

Processing videos for use with ELAN.

Digital videos can be encoded in many different ways, with a variety of codecs and containers.

Depending on the OS, ELAN supports different file formats, largely determined by the available media player frameworks. Each framework supports one or more proprietary formats but also a few formats that can be considered to be more or less cross-platform. Although there can be good reasons to use one of the proprietary formats, we recommend to choose a cross-platform, “standardized” format where possible.

In this document we present some recommendations for encoding MPEG-1, MPEG-2 and MP4 (H264) files for use in ELAN. Although MPEG-2 is not properly supported without installing additional codecs or plugins, we include it here because of its high quality.

The settings presented here are general recommendations that don’t guarantee good playback performance on all systems, you might still have to experiment which settings work best for your requirements.

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1. Recommended encoding settings for video

The following encoding settings per format are general (tool independent) recommendations.

1.1 MP4 settings.

1. General MP4:

	Recommended settings	Min settings	Max settings
Video codec	H.264 (x264)		
Preset*	superfast (default preset is medium in ffmpeg)	veryfast	ultrafast
Profile	High	baseline	High
Resolution	Same as source		
Frame-rate	Same as source (constant frame-rate)		
Quality (CRF) **	CRF 18-20	51	0
Entropy coding***	CABAC		
Pixel format	Yuv_420p		
GOP size	25	1 (I-frame	25

		only)	
Audio codec****	AAC		
Sampling rate	48khz	?	?
Channel mode	Stereo		
Bitrate	320 kb/s	128 kb/s	320 kb/s

Optional settings, do not need to be set.

Level*****	4.0	3.0	4.2
Average bitrate (ABR) *****	4000kb/s		

*Ultrafast will produce a somewhat larger file, but also has the best overall playback in ELAN. A slower preset will provide better compression, although that will result in unreliable frame-by-frame scrubbing.

**Range is 0-51, where lower values will result in higher quality.(More info about crf: <http://slhck.info/articles/crf>)

***CABAC is the default for ffmpeg and Handbrake, and produces better quality than CAVLC entropy coding.

****PCM audio will not work in ELAN. PCM is mostly used with players that can mux streams, such as a hardware blu-ray player.

***** Level is set automatically, but can be overridden if playback on an old player fails. Not applicable with ELAN. See https://en.wikipedia.org/wiki/H.264/MPEG-4_AVC_-_Levels for more info.

*****If you want an average bitrate (ABR), use this default value instead of using CRF. If the output quality is bad, increase it in small increments.

1.2 MPEG-2 settings.

3. General HD mpeg2

	Recommended settings	Min settings	Max settings
Video codec	Mpeg2video		
Profile*	MP (main profile), (ffmpeg = 4)	MP	HP
Level*	HL (high level), (ffmpeg = 4)	ML (for a resolution up to 720x576 only!)	HL (for resolution up to 1920x1152)
Resolution	Same as source		
Frame-rate	Same as source		
Rate control mode**	CBR (constant bitrate)		
Bitrate settings*	35000k (for 1920x1080) / 15000k (for 1280x720) / 6000k (for SD-video)	Variable; set a lower bitrate and check output image quality.	Higher then recommended is possible, depending on the source bitrate.
Buffer size	1500k	1500k	Higher if needed
Stream type	Program stream (vob)		
GOP size	12	1	25

B-frames	2		
Audio codec	MPEG-1 Audio Layer II (ffmpeg = mp2)		
Sampling rate	48khz	44khz	48khz
Channel mode	Stereo		
Bitrate	384 kb/s	128 kb/s	384 kb/s

* For more info regarding levels and bitrates, see tables here: https://en.wikipedia.org/wiki/H.262/MPEG-2_Part_2_-_Video_profiles_and_levels

** CBR is preferred, but VBR can be used instead. This requires a target bitrate, as well as a minimum and maximum bitrate.

1.3 MPEG-1 settings.

This is an older format, designed for lower (SD) resolutions. Its advantage is that it will play on almost any system, also on older machines. This is due to the low bitrates it handles. MPEG-1 can also be useful if storage and bandwidth connections are limited. The codec here is mpeg1video, inside an .mpg container.

5. General mpeg1

	Medium settings	Min	Max
Video codec	Mpeg1video		
Resolution	352x288	320x240/352x240	4095x4095
Frame-rate	25		
Rate control mode	CBR (constant bitrate)		
Bitrate settings	1500k	Variable; set a lower bitrate and check output image quality.	1800k
Buffer size	40k	?	40k
GOP size	25	1	25
Audio codec	MPEG-1 Audio Layer II		
Sampling rate	48khz	44khz	48khz
Channel mode	Stereo		
Bitrate	224k	128k	384k

2. Recommended free software for encoding video

Free software capable of video processing:

- FFmpeg (Mac OS X/Windows/Linux)
- Handbrake (Mac OS X/Windows)

FFmpeg (www.ffmpeg.org) is a command-line (terminal) based tool for conversion/encoding of videos. It can handle a vast amount of input and output formats. It requires some intermediate computer-skills.

Static builds can be found here, these are ready to use without installation.

Mac OS X - <https://evermeet.cx/ffmpeg/>

Windows - <https://ffmpeg.zeranoe.com/builds/>

Handbrake (<https://handbrake.fr/>) is a graphical solution to convert a video to MP4. It handles several input formats, but only outputs to .mp4 and .mkv. The latter is not a usable format that can be used in ELAN.

For more information about how to install and use these tools, please consult the (online) documentation and guides.

2.1 Settings for FFmpeg

2.1.1 MP4 settings for ffmpeg

FFmpeg is an open source audio and video encoder/decoder library. The following examples can be run from the command line.

```
ffmpeg(.exe) -i {input file} -c:v libx264 -preset superfast -crf 18 -pix_fmt yuv420p -coder vlc -refs 1 -qmin 4 -c:a libvo_aacenc -b:a 256k -ar 48000 {output name}.mp4
```

Media navigation in ELAN relies on your computer processing power; therefore frame-by-frame navigation may be slow at times. For smooth frame-by-frame stepping an I-frame (key-frame) only video often works best. This will increase the file size substantially as compared to .e.g. one key frame per 25 frames. The following ffmpeg command creates I-frame only video.

```
ffmpeg(.exe) -i {input file} -c:v libx264 -preset ultrafast -crf 18 -pix_fmt yuv420p -g 1 -bf 1 -coder vlc -refs 1 -qmin 4 -c:a libvo_aacenc -b:a 256k -ar 48000 {output name}.mp4
```

Note that only `-g 1` and `-bf 1` are added to the command. This will set the GOP to 1.

More information regarding FFmpeg and mp4:

<https://trac.ffmpeg.org/wiki/Encode/H.264>

2.1.2 HD MPEG-2 software settings for ffmpeg

The GOP of the encoded video will be 3, 12 (M= 3, N=12). That means: 2 "B" frames separating each "P" frames, and "I" frames with 12 frames of distance. Or simply: "IBBPBBPBBPBBBI". Bigger GOPs will make frame-scrubbing more difficult, as there will be more distance between two I-frames (key-frames).

-1920x1080, ffmpeg:

```
ffmpeg(.exe) -i {input file} -c:v mpeg2video -b:v 35000k -minrate 35000k -maxrate 35000k -bufsize 1500k -g 12 -bf 2 -f vob -c:a mp2 -b:a 384k -ar 48000 {output name}.mpeg
```

-1280x720, ffmpeg:

```
ffmpeg(.exe) -i {input file} -c:v mpeg2video -b:v 15000k -minrate 15000k -maxrate 15000k -bufsize 1500k -g 12 -bf 2 -f vob -c:a mp2 -b:a 384k -ar 48000 {output name}.mpeg
```

-SD format, ffmpeg:

```
ffmpeg(.exe) -i {input file} -c:v mpeg2video -b:v 6000k -minrate 6000k -maxrate 6000k -bufsize 1500k -g 12 -bf 2 -f vob -c:a mp2 -b:a 384k -ar 48000 {output name}.mpeg
```

For I-frame only:

-1920x1080 ffmpeg:

```
ffmpeg(.exe) -i {input file} -c:v mpeg2video -b:v 35000k -minrate 35000k -maxrate 35000k -bufsize 1500k -qmin 1 -intra -f vob -c:a mp2 -b:a 384k -ar 48000 {output name}.mpeg
```

-1280x720 ffmpeg:

```
ffmpeg(.exe) -i {input file} -c:v mpeg2video -b:v 15000k -minrate 15000k -maxrate 15000k -bufsize 1500k -qmin 1 -intra -f vob -c:a mp2 -b:a 384k -ar 48000 {output name}.mpeg
```

-SD format (720x576), ffmpeg:

```
ffmpeg(.exe) -i {input file} -c:v mpeg2video -b:v 6000k -minrate 6000k -maxrate 6000k -bufsize 1500k -qmin 1 -intra -f vob -c:a mp2 -b:a 384k -ar 48000 {output name}.mpeg
```

***Note on bitrates:**

Instead of constant bitrate, you can also use `qscale`, which will result in a variable bitrate. To do so, replace `-b:v 35000k -minrate 35000k -maxrate 35000k -bufsize 1500k` With `-qscale:v 2` (a range of 1-31 is possible, 1 is the highest quality, 31 the lowest). Playback may not be as good as with a constant bitrate setting.

2.1.3 MPEG-1 software settings for ffmpeg

```
ffmpeg(.exe) -i {input file} -c:v mpeg1video -s 512x288 -b:v 1500k -g 12 -bf 2 -c:a mp2 -b:a 384k {output name}.mpg
```

2.2 Settings for Handbrake

2.2.1 MP4 settings for Handbrake

Handbrake is a free conversion tool for Mac OS X, Windows and Linux.

In preferences (OSX) or options (Windows), set the default output extension to .mp4 before starting. Set the video and audio output settings according to table 1. Select .MP4 as the container.

In the additional options box ('extra' for windows), enter: *keyint=25*

For audio output settings: There should only be one source audio track added to the mp4 you are creating, if there are more source tracks with the same name visible, disable them.

For I-frame only video change the settings as follows:

Set the x264 preset slider to ultrafast, and the other settings according to table 1.

In the additional options box ('extra' for windows), enter: *keyint=1*

Optionally, you can choose to de-interlace the video. In Windows, click the tab 'Filter' and select 'Decomb' – 'Default'. In Mac OS X, click 'Picture settings' then the tab 'Filters' and set De-comb to 'Default'. This way, Handbrake will de-interlace the video if/when necessary.

More info about de-interlacing: <https://trac.handbrake.fr/wiki/DeinterlacingGuide>

Handbrake does not support MPEG-1 and MPEG-2.

3. Commercial software for processing media

There are a lot of options for commercial, paid software capable of processing media.

- TMPGEnc Video Mastering Works 6 (full version \$122) is capable of converting videos, adding subtitles, trimming media and much more.
- Telestream Episode (\$594) can transcode a variety of formats, but may be a bit complex.
- Adobe Media Encoder (part of CS/CC suite, not available as stand-alone software) does encoding, transcoding of media, Premiere projects.

There are of course much more options, but the Max Planck Institute has the most experience with the programs mentioned here. More info about usage of these programs will follow.

4. Audio visualization in ELAN

In order to have a visual representation of audio in ELAN, you must provide a separate audio-file, which has to be extracted from the video. ELAN supports uncompressed wave-files only; formats like mp3 or FLAC are not supported.

3.1 WAV audio settings

	Medium settings	Min	Max
Audio format	PCM, s16le		
Sampling rate	44.1000kHz / 48.000kHz	44.100Hz	48.000Hz
Bit depth	16 bits	8	16
Channel(s)	1 (mono) / 2 (stereo)	1	2

3.2 WAV software settings

ffmpeg, mono source file*:

```
ffmpeg(.exe) -i {input file} -c:a pcm_s16le -ac 1 -ar 48000 {output name}.wav
```

ffmpeg, stereo source file*:

```
ffmpeg(.exe) -i {input file} -c:a pcm_s16le -ac 2 -ar 48000 {output name}.wav
```

*Note: always check your source video to see if it is recorded in mono or stereo. Creating a mono track from a stereo source (or vice versa) involves a different approach with ffmpeg!

It is also possible to combine the ffmpeg command above with the one for the mp4 or mpeg2 creation. To do so, just add the last bit of the code above after the code for the respective video output:

```
ffmpeg(.exe) -i {input file} -c:v libx264 -preset ultrafast -crf 18 -  
pix_fmt yuv420p -coder vlc -refs 1 -qmin 4 -c:a libvo_aacenc -b:a 256k  
{output name}.mp4 -c:a pcm_s16le -ac 2 -ar 48000 {output name}.wav
```

Unfortunately, Handbrake does not support WAV output. Another way of extracting is to use VLC media player. Results with this software may vary!

For OSX users: Open VLC and select 'Convert/Stream' from the main menu. From there, load your video file and select the 'Audio - CD' profile. Finally, click 'Save as file' and your file will be saved.

For Windows users: Open VLC and select 'Convert/Save' from the main menu. Click 'Add' from the tab 'File' and locate your media file. Next, click the 'Convert/Save' button on the bottom. In the next dialog, 'convert' should be selected, and choose the Profile 'Audio-CD'. Browse for a destination and finally click 'Start' to run the conversion.