nothin
 ... addroi            V->V       Add region of intere
 ... alphaextract      V->V       Extract an alpha cha
                                  ↳ component
 T.. alphamerge        VV->V      Copy the luma value
                                  ↳ alpha channel of t
 TSC amplify           V->V       Amplify changes betw
 ... ass               V->V       Render ASS subtitles
                                  ↳ libass library

 TSC atadenoise        V->V       Apply an Adaptive Te
 T.C avgblur           V->V       Apply Average Blur f
 ... avgblur_opencl    V->V       Apply average blur f
```

```
... avgblur_vulkan    V->V       Apply avgblur mask t
T.C bbox              V->V       Compute bounding box
... bench             V->V       Benchmark part of a 
TSC bilateral         V->V       Apply Bilateral filt
T.. bitplanenoise     V->V       Measure bit plane no
.S. blackdetect       V->V       Detect video interva
... blackframe        V->V       Detect frames that a
TSC blend             VV->V      Blend two video fram
..C blend_vulkan      VV->V      Blend two video fram
... blockdetect       V->V       Blockdetect filter
... blurdetect        V->V       Blurdetect filter
TS. bm3d              N->V       Block-Matching 3D de
T.. boxblur           V->V       Blur the input
... boxblur_opencl    V->V       Apply boxblur filter
TS. bwdif             V->V       Deinterlace the inpu
TSC cas               V->V       Contrast Adaptive Sh
... chromaber_vulkan  V->V       Offset chroma of inp
                                 ↳ (chromatic aberrat
TSC chromahold        V->V       Turns a certain colo
TSC chromakey         V->V       Turns a certain colo
                                 ↳ Operates on YUV co
... chromakey_cuda    V->V       GPU accelerated chro
TSC chromanr          V->V       Reduce chrominance n
TSC chromashift       V->V       Shift chroma
... ciescope          V->V       Video CIE scope

T.. codecview         V->V       Visualize informatio
TSC colorbalance      V->V       Adjust the color bal
TSC colorchannelmixer V->V       Adjust colors by mix
```

```
TSC colorcontrast     V->V       Adjust color contras
TSC colorcorrect      V->V       Adjust color white b
                                 ↳ and whites
TSC colorize          V->V       Overlay a solid colo
TSC colorkey          V->V       Turns a certain colo
                                 ↳ on RGB colors
... colorkey_opencl   V->V       Turns a certain colo
                                 ↳ on RGB colors
TSC colorhold         V->V       Turns a certain colo
                                 ↳ RGB colors
TSC colorlevels       V->V       Adjust the color lev
TSC colormap          VVV->V     Apply custom Color M
TS. colormatrix       V->V       Convert color matrix
TS. colorspace        V->V       Convert between colo
TSC colortemperature  V->V       Adjust color tempera
TSC convolution       V->V       Apply convolution fi
... convolution_opencl V->V      Apply convolution ma
TS. convolve          VV->V      Convolve first video
                                 ↳ with second video
... copy              V->V       Copy the input video
... cover_rect        V->V       Find and cover a use
..C crop              V->V       Crop the input video
T.. cropdetect        V->V       Auto-detect crop siz
... cue               V->V       Delay filtering to m
TSC curves            V->V       Adjust components cu

.SC datascope         V->V       Video data analysis
T.C dblur             V->V       Apply Directional Bl
TS. dctdnoiz          V->V       Denoise frames using
```

```
TSC deband            V->V       Debands video
T.C deblock           V->V       Deblock video
... decimate          N->V       Decimate frames (pos
TS. deconvolve        VV->V      Deconvolve first vid
                                 ↳ with second video
TS. dedot             V->V       Reduce cross-luminan
TSC deflate           V->V       Apply deflate effect
... deflicker         V->V       Remove temporal fram
... deinterlace_vaapi V->V        Deinterlacing of VA
... deinterlace_qsv   V->V       QuickSync video dein
... dejudder          V->V       Remove judder produc
T.. delogo            V->V       Remove logo from inp
... denoise_vaapi     V->V       VAAPI VPP for de-noi
T.. derain            V->V       Apply derain filter
... deshake           V->V       Stabilize shaky vide
... deshake_opencl    V->V       Feature-point based
TSC despill           V->V       Despill video
... detelecine        V->V       Apply an inverse tel
TSC dilation          V->V       Apply dilation effec
... dilation_opencl   V->V       Apply dilation effec
T.. displace          VVV->V     Displace pixels
... dnn_classify      V->V       Apply DNN classify f
... dnn_detect        V->V       Apply DNN detect fil
... dnn_processing    V->V       Apply DNN processing
.S. doubleweave       V->V       Weave input video fi

                                 ↳ double number of f
T.C drawbox           V->V       Draw a colored box o
... drawgraph         V->V       Draw a graph using i
```

```
 T.C drawgrid          V->V       Draw a colored grid
 T.C drawtext          V->V       Draw text on top of
                                  ↳ library
 T.. edgedetect        V->V       Detect and draw edge
 ... elbg              V->V       Apply posterize effe
 T.. entropy           V->V       Measure video frames
 .S. epx               V->V       Scale the input usin
 T.C eq                V->V       Adjust brightness, c
 TSC erosion           V->V       Apply erosion effect
 ... erosion_opencl    V->V       Apply erosion effect
 TSC estdif            V->V       Apply Edge Slope Tra
 TSC exposure          V->V       Adjust exposure of t
 ... extractplanes     V->N       Extract planes as gr
 TS. fade              V->V       Fade in/out input vi
 ..C feedback          VV->VV     Apply feedback video
 TSC fftdnoiz          V->V       Denoise frames using
 TS. fftfilt           V->V       Apply arbitrary expr
                                  ↳ domain
 ... field             V->V       Extract a field from
 ... fieldhint         V->V       Field matching using
 ... fieldmatch        N->V       Field matching for i
 T.. fieldorder        V->V       Set the field order
 T.C fillborders       V->V       Fill borders of the
 ... find_rect         V->V       Find a user specifie
 ... flip_vulkan       V->V       Flip both horizontal

 T.. floodfill         V->V       Fill area with same
 ... format            V->V       Convert the input vi
                                  ↳ pixel formats
```

```
 ... fps              V->V       Force constant frame
 ... framepack        VV->V      Generate a frame pac
 .S. framerate        V->V       Upsamples or downsam
                                 ↳ between specified
 T.. framestep        V->V       Select one frame eve
 ... freezedetect     V->V       Detects frozen video
 ... freezeframes     VV->V      Freeze video frames
 T.C frei0r           V->V       Apply a frei0r effec
 T.. fspp             V->V       Apply Fast Simple Po
 TSC gblur            V->V       Apply Gaussian Blur
 ... gblur_vulkan     V->V       Gaussian Blur in Vul
 TS. geq              V->V       Apply generic equati
 T.. gradfun          V->V       Debands video quickl
 ... graphmonitor     V->V       Show various filterg
 TS. grayworld        V->V       Adjust white balance
 TS. greyedge         V->V       Estimates scene illu
                                 ↳ assumption
 TSC guided           N->V       Apply Guided filter
 TSC haldclut         VV->V      Adjust colors using
 TS. hflip            V->V       Horizontally flip th
 ... hflip_vulkan     V->V       Horizontally flip th
 T.. histeq           V->V       Apply global color h
 ... histogram        V->V       Compute and draw a h
 TSC hqdn3d           V->V       Apply a High Quality
 .S. hqx              V->V       Scale the input by 2

                                 ↳ hq*x magnification
 .S. hstack           N->V       Stack video inputs h
 TSC hsvhold          V->V       Turns a certain HSV
```

```
TSC hsvkey            V->V       Turns a certain HSV
                                   ↳ Operates on YUV c
T.C hue               V->V       Adjust the hue and s
TSC huesaturation     V->V       Apply hue-saturation
... hwdownload        V->V       Download a hardware
... hwmap             V->V       Map hardware frames
... hwupload          V->V       Upload a normal fram
... hwupload_cuda     V->V       Upload a system memo
T.. hysteresis        VV->V      Grow first stream in
                                  ↳ connecting compone
TS. identity          VV->V      Calculate the Identi
... idet              V->V       Interlace detect Fil
T.C il                V->V       Deinterleave or inte
TSC inflate           V->V       Apply inflate effect
... interlace         V->V       Convert progressive
... interleave        N->V       Temporally interleav
... kerndeint         V->V       Apply kernel deinter
TSC kirsch            V->V       Apply kirsch operato
TSC lagfun            V->V       Slowly update darker
T.. latency           V->V       Report video filteri
TSC lenscorrection    V->V       Rectify the image by
TS. lensfun           V->V       Apply correction to
                                  ↳ derived from the l
..C libplacebo        V->V       Apply various GPU fi
... libvmaf           VV->V      Calculate the VMAF b

TSC limitdiff         N->V       Apply filtering with
TSC limiter           V->V       Limit pixels compone
... loop              V->V       Loop video frames
```

```
 TSC lumakey           V->V       Turns a certain luma
 TSC lut               V->V       Compute and apply a
                                  ↳ input video
 TSC lut1d             V->V       Adjust colors using
 TSC lut2              VV->V      Compute and apply a
                                  ↳ video inputs
 TSC lut3d             V->V       Adjust colors using
 TSC lutrgb            V->V       Compute and apply a
                                  ↳ input video
 TSC lutyuv            V->V       Compute and apply a
                                  ↳ input video
 TSC maskedclamp       VVV->V     Clamp first stream w
                                  ↳ third stream
 TSC maskedmax         VVV->V     Apply filtering with
                                  ↳ two streams
 TSC maskedmerge       VVV->V     Merge first stream w
                                  ↳ stream as mask
 TSC maskedmin         VVV->V     Apply filtering with
                                  ↳ of two streams
 TSC maskedthreshold   VV->V      Pick pixels comparin
                                  ↳ streams with thres
 TSC maskfun           V->V       Create Mask
 TSC median            V->V       Apply Median filter
 ... mergeplanes       N->V       Merge planes
 ... mestimate         V->V       Generate motion vect

 T.. metadata          V->V       Manipulate video fra
 T.. midequalizer      VV->V      Apply Midway Equaliz
 ... minterpolate      V->V       Frame rate conversio
```

```
 TSC mix               N->V       Mix video inputs
 TSC monochrome        V->V       Convert video to gra
 T.C morpho            VV->V      Apply Morphological
 ... mpdecimate        V->V       Remove near-duplicat
 TS. msad              VV->V      Calculate the MSAD b
 TSC multiply          VV->V      Multiply first video
 TSC negate            V->V       Negate input video
 TS. nlmeans           V->V       Non-local means deno
 ... nlmeans_opencl    V->V       Non-local means deno
 TSC nnedi             V->V       Apply neural network
                                  ↳ intra-only deinter
 ... noformat          V->V       Force libavfilter no
                                  ↳ pixel formats for
 TS. noise             V->V       Add noise
 T.C normalize         V->V       Normalize RGB video
 ... null              V->V       Pass the source unch
 T.C oscilloscope      V->V       2D Video Oscilloscop
 TSC overlay           VV->V      Overlay a video sour
 ... overlay_opencl    VV->V      Overlay one video on
 ... overlay_vaapi     VV->V      Overlay one video on
 ... overlay_qsv       VV->V      Quick Sync Video ove
 ... overlay_vulkan    VV->V      Overlay a source on
 ... overlay_cuda      VV->V      Overlay one video on
 T.. owdenoise         V->V       Denoise using wavele
 ... pad               V->V       Pad the input video

 ... pad_opencl        V->V       Pad the input video
 ... palettegen        V->V       Find the optimal pal
 ... paletteuse        VV->V      Use a palette to dow
```

```
T.C perms             V->V      Set permissions for
TS. perspective       V->V      Correct the perspect
T.C phase             V->V      Phase shift fields
... photosensitivity  V->V      Filter out photosens
                                ↳ flashes
... pixdesctest       V->V      Test pixel format de
TSC pixelize          V->V      Pixelize video
T.C pixscope          V->V      Pixel data analysis
T.C pp                V->V      Filter video using l
T.. pp7               V->V      Apply Postprocessing
TS. premultiply       N->V      PreMultiply first st
                                ↳ second stream
TSC prewitt           V->V      Apply prewitt operat
... prewitt_opencl    V->V      Apply prewitt operat
... procamp_vaapi     V->V      ProcAmp (color balan
                                ↳ saturation, bright
... program_opencl    N->V      Filter video using a
TSC pseudocolor       V->V      Make pseudocolored v
TS. psnr              VV->V     Calculate the PSNR b
... pullup            V->V      Pullup from field se
T.. qp                V->V      Change video quantiz
... random            V->V      Return random frames
TSC readeia608        V->V      Read EIA-608 Closed
                                ↳ and write them to
... readvitc          V->V      Read vertical interv

                                ↳ frame metadata
..C realtime          V->V      Slow down filtering
.S. remap             VVV->V    Remap pixels
```

```
 ... remap_opencl      VVV->V     Remap pixels using O
 TS. removegrain       V->V       Remove grain
 T.. removelogo        V->V       Remove a TV logo bas
 ... repeatfields      V->V       Hard repeat fields b
 ... reverse           V->V       Reverse a clip
 TSC rgbashift         V->V       Shift RGBA
 TSC roberts           V->V       Apply roberts cross
 ... roberts_opencl    V->V       Apply roberts operat
 TSC rotate            V->V       Rotate the input ima
 T.. sab               V->V       Apply shape adaptive
 ..C scale             V->V       Scale the input vide
                                  ↳ image format
 ... scale_vaapi       V->V       Scale to/from VAAPI
 ... scale_cuda        V->V       GPU accelerated vide
 ... scale_qsv         V->V       QuickSync video scal
 ... scale_vulkan      V->V       Scale Vulkan frames
 ..C scale2ref         VV->VV     Scale the input vide
                                  ↳ image format to th
 ... scdet             V->V       Detect video scene c
 TSC scharr            V->V       Apply scharr operato
 TSC scroll            V->V       Scroll input video
 ... segment           V->N       Segment video stream
 ... select            V->N       Select video frames
 TS. selectivecolor    V->V       Apply CMYK adjustmen
 ... sendcmd           V->V       Send commands to fil

 ... separatefields    V->V       Split input video fr
 ... setdar            V->V       Set the frame displa
 ... setfield          V->V       Force field for the
```

```
... setparams         V->V       Force field, or colo
                                 ↳ video frame
... setpts            V->V       Set PTS for the outp
... setrange          V->V       Force color range fo
... setsar            V->V       Set the pixel sample
... settb             V->V       Set timebase for the
... sharpness_vaapi   V->V       VAAPI VPP for sharpn
TSC shear             V->V       Shear transform the
... showinfo          V->V       Show textual informa
... showpalette       V->V       Display frame palett
T.. shuffleframes     V->V       Shuffle video frames
TS. shufflepixels     V->V       Shuffle video pixels
T.. shuffleplanes     V->V       Shuffle video planes
T.. sidedata          V->V       Manipulate video fra
.S. signalstats       V->V       Generate statistics
... signature         N->V       Calculate the MPEG-7
... siti              V->V       Calculate spatial in
                                 ↳ information (TI)
T.. smartblur         V->V       Blur the input video
TSC sobel             V->V       Apply sobel operator
... sobel_opencl      V->V       Apply sobel operator
... split             V->N       Pass on the input to
T.C spp               V->V       Apply a simple post
... sr                V->V       Apply DNN-based imag
TS. ssim              VV->V      Calculate the SSIM b

.S. stereo3d          V->V       Convert video stereo
..C streamselect      N->N       Select video streams
... subtitles         V->V       Render text subtitle
```

```
                                   ↳ libass library
 .S. super2xsai        V->V        Scale the input by 2
                                   ↳ pixel art algorith
 T.C swaprect          V->V        Swap 2 rectangular o
 T.. swapuv            V->V        Swap U and V compone
 TSC tblend            V->V        Blend successive fra
 ... telecine          V->V        Apply a telecine pat
 ... thistogram        V->V        Compute and draw a t
 TSC threshold         VVVV->V     Threshold first vide
                                   ↳ streams
 T.. thumbnail         V->V        Select the most repr
                                   ↳ sequence of consec
 ... thumbnail_cuda    V->V        Select the most repr
                                   ↳ sequence of consec
 ... tile              V->V        Tile several success
 ... tinterlace        V->V        Perform temporal fie
 TSC tlut2             V->V        Compute and apply a
                                   ↳ frames
 TSC tmedian           V->V        Pick median pixels f
 T.. tmidequalizer     V->V        Apply Temporal Midwa
 TSC tmix              V->V        Mix successive video
 .S. tonemap           V->V        Conversion to/from d
 ... tonemap_opencl    V->V        Perform HDR to SDR c
 ... tonemap_vaapi     V->V        VAAPI VPP for tone-m
 ... tpad              V->V        Temporarily pad vide

 .S. transpose         V->V        Transpose input vide
 ... transpose_opencl  V->V        Transpose input vide
 ... transpose_vaapi   V->V        VAAPI VPP for transp
```

```
 ... transpose_vulkan  V->V       Transpose Vulkan Fil
 ... trim              V->V       Pick one continuous
                                  ↳ the rest
 TS. unpremultiply     N->V       UnPreMultiply first
                                  ↳ second stream
 TS. unsharp           V->V       Sharpen or blur the
 ... unsharp_opencl    V->V       Apply unsharp mask t
 ... untile            V->V       Untile a frame into
 .SC v360              V->V       Convert 360 projecti
 T.. vaguedenoiser     V->V       Apply a Wavelet base
 TSC varblur           VV->V      Apply Variable Blur
 ..C vectorscope       V->V       Video vectorscope
 T.. vflip             V->V       Flip the input video
 ... vflip_vulkan      V->V       Vertically flip the
                                  ↳ video in Vulk an
 ... vfrdet            V->V       Variable frame rate
 TSC vibrance          V->V       Boost or alter satur
 ... vidstabdetect     V->V       Extract relative tra
                                  ↳ stabilization (see
 ... vidstabtransform  V->V       Transform the frames
                                  ↳ stabilization (see
 TS. vif               VV->V      Calculate the VIF be
 T.. vignette          V->V       Make or reverse a vi
 ... vmafmotion        V->V       Calculate the VMAF M
 ... vpp_qsv           V->V       Quick Sync Video VPP

 .S. vstack            N->V       Stack video inputs v
 TSC w3fdif            V->V       Apply Martin Weston
 .SC waveform          V->V       Video waveform monit
```

```
 .S. weave             V->V       Weave input video fi
 .S. xbr               V->V       Scale the input usin
 TS. xcorrelate        VV->V      Cross-correlate firs
                                  ↳ stream
 .S. xfade             VV->V      Cross fade one video
 ... xfade_opencl      VV->V      Cross fade one video
 TSC xmedian           N->V       Pick median pixels f
 .S. xstack            N->V       Stack video inputs i
 TS. yadif             V->V       Deinterlace the inpu
 T.. yadif_cuda        V->V       Deinterlace CUDA fra
 TSC yaepblur          V->V       Yet another edge pre
 ... zmq               V->V       Receive commands thr
                                  ↳ and broker them to
 ... zoompan           V->V       Apply Zoom & Pan eff
 .SC zscale            V->V       Apply resizing, colo
                                  ↳ and bit depth conv
 ... allrgb            |->V       Generate all RGB col
 ... allyuv            |->V       Generate all yuv col
 ... cellauto          |->V       Create pattern gener
                                  ↳ automaton
 ..C color             |->V       Provide an uniformly
 ... colorchart        |->V       Generate color check
 ... colorspectrum     |->V       Generate colors spec
 ... ddagrab           |->V       Grab Windows Desktop
                                  ↳ using Desktop Dupl

 ... frei0r_src        |->V       Generate a frei0r so
 .S. gradients         |->V       Draw a gradients
 ... haldclutsrc       |->V       Provide an identity
```

```
 ... life              |->V       Create life
 ... mandelbrot        |->V       Render a Mandelbrot
 ... mptestsrc         |->V       Generate various tes
 ... nullsrc           |->V       Null video source, r
                                  ↳ unprocessed video
 ... openclsrc         |->V       Generate video using
 ... pal75bars         |->V       Generate PAL 75% col
 ... pal100bars        |->V       Generate PAL 100% co
 ... rgbtestsrc        |->V       Generate RGB test pa
 .S. sierpinski        |->V       Render a Sierpinski
 ... smptebars         |->V       Generate SMPTE color
 ... smptehdbars       |->V       Generate SMPTE HD co
 ... testsrc           |->V       Generate test patter
 ... testsrc2          |->V       Generate another tes
 ... yuvtestsrc        |->V       Generate YUV test pa
 ... nullsink          V->|       Do absolutely nothin
 ... abitscope         A->V       Convert input audio
                                  ↳ bitscope video out
 ... adrawgraph        A->V       Draw a graph using i
 ... agraphmonitor     A->V       Show various filterg
 ... ahistogram        A->V       Convert input audio
 ... aphasemeter       A->N       Convert input audio
 .SC avectorscope      A->V       Convert input audio
 ..C concat            N->N       Concatenate audio an
 ... showcqt           A->V       Convert input audio

                                  ↳ Transform) spectru
 ... showfreqs         A->V       Convert input audio
 .S. showspatial       A->V       Convert input audio
```

```
 .S. showspectrum      A->V       Convert input audio
 .S. showspectrumpic   A->V       Convert input audio
                                  ↳ single picture
 ... showvolume        A->V       Convert input audio
 ... showwaves         A->V       Convert input audio
 ... showwavespic      A->V       Convert input audio
 ... spectrumsynth     VV->A      Convert input spectr
 ... avsynctest        |->AV      Generate an Audio Vi
 ..C amovie            |->N       Read audio from a mo
 ..C movie             |->N       Read from a movie so
 ... afifo             A->A       Buffer input frames
                                  ↳ requested
 ... fifo              V->V       Buffer input images
                                  ↳ requested
 ... abuffer           |->A       Buffer audio frames,
                                  ↳ filterchain
 ... buffer            |->V       Buffer video frames,
                                  ↳ filterchain
 ... abuffersink       A->|       Buffer audio frames,
                                  ↳ end of the filter
 ... buffersink        V->|       Buffer video frames,
                                  ↳ to the end of the
```

Annexure 5: Sample List of Formats

This annexure contains sample output for the command `ffmpeg –formats`.

```
File formats:
 D. = Demuxing supported
 .E = Muxing supported
 --
 D  3dostr          3DO STR
  E 3g2             3GP2 (3GPP2 file format)
  E 3gp             3GP (3GPP file format)
 D  4xm             4X Technologies
  E a64             a64 - video for Commodore 64
 D  aa              Audible AA format files
 D  aac             raw ADTS AAC (Advanced Audio Codi
 D  aax             CRI AAX
 DE ac3             raw AC-3
 D  ace             tri-Ace Audio Container
 D  acm             Interplay ACM
 D  act             ACT Voice file format
 D  adf             Artworx Data Format
 D  adp             ADP
 D  ads             Sony PS2 ADS
  E adts            ADTS AAC (Advanced Audio Coding)
 DE adx             CRI ADX
 D  aea             MD STUDIO audio
 D  afc             AFC
 DE aiff            Audio IFF
 D  aix             CRI AIX

 DE alaw            PCM A-law
 D  alias_pix       Alias/Wavefront PIX image
 DE alp             LEGO Racers ALP
```

```
DE alp             LEGO Racers ALP
DE alsa            ALSA audio output
DE amr             3GPP AMR
D  amrnb           raw AMR-NB
D  amrwb           raw AMR-WB
 E amv             AMV
D  anm             Deluxe Paint Animation
D  apc             CRYO APC
D  ape             Monkey's Audio
DE apm             Ubisoft Rayman 2 APM
DE apng            Animated Portable Network Graphic
DE aptx            raw aptX (Audio Processing Techno
DE aptx_hd         raw aptX HD (Audio Processing Tec
D  aqtitle         AQTitle subtitles
DE argo_asf        Argonaut Games ASF
D  argo_brp        Argonaut Games BRP
DE argo_cvg        Argonaut Games CVG
DE asf             ASF (Advanced / Active Streaming
D  asf_o           ASF (Advanced / Active Streaming
 E asf_stream      ASF (Advanced / Active Streaming
DE ass             SSA (SubStation Alpha) subtitle
DE ast             AST (Audio Stream)
DE au              Sun AU
D  av1             AV1 Annex B
DE avi             AVI (Audio Video Interleaved)
 E avif            AVIF

D  avisynth        AviSynth script
 E avm2            SWF (ShockWave Flash) (AVM2)
D  avr             AVR (Audio Visual Research)
```

```
D  avr            AVR (Audio Visual Research)
D  avs            Argonaut Games Creature Shock
DE avs2           raw AVS2-P2/IEEE1857.4 video
DE avs3           AVS3-P2/IEEE1857.10
D  bethsoftvid    Bethesda Softworks VID
D  bfi            Brute Force & Ignorance
D  bfstm          BFSTM (Binary Cafe Stream)
D  bin            Binary text
D  bink           Bink
D  binka          Bink Audio
DE bit            G.729 BIT file format
D  bitpacked      Bitpacked
D  bmp_pipe       piped bmp sequence
D  bmv            Discworld II BMV
D  boa            Black Ops Audio
D  brender_pix    BRender PIX image
D  brstm          BRSTM (Binary Revolution Stream)
D  c93            Interplay C93
 E caca           caca (color ASCII art) output dev
DE caf            Apple CAF (Core Audio Format)
DE cavsvideo      raw Chinese AVS (Audio Video Stan
D  cdg            CD Graphics
D  cdxl           Commodore CDXL video
 E chromaprint    Chromaprint
D  cine           Phantom Cine
DE codec2         codec2 .c2 muxer

DE codec2raw      raw codec2 muxer
D  concat         Virtual concatenation script
 E crc            CRC testing
```

```
 E crc             CRC testing
D  cri_pipe        piped cri sequence
DE dash            DASH Muxer
DE data            raw data
DE daud            D-Cinema audio
D  dcstr           Sega DC STR
D  dds_pipe        piped dds sequence
D  derf            Xilam DERF
D  dfa             Chronomaster DFA
DE dfpwm           raw DFPWM1a
D  dhav            Video DAV
DE dirac           raw Dirac
DE dnxhd           raw DNxHD (SMPTE VC-3)
D  dpx_pipe        piped dpx sequence
D  dsf             DSD Stream File (DSF)
D  dshow           DirectShow capture
D  dsicin          Delphine Software International C
D  dss             Digital Speech Standard (DSS)
DE dts             raw DTS
D  dtshd           raw DTS-HD
DE dv              DV (Digital Video)
D  dvbsub          raw dvbsub
D  dvbtxt          dvbtxt
 E dvd             MPEG-2 PS (DVD VOB)
D  dxa             DXA
D  ea              Electronic Arts Multimedia

D  ea_cdata        Electronic Arts cdata
DE eac3            raw E-AC-3
D  epaf            Ensoniq Paris Audio File
```

```
D  epaf            Ensoniq Paris Audio File
D  exr_pipe        piped exr sequence
DE f32be           PCM 32-bit floating-point big-end
DE f32le           PCM 32-bit floating-point little-
 E f4v             F4V Adobe Flash Video
DE f64be           PCM 64-bit floating-point big-end
DE f64le           PCM 64-bit floating-point little-
DE fbdev           Linux framebuffer
DE ffmetadata      FFmpeg metadata in text
 E fifo            FIFO queue pseudo-muxer
 E fifo_test       Fifo test muxer
DE film_cpk        Sega FILM / CPK
DE filmstrip       Adobe Filmstrip
DE fits            Flexible Image Transport System
DE flac            raw FLAC
D  flic            FLI/FLC/FLX animation
DE flv             FLV (Flash Video)
 E framecrc        framecrc testing
 E framehash       Per-frame hash testing
 E framemd5        Per-frame MD5 testing
D  frm             Megalux Frame
D  fsb             FMOD Sample Bank
D  fwse            Capcom's MT Framework sound
DE g722            raw G.722
DE g723_1          raw G.723.1
DE g726            raw big-endian G.726 ("left-justi

DE g726le          raw little-endian G.726 ("right-j
D  g729            G.729 raw format demuxer
D  gdigrab         GDI API Windows frame grabber
```

```
 D  gdigrab         GDI API Windows frame grabber
 D  gdv             Gremlin Digital Video
 D  gem_pipe        piped gem sequence
 D  genh            GENeric Header
 DE gif             CompuServe Graphics Interchange F
 D  gif_pipe        piped gif sequence
 DE gsm             raw GSM
 DE gxf             GXF (General eXchange Format)
 DE h261            raw H.261
 DE h263            raw H.263
 DE h264            raw H.264 video
  E hash            Hash testing
 D  hca             CRI HCA
 D  hcom            Macintosh HCOM
 D  hdr_pipe        piped hdr sequence
  E hds             HDS Muxer
 DE hevc            raw HEVC video
 DE hls             Apple HTTP Live Streaming
 D  hnm             Cryo HNM v4
 DE ico             Microsoft Windows ICO
 D  idcin           id Cinematic
 D  idf             iCE Draw File
 D  iff             IFF (Interchange File Format)
 D  ifv             IFV CCTV DVR
 DE ilbc            iLBC storage
 DE image2          image2 sequence

 DE image2pipe      piped image2 sequence
 D  imf             IMF (Interoperable Master Format)
 D  ingenient       raw Ingenient MJPEG
```

```
D  ingenient        raw Ingenient MJPEG
D  ipmovie          Interplay MVE
 E ipod             iPod H.264 MP4 (MPEG-4 Part 14)
D  ipu              raw IPU Video
DE ircam            Berkeley/IRCAM/CARL Sound Format
 E ismv             ISMV/ISMA (Smooth Streaming)
D  iss              Funcom ISS
D  iv8              IndigoVision 8000 video
DE ivf              On2 IVF
D  ivr              IVR (Internet Video Recording)
D  j2k_pipe         piped j2k sequence
DE jacosub          JACOsub subtitle format
D  jpeg_pipe        piped jpeg sequence
D  jpegls_pipe      piped jpegls sequence
D  jpegxl_pipe      piped jpegxl sequence
D  jv               Bitmap Brothers JV
D  kux              KUX (YouKu)
DE kvag             Simon & Schuster Interactive VAG
 E latm             LOAS/LATM
D  lavfi            Libavfilter virtual input device
D  libcdio
D  libgme           Game Music Emu demuxer
D  libmodplug       ModPlug demuxer
D  libopenmpt       Tracker formats (libopenmpt)
D  live_flv         live RTMP FLV (Flash Video)
D  lmlm4            raw lmlm4

D  loas             LOAS AudioSyncStream
DE lrc              LRC lyrics
D  luodat           Video CCTV DAT
```

```
D  luodat          Video CCTV DAT
D  lvf             LVF
D  lxf             VR native stream (LXF)
DE m4v             raw MPEG-4 video
 E matroska        Matroska
D  matroska,webm   Matroska / WebM
D  mca             MCA Audio Format
D  mcc             MacCaption
 E md5             MD5 testing
D  mgsts           Metal Gear Solid: The Twin Snakes
DE microdvd        MicroDVD subtitle format
DE mjpeg           raw MJPEG video
D  mjpeg_2000      raw MJPEG 2000 video
 E mkvtimestamp_v2 extract pts as timecode v2 format
DE mlp             raw MLP
D  mlv             Magic Lantern Video (MLV)
D  mm              American Laser Games MM
DE mmf             Yamaha SMAF
D  mods            MobiClip MODS
D  moflex          MobiClip MOFLEX
 E mov             QuickTime / MOV
D  mov,mp4,m4a,3gp,3g2,mj2 QuickTime / MOV
 E mp2             MP2 (MPEG audio layer 2)
DE mp3             MP3 (MPEG audio layer 3)
 E mp4             MP4 (MPEG-4 Part 14)
D  mpc             Musepack

D  mpc8            Musepack SV8
DE mpeg            MPEG-1 Systems / MPEG program str
 E mpeg1video      raw MPEG-1 video
```

```
 E mpeg1video      raw MPEG-1 video
 E mpeg2video      raw MPEG-2 video
DE mpegts          MPEG-TS (MPEG-2 Transport Stream)
D  mpegtsraw       raw MPEG-TS (MPEG-2 Transport Str
D  mpegvideo       raw MPEG video
DE mpjpeg          MIME multipart JPEG
D  mpl2            MPL2 subtitles
D  mpsub           MPlayer subtitles
D  msf             Sony PS3 MSF
D  msnwctcp        MSN TCP Webcam stream
D  msp             Microsoft Paint (MSP)
D  mtaf            Konami PS2 MTAF
D  mtv             MTV
DE mulaw           PCM mu-law
D  musx            Eurocom MUSX
D  mv              Silicon Graphics Movie
D  mvi             Motion Pixels MVI
DE mxf             MXF (Material eXchange Format)
 E mxf_d10         MXF (Material eXchange Format) D-
 E mxf_opatom      MXF (Material eXchange Format) Op
D  mxg             MxPEG clip
D  nc              NC camera feed
D  nistsphere      NIST SPeech HEader REsources
D  nsp             Computerized Speech Lab NSP
D  nsv             Nullsoft Streaming Video
 E null            raw null video

DE nut             NUT
D  nuv             NuppelVideo
DE obu             AV1 low overhead OBU
```

```
DE obu             AV1 low overhead OBU
 E oga             Ogg Audio
DE ogg             Ogg
 E ogv             Ogg Video
DE oma             Sony OpenMG audio
 E opengl          OpenGL output
 E opus            Ogg Opus
DE oss             OSS (Open Sound System) playback
D  paf             Amazing Studio Packed Animation F
D  pam_pipe        piped pam sequence
D  pbm_pipe        piped pbm sequence
D  pcx_pipe        piped pcx sequence
D  pfm_pipe        piped pfm sequence
D  pgm_pipe        piped pgm sequence
D  pgmyuv_pipe     piped pgmyuv sequence
D  pgx_pipe        piped pgx sequence
D  phm_pipe        piped phm sequence
D  photocd_pipe    piped photocd sequence
D  pictor_pipe     piped pictor sequence
D  pjs             PJS (Phoenix Japanimation Society
D  pmp             Playstation Portable PMP
D  png_pipe        piped png sequence
D  pp_bnk          Pro Pinball Series Soundbank
D  ppm_pipe        piped ppm sequence
D  psd_pipe        piped psd sequence
 E psp             PSP MP4 (MPEG-4 Part 14)

D  psxstr          Sony Playstation STR
DE pulse           Pulse audio output
D  pva             TechnoTrend PVA
```

```
D  pva              TechnoTrend PVA
D  pvf              PVF (Portable Voice Format)
D  qcp              QCP
D  qdraw_pipe       piped qdraw sequence
D  qoi_pipe         piped qoi sequence
D  r3d              REDCODE R3D
DE rawvideo         raw video
D  realtext         RealText subtitle format
D  redspark         RedSpark
D  rl2              RL2
DE rm               RealMedia
DE roq              raw id RoQ
D  rpl              RPL / ARMovie
D  rsd              GameCube RSD
DE rso              Lego Mindstorms RSO
DE rtp              RTP output
 E rtp_mpegts       RTP/mpegts output format
DE rtsp             RTSP output
DE s16be            PCM signed 16-bit big-endian
DE s16le            PCM signed 16-bit little-endian
DE s24be            PCM signed 24-bit big-endian
DE s24le            PCM signed 24-bit little-endian
DE s32be            PCM signed 32-bit big-endian
DE s32le            PCM signed 32-bit little-endian
D  s337m            SMPTE 337M
DE s8               PCM signed 8-bit

D  sami             SAMI subtitle format
DE sap              SAP output
DE sbc              raw SBC
```

```
DE sbc             raw SBC
D  sbg             SBaGen binaural beats script
DE scc             Scenarist Closed Captions
D  scd             Square Enix SCD
 E sdl,sdl2        SDL2 output device
D  sdp             SDP
D  sdr2            SDR2
D  sds             MIDI Sample Dump Standard
D  sdx             Sample Dump eXchange
 E segment         segment
D  ser             SER (Simple uncompressed video fo
D  sga             Digital Pictures SGA
D  sgi_pipe        piped sgi sequence
D  shn             raw Shorten
D  siff            Beam Software SIFF
D  simbiosis_imx   Simbiosis Interactive IMX
D  sln             Asterisk raw pcm
DE smjpeg          Loki SDL MJPEG
D  smk             Smacker
 E smoothstreaming Smooth Streaming Muxer
D  smush           LucasArts Smush
DE sndio           sndio audio playback
D  sol             Sierra SOL
DE sox             SoX native
DE spdif           IEC 61937 (used on S/PDIF - IEC95
 E spx             Ogg Speex

DE srt             SubRip subtitle
D  stl             Spruce subtitle format
 E stream_segment,ssegment streaming segment muxer
```

```
 E stream_segment,ssegment streaming segment muxer
 E streamhash      Per-stream hash testing
D  subviewer       SubViewer subtitle format
D  subviewer1      SubViewer v1 subtitle format
D  sunrast_pipe    piped sunrast sequence
DE sup             raw HDMV Presentation Graphic Str
D  svag            Konami PS2 SVAG
 E svcd            MPEG-2 PS (SVCD)
D  svg_pipe        piped svg sequence
D  svs             Square SVS
DE swf             SWF (ShockWave Flash)
D  tak             raw TAK
D  tedcaptions     TED Talks captions
 E tee             Multiple muxer tee
D  thp             THP
D  tiertexseq      Tiertex Limited SEQ
D  tiff_pipe       piped tiff sequence
D  tmv             8088flex TMV
DE truehd          raw TrueHD
DE tta             TTA (True Audio)
 E ttml            TTML subtitle
D  tty             Tele-typewriter
D  txd             Renderware TeXture Dictionary
D  ty              TiVo TY Stream
DE u16be           PCM unsigned 16-bit big-endian
DE u16le           PCM unsigned 16-bit little-endian

DE u24be           PCM unsigned 24-bit big-endian
DE u24le           PCM unsigned 24-bit little-endian
DE u32be           PCM unsigned 32-bit big-endian
```

```
DE u32be           PCM unsigned 32-bit big-endian
DE u32le           PCM unsigned 32-bit little-endian
DE u8              PCM unsigned 8-bit
 E uncodedframecrc uncoded framecrc testing
D  v210            Uncompressed 4:2:2 10-bit
D  v210x           Uncompressed 4:2:2 10-bit
D  vag             Sony PS2 VAG
D  vbn_pipe        piped vbn sequence
DE vc1             raw VC-1 video
DE vc1test         VC-1 test bitstream
 E vcd             MPEG-1 Systems / MPEG program str
D  vfwcap          VfW video capture
DE vidc            PCM Archimedes VIDC
DE video4linux2,v4l2 Video4Linux2 output device
D  vividas         Vividas VIV
D  vivo            Vivo
D  vmd             Sierra VMD
 E vob             MPEG-2 PS (VOB)
D  vobsub          VobSub subtitle format
DE voc             Creative Voice
D  vpk             Sony PS2 VPK
D  vplayer         VPlayer subtitles
D  vqf             Nippon Telegraph and Telephone Co
DE w64             Sony Wave64
DE wav             WAV / WAVE (Waveform Audio)
D  wc3movie        Wing Commander III movie

 E webm            WebM
 E webm_chunk      WebM Chunk Muxer
DE webm_dash_manifest WebM DASH Manifest
```

```
DE webm_dash_manifest WebM DASH Manifest
 E webp            WebP
D  webp_pipe       piped webp sequence
DE webvtt          WebVTT subtitle
DE wsaud           Westwood Studios audio
D  wsd             Wideband Single-bit Data (WSD)
D  wsvqa           Westwood Studios VQA
DE wtv             Windows Television (WTV)
DE wv              raw WavPack
D  wve             Psion 3 audio
D  x11grab         X11 screen capture, using XCB
D  xa              Maxis XA
D  xbin            eXtended BINary text (XBIN)
D  xbm_pipe        piped xbm sequence
D  xmv             Microsoft XMV
D  xpm_pipe        piped xpm sequence
 E xv              XV (XVideo) output device
D  xvag            Sony PS3 XVAG
D  xwd_pipe        piped xwd sequence
D  xwma            Microsoft xWMA
D  yop             Psygnosis YOP
DE yuv4mpegpipe    YUV4MPEG pipe
```

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-b
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-c:s
-c:v
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-framerate
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-hide_banner
-i
-id3v2_version
-loop
-map
-map_metadata
-metadata
obsolete/incorrect options
-pass
-passlogfile
-pix_fmt

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T, U

V, W, X, Y, Z

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reverse

rotate

sample aspect ratio (SAR)

sharpen

side-by-side split

slow down

speed up

test

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