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

Original Go Pro Hero 3+ Black

```
|00000000  00 00 00 20 66 74 79 70  61 76 63 31 00 00 00 00  |... ftypavc1....|
|00000010  61 76 63 31 69 73 6f 6d  00 00 00 00 00 00 00 00  |avc1isom........|
|00000020  00 00 58 d6 6d 6f 6f 76  00 00 00 6c 6d 76 68 64  |..X.moov...lmvhd|
|00000030  00 00 00 00 cd 07 da 7e  cd 07 da 7e 00 01 5f 90  |.......~...~.._.|
|00000040  00 24 15 be 00 01 00 00  01 00 00 00 00 00 00 00  |.$..............|
|00000050  00 00 00 00 00 01 00 00  00 00 00 00 00 00 00 00  |................|
*
|00000070  00 00 00 00 40 00 00 00  00 00 00 00 00 00 00 00  |....@...........|
|00000080  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00  |................|
|00000090  00 00 00 04 00 00 01 80  75 64 74 61 00 00 00 14  |........udta....|
|000000a0  46 49 52 4d 48 44 33 2e  31 31 2e 30 32 2e 30 30  |FIRMHD3.11.02.00|
|000000b0  00 00 00 38 4c 45 4e 53  4c 57 31 33 30 38 32 31  |...8LENSLW130821|
|000000c0  30 33 30 30 31 33 30 32  00 00 00 00 00 00 00 00  |03001302........|
|000000d0  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00  |................|
|000000e0  00 00 00 00 00 00 00 00  00 00 00 18 43 41 4d 45  |............CAME|
|000000f0  48 33 42 2b 42 30 38 31  33 33 39 38 43 32 31 00  |H3B+B0813398C21.|
|00000100  00 00 00 10 53 45 54 54  03 e0 00 10 00 00 a1 84  |....SETT........|
|00000110  00 00 00 80 41 4d 42 41  00 10 00 09 01 01 0f 00  |....AMBA........|
|00000120  00 00 00 02 00 00 3a a7  00 05 7e 40 01 c9 c3 80  |......:...~@....|
|00000130  01 c9 c3 80 00 00 00 01  00 00 00 00 00 00 00 00  |................|
|00000140  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00  |................|
*
|00000180  00 00 00 00 00 00 00 00  00 00 00 00 01 05 01 01  |................|
|00000190  00 00 00 84 66 72 65 65  00 00 00 00 00 00 00 00  |....free........|
|000001a0  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00  |................|
*
|00000200
```

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	... ftypavc1....
0010h:	61	76	63	31	69	73	6F	6D	00	00	00	00	00	00	00	00	avc1isom........

- 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	... ftypavc1....
0010h:	61	76	63	31	69	73	6F	6D	00	00	00	00	00	00	00	00	avc1isom........
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

Offset	Hex	ASCII
0000h:	00 00 00 20 66 74 79 70 61 76 63 31 00 00 00 00	... ftypavc1....
0010h:	61 76 63 31 69 73 6F 6D 00 00 00 00 00 00 00 00	avc1isom........
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....
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.
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	...€AMBA........
0120h:	00 00 00 02 00 00 3A A7 00 05 7E 40 01 C9 C3 80	......:§..~@.ÉÃ€
0130h:	01 C9 C3 80 00 00 00 01 00 00 00 00 00 00 00 00	.ÉÃ€............
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....Í.Ú~Í.Ú~
0230h:	00 00 00 01 00 00 00 00 00 24 15 BE 00 00 00 00	.........$.¾....
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	.€...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	.....$.¾........
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	....Í.Ú~Í.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 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

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
```
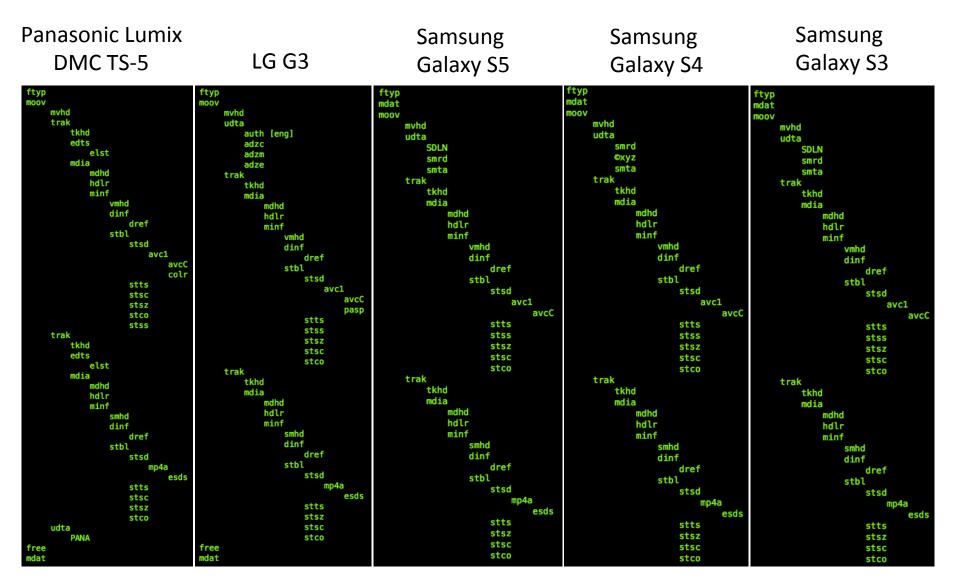
ffmpeg Structure Change

Original vs. ffmpeg

Left panel:
```
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
```

Right panel:
```
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

Notes

- <u>Forensic Analysis of Video File Formats</u> 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