



## MP4 Video Authentication Using File Structure and Metadata

*By*

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# MP4/3GP Video

- Video Coding Formats
  - H.264
  - MPEG-4 Part 10
  - Advanced Video Coding (AVC)
- File Container Format
  - MP4
  - 3GP, 3G2

# Movie Atoms

- QuickTime File Format Specification
- Allow the media and the description to be stored separately
- Size > Type > Data
- Parent / Child Nesting Convention



# Parsing

↑	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	0123456789ABCDEF
0000h:	00	00	00	20	66	74	79	70	61	76	63	31	00	00	00	00	...ftypavcl...
0010h:	61	76	63	31	69	73	6F	6D	00	00	00	00	00	00	00	00	avclisom.....

- 4 bytes @ 0x00 – size of atom – 32 bytes
- 4 bytes @ 0x04 – type of atom – ftyp
  - File Type Compatibility

# Parsing

↑	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	0123456789ABCDEF
0000h:	00	00	00	20	66	74	79	70	61	76	63	31	00	00	00	00	... ftypavcl...
0010h:	61	76	63	31	69	73	6F	6D	00	00	00	00	00	00	00	00	avclisom.....
0020h:	00	00	58	D6	6D	6F	6F	76	00	00	00	6C	6D	76	68	64	..XÖmoov...lmvhd
0030h:	00	00	00	00	CD	07	DA	7E	CD	07	DA	7E	00	01	5F	90	....í.Ú~í.Ú~..._.
0040h:	00	24	15	BE	00	01	00	00	01	00	00	00	00	00	00	00	.\$¾.....
0050h:	00	00	00	00	00	01	00	00	00	00	00	00	00	00	00	00	.....
0060h:	00	00	00	00	00	01	00	00	00	00	00	00	00	00	00	00	.....
0070h:	00	00	00	00	40	00	00	00	00	00	00	00	00	00	00	00	....@.....
0080h:	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
0090h:	00	00	00	04	00	00	01	80	75	64	74	61	00	00	00	14	....€udta....

- 4 bytes @ 0x20 – size of atom – 22742 bytes
- 4 bytes @ 0x24 – type of atom – moov
- 4 bytes @ 0x28 – size of atom – 108 bytes
- 4 bytes @ 0x2C – type of atom – mvhd – Movie Header Atom

0000h:	00 00 00 20	66 74 79 70	61 76 63 31	00 00 00 00	... ftypavcl....
0010h:	61 76 63 31	69 73 6F 6D	00 00 00 00	00 00 00 00	avclisom.....
0020h:	00 00 58 D6	6D 6F 6F 76	00 00 00 6C	6D 76 68 64	..X0moov...l mvhd
0030h:	00 00 00 00	CD 07 DA 7E	CD 07 DA 7E	00 01 5F 90	....f.Ú~f.Ú~...
0040h:	00 24 15 BE	00 01 00 00	01 00 00 00	00 00 00 00	.\$.%.....
0050h:	00 00 00 00	00 01 00 00	00 00 00 00	00 00 00 00	.....
0060h:	00 00 00 00	00 01 00 00	00 00 00 00	00 00 00 00	.....
0070h:	00 00 00 00	40 00 00 00	00 00 00 00	00 00 00 00	....@.....
0080h:	00 00 00 00	00 00 00 00	00 00 00 00	00 00 00 00	.....
0090h:	00 00 00 04	00 00 01 80	75 64 74 61	00 00 00 14	.....eudta....
00A0h:	46 49 52 4D	48 44 33 2E	31 31 2E 30	32 2E 30 30	FIRMD3.11.02.00
00B0h:	00 00 00 38	4C 45 4E 53	4C 57 31 33	30 38 32 31	...8LENSLW130821
00C0h:	30 33 30 30	31 33 30 32	00 00 00 00	00 00 00 00	03001302.....
00D0h:	00 00 00 00	00 00 00 00	00 00 00 00	00 00 00 00	.....
00E0h:	00 00 00 00	00 00 00 00	00 00 00 18	43 41 4D 45	.....CAME
00F0h:	48 33 42 2B	42 30 38 31	33 33 39 38	43 32 31 00	H3B+B0813398C21.
0100h:	00 00 00 10	53 45 54 54	03 E0 00 10	00 00 A1 84	....SETT.à....;”
0110h:	00 00 00 80	41 4D 42 41	00 10 00 09	01 01 0F 00	...eAMBA.....
0120h:	00 00 00 02	00 00 3A A7	00 05 7E 40	01 C9 C3 80	.....\$.~@.ÉÆ
0130h:	01 C9 C3 80	00 00 00 01	00 00 00 00	00 00 00 00	.ÉÆ.....
0140h:	00 00 00 00	00 00 00 00	00 00 00 00	00 00 00 00	.....
0150h:	00 00 00 00	00 00 00 00	00 00 00 00	00 00 00 00	.....
0160h:	00 00 00 00	00 00 00 00	00 00 00 00	00 00 00 00	.....
0170h:	00 00 00 00	00 00 00 00	00 00 00 00	00 00 00 00	.....
0180h:	00 00 00 00	00 00 00 00	00 00 00 00	01 05 01 01	.....
0190h:	00 00 00 84	66 72 65 65	00 00 00 00	00 00 00 00	...”free.....
01A0h:	00 00 00 00	00 00 00 00	00 00 00 00	00 00 00 00	.....
01B0h:	00 00 00 00	00 00 00 00	00 00 00 00	00 00 00 00	.....
01C0h:	00 00 00 00	00 00 00 00	00 00 00 00	00 00 00 00	.....
01D0h:	00 00 00 00	00 00 00 00	00 00 00 00	00 00 00 00	.....
01E0h:	00 00 00 00	00 00 00 00	00 00 00 00	00 00 00 00	.....
01F0h:	00 00 00 00	00 00 00 00	00 00 00 00	00 00 00 00	.....
0200h:	00 00 00 00	00 00 00 00	00 00 00 00	00 00 00 00	.....
0210h:	00 00 00 00	00 00 2C B8	74 72 61 6B	00 00 00 5C	.....trak...\\
0220h:	74 6B 68 64	00 00 00 07	CD 07 DA 7E	CD 07 DA 7E	tkhd....f.Ú~f.Ú~
0230h:	00 00 00 01	00 00 00 00	00 24 15 BE	00 00 00 00	.....\$.%....
0240h:	00 00 00 00	00 00 00 00	00 00 00 00	00 01 00 00	.....
0250h:	00 00 00 00	00 00 00 00	00 00 00 00	00 01 00 00	.....
0260h:	00 00 00 00	00 00 00 00	00 00 00 00	40 00 00 00	.....@...
0270h:	07 80 00 00	04 38 00 00	00 00 00 14	74 72 65 66	.e...8.....tref
0280h:	00 00 00 0C	74 6D 63 64	00 00 00 03	00 00 00 24	....tmcd.....\$
0290h:	65 64 74 73	00 00 00 1C	65 6C 73 74	00 00 00 00	edts....elst....
02A0h:	00 00 00 01	00 24 15 BE	00 00 00 00	00 01 00 00	.....\$.%....
02B0h:	00 00 2C 1C	6D 64 69 61	00 00 00 20	6D 64 68 64	...mdia... mdhd
02C0h:	00 00 00 00	CD 07 DA 7E	CD 07 DA 7E	00 05 7E 40	....f.Ú~f.Ú~...@

ftyp @ 0x00

moov @ 0x20

- mvhd @ 0x28
- udta @ 0x94
  - FIRM @ 0x9C
  - LENS @ 0xB0
  - CAME @ 0xE8
  - SETT @ 0x100
  - AMBA @ 0x110
  - free @ 0x190
- trak @ 0x214
  - tkhd @ 0x21C
  - tref @ 0x278
    - tmcd @ 0x280
  - edts @ 0x28C
    - elst @ 0x294
  - mdia @ 0x2B0
    - mdhd @ 0x2B8
    - ...

71 atoms in total



# Using Atomic Parsley to Render Original Go Pro

```
Atom ftyp @ 0 of size: 32, ends @ 32
Atom moov @ 32 of size: 22742, ends @ 22774
  Atom mvhd @ 40 of size: 108, ends @ 148
  Atom udta @ 148 of size: 384, ends @ 532
    Atom FIRM @ 156 of size: 20, ends @ 176
    Atom LENS @ 176 of size: 56, ends @ 232
    Atom CAME @ 232 of size: 24, ends @ 256
    Atom SETT @ 256 of size: 16, ends @ 272
    Atom AMBA @ 272 of size: 128, ends @ 400
    Atom free @ 400 of size: 132, ends @ 532
  Atom trak @ 532 of size: 11448, ends @ 11980
    Atom tkhd @ 540 of size: 92, ends @ 632
    Atom tref @ 632 of size: 20, ends @ 652
      Atom tmcd @ 640 of size: 12, ends @ 652
    Atom edts @ 652 of size: 36, ends @ 688
      Atom elst @ 660 of size: 28, ends @ 688
    Atom mdia @ 688 of size: 11292, ends @ 11980
      Atom mdhd @ 696 of size: 32, ends @ 728
      Atom hdlr @ 728 of size: 46, ends @ 774
      Atom minf @ 774 of size: 11206, ends @ 11980
        Atom vmhd @ 782 of size: 20, ends @ 802
        Atom dinf @ 802 of size: 36, ends @ 838
          Atom dref @ 810 of size: 28, ends @ 838
        Atom stbl @ 838 of size: 11142, ends @ 11980
          Atom stsd @ 846 of size: 208, ends @ 1054
            Atom avc1 @ 862 of size: 192, ends @ 1054
              Atom colr @ 948 of size: 18, ends @ 966
              Atom stts @ 1054 of size: 24, ends @ 1078
              Atom ctts @ 1078 of size: 5056, ends @ 6134
              Atom stsc @ 6134 of size: 28, ends @ 6162
              Atom stsz @ 6162 of size: 2540, ends @ 8702
              Atom stco @ 8702 of size: 2536, ends @ 11238
              Atom stss @ 11238 of size: 100, ends @ 11338
              Atom sdtp @ 11338 of size: 642, ends @ 11980
        Atom trak @ 11980 of size: 10312, ends @ 22292
          Atom tkhd @ 11988 of size: 92, ends @ 12080
          Atom tref @ 12080 of size: 20, ends @ 12100
            Atom tmcd @ 12088 of size: 12, ends @ 12100
          Atom mdia @ 12100 of size: 10192, ends @ 22292
            Atom mdhd @ 12108 of size: 32, ends @ 12140
            Atom hdlr @ 12140 of size: 46, ends @ 12186
            Atom minf @ 12186 of size: 10106, ends @ 22292
              Atom smhd @ 12194 of size: 16, ends @ 12210
              Atom dinf @ 12210 of size: 36, ends @ 12246
                Atom dref @ 12218 of size: 28, ends @ 12246
                Atom stbl @ 12246 of size: 10046, ends @ 22292
                  Atom stsd @ 12254 of size: 102, ends @ 12356
                    Atom mp4a @ 12270 of size: 86, ends @ 12356
                      Atom esds @ 12306 of size: 50, ends @ 12356
                        Atom stts @ 12356 of size: 24, ends @ 12380
                        Atom stsc @ 12380 of size: 28, ends @ 12408
                        Atom stsz @ 12408 of size: 4944, ends @ 17352
                        Atom stco @ 17352 of size: 4940, ends @ 22292
                  Atom trak @ 22292 of size: 482, ends @ 22774
                    Atom tkhd @ 22300 of size: 92, ends @ 22392
                    Atom mdia @ 22392 of size: 382, ends @ 22774
                      Atom mdhd @ 22400 of size: 32, ends @ 22432
                      Atom hdlr @ 22432 of size: 33, ends @ 22465
                      Atom minf @ 22465 of size: 309, ends @ 22774
                        Atom gmhd @ 22473 of size: 82, ends @ 22555
                        Atom hdlr @ 22555 of size: 33, ends @ 22588
                        Atom dinf @ 22588 of size: 36, ends @ 22624
                          Atom dref @ 22596 of size: 28, ends @ 22624
                        Atom stbl @ 22624 of size: 150, ends @ 22774
                          Atom stsd @ 22632 of size: 50, ends @ 22682
                            Atom tmcd @ 22648 of size: 34, ends @ 22682
                          Atom stts @ 22682 of size: 24, ends @ 22706
                          Atom stsc @ 22706 of size: 28, ends @ 22734
                          Atom stsz @ 22734 of size: 20, ends @ 22754
                          Atom stco @ 22754 of size: 20, ends @ 22774
                      Atom free @ 22774 of size: 501506, ends @ 524280
                      Atom mdat @ 524280 of size: 100568146, ends @ 101092426
                    ~ denotes an unknown atom
                  Total size: 101092426 bytes; 71 atoms total. AtomicParsley version: 0.9.0 (utf8)
```

# Examples of Unique Atom Data

00A0h:	46 49 52 4D	48 44 33 2E	31 31 2E 30	32 2E 30 30	FIRMHD3.11.02.00
00B0h:	00 00 00 38	4C 45 4E 53	4C 57 31 33	30 38 32 31	...8LENSLW130821
00C0h:	30 33 30 30	31 33 30 32	00 00 00 00	00 00 00 00	03001302.....
00D0h:	00 00 00 00	00 00 00 00	00 00 00 00	00 00 00 00	.....
00E0h:	00 00 00 00	00 00 00 00	00 00 00 18	43 41 4D 45	.....CAME
00F0h:	48 33 42 2B	42 30 38 31	33 33 39 38	43 32 31 00	H3B+B0813398C21.

# Adobe Premiere Structure Change

↑	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	0123456789ABCDEF
0000h:	00	00	00	18	66	74	79	70	6D	70	34	32	00	00	00	00	....ftypmp42....
0010h:	6D	70	34	32	6D	70	34	31	00	00	35	31	6D	6F	6F	76	mp42mp41..51moov
0020h:	00	00	00	6C	6D	76	68	64	00	00	00	00	D1	E1	FC	F8	...lmvhd....Náüø
0030h:	D1	E1	FC	F9	00	01	5F	90	00	24	27	00	00	01	00	00	Náüü.._...\$'.....
0040h:	01	00	00	00	00	00	00	00	00	00	00	00	00	01	00	00	.....
0050h:	00	00	00	00	00	00	00	00	00	00	00	00	00	01	00	00	.....
0060h:	00	00	00	00	00	00	00	00	00	00	00	00	40	00	00	00	.....@...
0070h:	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
0080h:	00	00	00	00	00	00	00	00	00	00	00	03	00	00	1B	7E	.....~
0090h:	74	72	61	6B	00	00	00	5C	74	6B	68	64	00	00	00	01	trak....\tkhd....
00A0h:	D1	E1	FC	F8	D1	E1	FC	F8	00	00	00	01	00	00	00	00	NáüøNáüø.....
00B0h:	00	24	15	BF	00	00	00	00	00	00	00	00	00	00	00	00	.\$..ç.....
00C0h:	00	00	00	00	00	01	00	00	00	00	00	00	00	00	00	00	.....
00D0h:	00	00	00	00	00	01	00	00	00	00	00	00	00	00	00	00	.....
00E0h:	00	00	00	00	40	00	00	00	07	80	00	00	04	38	00	00	....@....e...8..
00F0h:	00	00	00	24	65	64	74	73	00	00	00	1C	65	6C	73	74	...\$edts....elst
0100h:	00	00	00	00	00	00	00	01	00	24	15	BF	00	00	03	E9	.....\$.ç....é
0110h:	00	01	00	00	00	00	1A	F6	6D	64	69	61	00	00	00	20	.....ömdia...
0120h:	6D	64	68	64	00	00	00	00	D1	E1	FC	F8	D1	E1	FC	F8	mdhd....NáüøNáüø
0130h:	00	00	5D	C0	00	09	9F	66	15	C7	00	00	00	00	00	40	..]Ä..Ÿf.Ç.....@
0140h:	68	64	6C	72	00	00	00	00	00	00	00	00	76	69	64	65	hdlr.....vide
0150h:	00	00	00	00	00	00	00	00	00	00	00	00	1F	4D	61	69	.....Mai
0160h:	6E	63	6F	6E	63	65	70	74	20	56	69	64	65	6F	20	4D	nconcept Video M
0170h:	65	64	69	61	20	48	61	6E	64	6C	65	72	00	00	1A	8E	edia Handler...Ž
0180h:	6D	69	6E	66	00	00	00	14	76	6D	68	64	00	00	00	01	minf....vmhd....
0190h:	00	00	00	00	00	00	00	00	00	00	00	33	68	64	6C	72	.....3hdlr
01A0h:	00	00	00	00	00	00	00	00	61	6C	69	73	00	00	00	00	.....alis....
01B0h:	00	00	00	00	00	00	00	00	41	6C	69	61	73	20	44	61	.....Alias Da
01C0h:	74	61	20	48	61	6E	64	6C	65	72	00	00	00	00	24	64	ta Handler....\$d

# Original vs. Premiere

```
Atom ftyp @ 0 of size: 32, ends @ 32
Atom moov @ 32 of size: 22742, ends @ 22774
  Atom mvhd @ 40 of size: 108, ends @ 148
  Atom udta @ 148 of size: 384, ends @ 532
    Atom FIRM @ 156 of size: 20, ends @ 176
    Atom LENS @ 176 of size: 56, ends @ 232
    Atom CAME @ 232 of size: 24, ends @ 256
    Atom SETT @ 256 of size: 16, ends @ 272
    Atom AMBA @ 272 of size: 128, ends @ 400
    Atom free @ 400 of size: 132, ends @ 532
  Atom trak @ 532 of size: 11448, ends @ 11980
    Atom tkhd @ 540 of size: 92, ends @ 632
    Atom tref @ 632 of size: 20, ends @ 652
      Atom tmcD @ 640 of size: 12, ends @ 652
    Atom edts @ 652 of size: 36, ends @ 688
      Atom elst @ 660 of size: 28, ends @ 688
    Atom mdia @ 688 of size: 11292, ends @ 11980
      Atom mdhd @ 696 of size: 32, ends @ 728
      Atom hdlr @ 728 of size: 46, ends @ 774
      Atom minf @ 774 of size: 11206, ends @ 11980
        Atom vmhd @ 782 of size: 20, ends @ 802
        Atom dinf @ 802 of size: 36, ends @ 838
        Atom dref @ 810 of size: 28, ends @ 838
      Atom stbl @ 838 of size: 11142, ends @ 11980
        Atom stsd @ 846 of size: 208, ends @ 1054
          Atom avc1 @ 862 of size: 192, ends @ 1054
            Atom colr @ 948 of size: 18, ends @ 966
          Atom stts @ 1054 of size: 24, ends @ 1078
          Atom ctts @ 1078 of size: 5056, ends @ 6134
          Atom stsc @ 6134 of size: 28, ends @ 6162
          Atom stsZ @ 6162 of size: 2540, ends @ 8702
          Atom stco @ 8702 of size: 2536, ends @ 11238
          Atom stss @ 11238 of size: 100, ends @ 11338
          Atom sdtP @ 11338 of size: 642, ends @ 11980
      Atom trak @ 11980 of size: 10312, ends @ 22292
        Atom tkhd @ 11988 of size: 92, ends @ 12080
        Atom tref @ 12080 of size: 20, ends @ 12100
          Atom tmcD @ 12088 of size: 12, ends @ 12100
        Atom mdia @ 12100 of size: 10192, ends @ 22292
          Atom mdhd @ 12108 of size: 32, ends @ 12140
```

```
Atom ftyp @ 0 of size: 24, ends @ 24
Atom moov @ 24 of size: 13617, ends @ 13641
  Atom mvhd @ 32 of size: 108, ends @ 140
  Atom trak @ 140 of size: 7038, ends @ 7178
    Atom tkhd @ 148 of size: 92, ends @ 240
    Atom edts @ 240 of size: 36, ends @ 276
      Atom elst @ 248 of size: 28, ends @ 276
    Atom mdia @ 276 of size: 6902, ends @ 7178
      Atom mdhd @ 284 of size: 32, ends @ 316
      Atom hdlr @ 316 of size: 64, ends @ 380
      Atom minf @ 380 of size: 6798, ends @ 7178
        Atom vmhd @ 388 of size: 20, ends @ 408
        Atom hdlr @ 408 of size: 51, ends @ 459
        Atom dinf @ 459 of size: 36, ends @ 495
          Atom dref @ 467 of size: 28, ends @ 495
        Atom stbl @ 495 of size: 6683, ends @ 7178
          Atom stsd @ 503 of size: 149, ends @ 652
            Atom avc1 @ 519 of size: 133, ends @ 652
              Atom avcC @ 605 of size: 47, ends @ 652
            Atom stts @ 652 of size: 24, ends @ 676
            Atom stss @ 676 of size: 128, ends @ 804
            Atom sdtP @ 804 of size: 642, ends @ 1446
            Atom stsc @ 1446 of size: 28, ends @ 1474
            Atom stsZ @ 1474 of size: 2540, ends @ 4014
            Atom stco @ 4014 of size: 268, ends @ 4282
            Atom ctts @ 4282 of size: 2896, ends @ 7178
        Atom trak @ 7178 of size: 6399, ends @ 13577
          Atom tkhd @ 7186 of size: 92, ends @ 7278
          Atom edts @ 7278 of size: 36, ends @ 7314
            Atom elst @ 7286 of size: 28, ends @ 7314
          Atom mdia @ 7314 of size: 6263, ends @ 13577
            Atom mdhd @ 7322 of size: 32, ends @ 7354
            Atom hdlr @ 7354 of size: 68, ends @ 7422
            Atom minf @ 7422 of size: 6155, ends @ 13577
              Atom smhd @ 7430 of size: 16, ends @ 7446
              Atom hdlr @ 7446 of size: 51, ends @ 7497
              Atom dinf @ 7497 of size: 36, ends @ 7533
                Atom dref @ 7505 of size: 28, ends @ 7533
              Atom stbl @ 7533 of size: 6044, ends @ 13577
                Atom stsd @ 7541 of size: 100, ends @ 7641
```



# ffmpeg Structure Change

↑	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	0123456789ABCDEF
0000h:	00	00	00	20	66	74	79	70	69	73	6F	6D	00	00	02	00	... ftypisom....
0010h:	69	73	6F	6D	69	73	6F	32	61	76	63	31	6D	70	34	31	isomiso2avc1mp41
0020h:	00	00	00	08	66	72	65	65	00	B2	A3	CC	6D	64	61	74	....free.2f1mdat
0030h:	00	00	00	02	09	10	00	00	00	20	06	00	0D	80	99	D0	.....E
0040h:	00	15	F9	00	99	D0	00	15	F9	40	01	09	00	00	08	24	..ù.™D..ù@.....\$
0050h:	68	00	00	03	00	01	06	01	C4	80	00	06	29	7E	25	B8	h.....ÄE..)~%,
0060h:	01	00	00	EF	FA	74	0D	15	C0	EC	28	D1	5D	9A	B4	2E	...ÿút..Äi(Ñ]š´.
0070h:	E8	68	30	10	31	8B	0B	A2	23	24	2F	FC	81	67	C6	4A	èh0.1<.ç#\$/ü.gEJ
0080h:	DB	2B	79	05	59	64	5C	48	4C	47	1E	85	0D	C1	54	58	Û+y.Yd\HLG....ÁTX
0090h:	9E	45	36	2D	CF	DA	1C	D0	20	44	B3	0F	26	EB	D7	D8	žE6-ÿÜ.D D³.&ë×Ø
00A0h:	E4	50	D2	1D	A1	95	A8	24	8D	45	4A	1A	59	A1	3C	74	äPÖ.;•"\$\$.EJ.Y; <t
00B0h:	0C	87	2F	25	1D	CB	C9	48	48	AE	B9	56	9D	DB	29	A1	./%\$.ËËHH®¹V.Û);
00C0h:	84	6D	7D	2D	56	44	DF	CF	AB	D7	E1	A8	BF	53	79	FE	„m)-VDBÿ«×á"¿Syþ
00D0h:	9A	C6	65	61	4B	D7	7B	79	6A	DC	CD	9A	13	B4	8F	11	šEeaK×{y]Ûíš.´..
00E0h:	5E	FB	0A	FF	37	F5	90	4D	99	C6	3E	D3	92	4B	B6	C1	^û.ÿ7ð.M™E>Ó'KqÁ
00F0h:	0D	1F	CA	A0	15	FE	CD	91	03	6F	14	84	69	D3	35	DB	..ê .pí'.o.„iÓ5Û
0100h:	6D	F7	16	38	AD	30	03	DA	26	75	46	E1	FA	C5	2B	FF	m÷.8-0.Û&uFáúÁ+ÿ
0110h:	16	A2	A0	3A	E3	4C	D4	6B	01	E4	B2	ED	E5	FF	D2	C0	.ç :äLÔk.ä²iäÿÒÀ
0120h:	D2	76	04	7E	C1	46	93	7B	70	1B	F9	44	AF	15	19	E2	Òv.~ÁF" {p.ùD¯..â
0130h:	17	44	D7	9C	69	B3	13	8F	04	84	BE	B7	7A	B9	6E	85	.D×œi³....„¾·z¹n...
0140h:	84	AA	46	FB	37	43	BD	6E	C1	A3	21	DA	0D	85	34	D1	„*Fû7C³mÁ£!Û....4Ñ
0150h:	E9	6E	4B	8A	B7	78	AB	25	3C	FF	DE	22	2E	79	D5	D4	énKŠ·x«%<ÿB".yÖÔ
0160h:	B2	68	20	B6	6C	73	36	BD	E2	6A	06	2D	62	4D	64	A2	²h ¶ls6¾âj.-bMdç
0170h:	C2	60	A3	69	15	E9	FE	19	FF	EC	CB	DE	56	9C	73	1E	Â`£i.ép.ÿiËBVes.
0180h:	95	E3	CA	A4	01	16	CF	57	B2	97	C7	06	DD	21	A9	6A	•äÊ=..ÿW²-Ç.Ý!@j
0190h:	1A	3E	B1	F3	50	A2	B7	11	95	37	EF	09	AB	FA	F4	1A	.>±óPç·.·7i.«úð.
01A0h:	7C	7B	E8	E1	E6	4B	07	2B	D7	6A	91	E0	C1	C1	1E	E5	{èääK.+×j`àÁÁ.â
01B0h:	89	F2	F7	59	E1	55	20	17	32	74	A9	E1	29	09	03	94	%ò÷YáU .2t@á).."
01C0h:	DE	D6	6D	51	47	8B	82	1A	D5	6A	A8	28	36	14	4F	61	ßÖmQG<,.Öj" (6.Oa

# Original vs. ffmpeg

```
Atom ftyp @ 0 of size: 32, ends @ 32
Atom moov @ 32 of size: 22742, ends @ 22774
  Atom mvhd @ 40 of size: 108, ends @ 148
  Atom udta @ 148 of size: 384, ends @ 532
    Atom FIRM @ 156 of size: 20, ends @ 176
    Atom LENS @ 176 of size: 56, ends @ 232
    Atom CAME @ 232 of size: 24, ends @ 256
    Atom SETT @ 256 of size: 16, ends @ 272
    Atom AMBA @ 272 of size: 128, ends @ 400
    Atom free @ 400 of size: 132, ends @ 532
  Atom trak @ 532 of size: 11448, ends @ 11980
    Atom tkhd @ 540 of size: 92, ends @ 632
    Atom tref @ 632 of size: 20, ends @ 652
      Atom tmcd @ 640 of size: 12, ends @ 652
    Atom edts @ 652 of size: 36, ends @ 688
      Atom elst @ 660 of size: 28, ends @ 688
    Atom mdia @ 688 of size: 11292, ends @ 11980
      Atom mdhd @ 696 of size: 32, ends @ 728
      Atom hdlr @ 728 of size: 46, ends @ 774
      Atom minf @ 774 of size: 11206, ends @ 11980
        Atom vmhd @ 782 of size: 20, ends @ 802
        Atom dinf @ 802 of size: 36, ends @ 838
          Atom dref @ 810 of size: 28, ends @ 838
        Atom stbl @ 838 of size: 11142, ends @ 11980
          Atom stsd @ 846 of size: 208, ends @ 1054
            Atom avc1 @ 862 of size: 192, ends @ 1054
              Atom colr @ 948 of size: 18, ends @ 966
            Atom stts @ 1054 of size: 24, ends @ 1078
            Atom ctts @ 1078 of size: 5056, ends @ 6134
            Atom stsc @ 6134 of size: 28, ends @ 6162
            Atom stsz @ 6162 of size: 2540, ends @ 8702
            Atom stco @ 8702 of size: 2536, ends @ 11238
            Atom stss @ 11238 of size: 100, ends @ 11338
            Atom sdtp @ 11338 of size: 642, ends @ 11980
          Atom trak @ 11980 of size: 10312, ends @ 22292
            Atom tkhd @ 11988 of size: 92, ends @ 12080
            Atom tref @ 12080 of size: 20, ends @ 12100
              Atom tmcd @ 12088 of size: 12, ends @ 12100
            Atom mdia @ 12100 of size: 10192, ends @ 22292
              Atom mdhd @ 12108 of size: 32, ends @ 12140
```

```
Atom ftyp @ 0 of size: 32, ends @ 32
Atom free @ 32 of size: 8, ends @ 40
Atom mdat @ 40 of size: 99405757, ends @ 99405797
Atom moov @ 99405797 of size: 14524, ends @ 99420321
  Atom mvhd @ 99405805 of size: 108, ends @ 99405913
  Atom trak @ 99405913 of size: 5699, ends @ 99411612
    Atom tkhd @ 99405921 of size: 92, ends @ 99406013
    Atom edts @ 99406013 of size: 36, ends @ 99406049
      Atom elst @ 99406021 of size: 28, ends @ 99406049
    Atom mdia @ 99406049 of size: 5563, ends @ 99411612
      Atom mdhd @ 99406057 of size: 32, ends @ 99406089
      Atom hdlr @ 99406089 of size: 45, ends @ 99406134
      Atom minf @ 99406134 of size: 5478, ends @ 99411612
        Atom vmhd @ 99406142 of size: 20, ends @ 99406162
        Atom dinf @ 99406162 of size: 36, ends @ 99406198
          Atom dref @ 99406170 of size: 28, ends @ 99406198
        Atom stbl @ 99406198 of size: 5414, ends @ 99411612
          Atom stsd @ 99406206 of size: 178, ends @ 99406384
            Atom avc1 @ 99406222 of size: 162, ends @ 99406384
              Atom avcC @ 99406308 of size: 76, ends @ 99406384
            Atom stts @ 99406384 of size: 24, ends @ 99406408
            Atom stss @ 99406408 of size: 100, ends @ 99406508
            Atom stsc @ 99406508 of size: 28, ends @ 99406536
            Atom stsz @ 99406536 of size: 2540, ends @ 99409076
            Atom stco @ 99409076 of size: 2536, ends @ 99411612
          Atom trak @ 99411612 of size: 8611, ends @ 99420223
            Atom tkhd @ 99411620 of size: 92, ends @ 99411712
            Atom edts @ 99411712 of size: 36, ends @ 99411748
              Atom elst @ 99411720 of size: 28, ends @ 99411748
            Atom mdia @ 99411748 of size: 8475, ends @ 99420223
              Atom mdhd @ 99411756 of size: 32, ends @ 99411788
              Atom hdlr @ 99411788 of size: 45, ends @ 99411833
              Atom minf @ 99411833 of size: 8390, ends @ 99420223
                Atom smhd @ 99411841 of size: 16, ends @ 99411857
                Atom dinf @ 99411857 of size: 36, ends @ 99411893
                  Atom dref @ 99411865 of size: 28, ends @ 99411893
                Atom stbl @ 99411893 of size: 8330, ends @ 99420223
                  Atom stsd @ 99411901 of size: 106, ends @ 99412007
                    Atom mp4a @ 99411917 of size: 90, ends @ 99412007
                    Atom esds @ 99411953 of size: 54, ends @ 99412007
```

# Comparison With Other Devices

Panasonic Lumix  
DMC TS-5

LG G3

Samsung  
Galaxy S5

Samsung  
Galaxy S4

Samsung  
Galaxy S3

```
ftyp
moov
  mvhd
  trak
    tkhd
    edts
      elst
        mdia
          mdhd
          hdlr
          minf
            vmhd
            dinf
              dref
                stbl
                  stsd
                    avc1
                      avcC
                        colr
                          stts
                          stsc
                          stsz
                          stco
                          stss
                        trak
                          tkhd
                          edts
                            elst
                              mdia
                                mdhd
                                hdlr
                                minf
                                  smhd
                                  dinf
                                    dref
                                      stbl
                                        stsd
                                          mp4a
                                            esds
                                              stts
                                              stsc
                                              stsz
                                              stco
                                              udta
                                                PANA
                                              free
                                              mdat
```

```
ftyp
moov
  mvhd
  udta
    auth [eng]
    adzc
    adzm
    adze
  trak
    tkhd
    mdia
      mdhd
      hdlr
      minf
        vmhd
        dinf
          dref
            stbl
              stsd
                avc1
                  avcC
                    pasp
                      stts
                      stss
                      stsz
                      stsc
                      stco
                    trak
                      tkhd
                      mdia
                        mdhd
                        hdlr
                        minf
                          smhd
                          dinf
                            dref
                              stbl
                                stsd
                                  mp4a
                                    esds
                                      stts
                                      stsz
                                      stsc
                                      stco
                                    free
                                    mdat
```

```
ftyp
mdat
moov
  mvhd
  udta
    SDLN
    smrd
    smta
  trak
    tkhd
    mdia
      mdhd
      hdlr
      minf
        vmhd
        dinf
          dref
            stbl
              stsd
                avc1
                  avcC
                    stts
                    stss
                    stsz
                    stsc
                    stco
                  trak
                    tkhd
                    mdia
                      mdhd
                      hdlr
                      minf
                        smhd
                        dinf
                          dref
                            stbl
                              stsd
                                mp4a
                                  esds
                                    stts
                                    stsz
                                    stsc
                                    stco
```

```
ftyp
mdat
moov
  mvhd
  udta
    smrd
    xyz
    smta
  trak
    tkhd
    mdia
      mdhd
      hdlr
      minf
        vmhd
        dinf
          dref
            stbl
              stsd
                avc1
                  avcC
                    stts
                    stss
                    stsz
                    stsc
                    stco
                  trak
                    tkhd
                    mdia
                      mdhd
                      hdlr
                      minf
                        smhd
                        dinf
                          dref
                            stbl
                              stsd
                                mp4a
                                  esds
                                    stts
                                    stsz
                                    stsc
                                    stco
```

```
ftyp
mdat
moov
  mvhd
  udta
    SDLN
    smrd
    smta
  trak
    tkhd
    mdia
      mdhd
      hdlr
      minf
        vmhd
        dinf
          dref
            stbl
              stsd
                avc1
                  avcC
                    stts
                    stss
                    stsz
                    stsc
                    stco
                  trak
                    tkhd
                    mdia
                      mdhd
                      hdlr
                      minf
                        smhd
                        dinf
                          dref
                            stbl
                              stsd
                                mp4a
                                  esds
                                    stts
                                    stsz
                                    stsc
                                    stco
```

# Notes

- Forensic Analysis of Video File Formats by Gloe, Fischer, Kirchner
  - <http://dx.doi.org/10.1016/j.diin.2014.03.009>
- QuickTime File Format Specification
  - <http://developer.apple.com/library/mac/documentation/QuickTime/QTFF/qtff.pdf>
- Atomic Parsley
  - <http://github.com/wez/atomicparsley>