How does digital video work?

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Definition

Container format - (sometimes called *wrapper*) a file format that stores multiple data streams in one file.
A common example would be a `ZIP` file, as it contains multiple files.

```
Input #0, matroska,webm, from 'Fullmetal Alchemist - Brotherhood - S01E01 - Fullmetal Alchemist.mkv':
  Metadata:
    title           : Fullmetal Alchemist: Brotherhood - 01
    encoder         : libebml v1.3.10 + libmatroska v1.5.2
    creation_time   : 2021-02-16T20:29:53.000000Z
  Duration: 00:24:29.64, start: 0.000000, bitrate: 9739 kb/s
    Chapter #0:0: start 0.000000, end 58.809000
    Metadata:
      title           : Prologue
    Chapter #0:1: start 58.809000, end 148.774000
    Metadata:
      title           : OP
    Chapter #0:2: start 148.774000, end 655.154000
    Metadata:
      title           : Part A
    Chapter #0:3: start 655.154000, end 1347.137000
    Metadata:
      title           : Part B
    Chapter #0:4: start 1347.137000, end 1437.603000
    Metadata:
      title           : ED
    Chapter #0:5: start 1437.603000, end 1469.635000
    Metadata:
      title           : Preview
    Stream #0:0(jpn): Video: h264 (High 10), yuv420p10le(tv, bt709/unknown/unknown, progressive), \
                      1920x1080, SAR 1:1 DAR 16:9, 23.98 fps, 23.98 tbr, 1k tbn, 47.95 tbc (default)
    Metadata:
      BPS-eng         : 6345806
      DURATION-eng    : 00:24:29.635000000
```

```
30        NUMBER_OF_FRAMES-eng: 35236
31        NUMBER_OF_BYTES-eng: 1165752385
32      Stream #0:1(eng): Audio: flac, 48000 Hz, 5.1(side), s16 (default)
33      Metadata:
34        BPS-eng          : 1473847
35        DURATION-eng     : 00:24:27.297000000
36        NUMBER_OF_FRAMES-eng: 17195
37        NUMBER_OF_BYTES-eng: 270321527
38      Stream #0:2(jpn): Audio: flac, 48000 Hz, stereo, s16
39      Metadata:
40        BPS-eng          : 714029
41        DURATION-eng     : 00:24:29.635000000
42        NUMBER_OF_FRAMES-eng: 17223
43        NUMBER_OF_BYTES-eng: 131170331
44      Stream #0:3(eng): Audio: flac, 48000 Hz, stereo, s32 (24 bit)
45      Metadata:
46        title            : Commentary
47        BPS-eng          : 1162785
48        DURATION-eng     : 00:24:28.622000000
49        NUMBER_OF_FRAMES-eng: 17211
50        NUMBER_OF_BYTES-eng: 213461522
51      Stream #0:4(eng): Subtitle: ass (default)
52      Metadata:
53        title            : Signs/Songs
54        BPS-eng          : 36
55        DURATION-eng     : 00:23:22.880000000
56        NUMBER_OF_FRAMES-eng: 87
57        NUMBER_OF_BYTES-eng: 6321
58      Stream #0:5(jpn): Subtitle: ass
59      Metadata:
```

```
60        BPS-eng          : 132
61        DURATION-eng     : 00:24:15.800000000
62        NUMBER_OF_FRAMES-eng: 393
63        NUMBER_OF_BYTES-eng: 24189
64      Stream #0:6: Attachment: otf
65      Metadata:
66        filename         : Wunderlich-Medium.otf
67        mimetype         : application/vnd.ms-opentype
68      Stream #0:7: Attachment: ttf
69      Metadata:
70        filename         : Calligraphic-810-BT.ttf
71        mimetype         : application/x-truetype-font
72      Stream #0:8: Attachment: otf
73      Metadata:
74        filename         : A-OTF-SHINMGOPRO-MEDIUM.OTF
75        mimetype         : application/vnd.ms-opentype
76      Stream #0:9: Attachment: ttf
77      Metadata:
78        filename         : DFPHSMincho-W9.ttf
79        mimetype         : application/x-truetype-font
```

What is a codec?

Codec is a software or hardware that encodes or decodes data, that is stored in a specified standard format. That data might be compressed, but does not need to be.

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Format is a specification, that describes the way data will be stored.

For example:

format: `h.264` codec: `libx264`

format: `mp3` codec: `libmp3lame`

What does effect picture quality?

bitrate - How much data is the stream allowed to take up in a unit of time, you can usually set it as a min/max value.

CRF - Alternative to bitrate, what is the target quality, encoder will vary the bitrate accordingly.

patience - Some encoders can do a better job if they are given more time, much more time.

pixel format

What is a pixel format?

Pixel format is specified in part by bit depth (aka number of colors):

Most common bit depth is 24, also known as “milions of colors”

Pixel format also includes information about *chroma subsampling*.

What is chroma subsampling?

Instead of **RGB** we can use other formats such as YC_bC_r:

Y - Luminance, or "Black&White"

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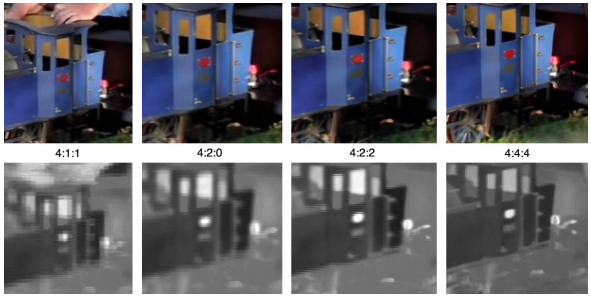

The end!

Sources:

- Wikipedia articles
- FFmpeg wiki
- Technology Connections - “Lines of Light: How Analog Television Works”