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1 Introduction

During writing software to change dates in MP4/MOV files I had a lot of moments that I thought: how is this data stored? There are a lot of special cases that have probably grown during the development and merging with other standards. This document (for now) focuses on the atoms/boxes where metadata is stored. The idea behind this document to make things more clear and explain some of the knotty terminology with things often meaning the same (or not).

About this ***webpage design***: there is none. I am currently updating this information in an HTML file that I edit MS Word, with the main aim to also make it printable on A4/letter format. There are Excel tables linked in this document that I want to 'keep on the page'. I realise that it looks sub-optimal in a browser… Please resize the browser to a small width, or you can view the pdf version index.pdf.

MP4 or Quicktime? What name to use: The MP4 format is based on the Quicktime format[1] but from here I will call it MP4 format since this has become more general.

2 Dates and data in MP4 files

This whole exercise started with the annoyance of having MP4 files wrongly dated because of wrong time-setting on the recording device and also by noticing strange sorting behavior during sorting in Google Photos and other applications. Simply, the first distinction is between the operating system file attributes (time created, modified, last opened) and the data stored within the MP4 file.

3 Atoms that contain metadata

3.1 Metadata atom

The 'meta' atom, full name 'metadata atom' is one container where metadata is stored in an MP4/MOV file. It can be either a so-called 'full atom' with version and flag bytes added, or a non-full atom without the latter two. The size of the atom is variable and depends on all the data inside of it (child atoms).

Metadata atom			
Variable	# Bytes	Type	Values
Size	4	uint32	*variable*
Type	4	uint32	'meta'
Version	1		1
Flags	3	3 bytes	

Position in file. The path of metadata atom can be either \moov\meta or \moov\udta\meta, or both. No more than one atom is allowed in each path. The metadata atom can also be present in :[trak ?].

The meta atom contains many childatoms and data stored in keys. I will not describe the structure of each separate atom inside as this has been often described elsewhere, e.g. (1) and references therein. The idea of this document is to show the structure of the atoms using data from real-life examples in illustrations such as in Table 1. In the top-line the hexadecimal byte values are shown and below descriptive information.

Table 1: Example of metadata atom that has no 'keys' section. (file had no metadata before, metadata inserted by Windows property editor). Note that metadata atom is a **full-atom here**. File:[2]

Metadata atom	00 00 00 C0 size	6D 65 74 61 type meta	00 v	00 00 00 flags					
Metadata handler atom	00 00 00 21 size	68 64 6C 72 type hdlr	00 v	00 00 00 flags	*00 00 00 00 predefined=0*	6D 64 69 72 handler type mdir	*00 00 00 00 Reserved=0*	*00 00 00 00 Reserved=0*	*00 00 00 00 Reserved=0*
									00 Name
Metadata Item List Atom	00 00 00 93 size	69 6C 73 74 type ilst							
Metadata Item Atom	00 00 00 2E size	A9 77 72 74 type ©wrt							
Value atom	00 00 00 26 size	64 61 74 61 type data	00 00 00 01 type indicator (DF, wknown types)	00 00 00 00 locale indicator (country, language)	57 6E 20 63 6F 6D 70 6F 73 65 72 … type=1: string Wn composer1/c..				
Metadata Item Atom	00 00 00 19 size	74 6D 70 6F type tmpo							
Value atom	00 00 00 11 size	64 61 74 61 type data	00 00 00 15 type indicator (DF, wknown types)	00 00 00 00 locale indicator (country, language)	00 type=$15=21: big-endian signed int in 1,2,3 or 4 bytes				
Metadata Item Atom	00 00 00 20 size	A9 6E 61 6D type ©nam							
Value atom	00 00 00 18 size	64 61 74 61 type data	00 00 00 01 type indicator (DF, wknown types)	00 00 00 00 locale indicator (country, language)	57 69 6E 54 69 74 6C 65 type=1: string "WinTitle"				
Metadata Item Atom	00 00 00 24 size	A9 63 6D 74 type ©cmt							
Value atom	00 00 00 1C size	64 61 74 61 type data	00 00 00 01 type indicator (DF, wknown types)	00 00 00 00 locale indicator (country, language)	57 69 6E 20 43 6F 6D 6D 65 6E 74 73 type=1: string "Win Comments"				

Table 2: Example of metadata atom that has a 'keys' section. Note that metadata atom is a **non-full**-atom here. File: [3]

Metadata atom	00 00 xx xx size	6D 65 74 61 type meta							
Metadata handler atom	00 00 00 22 size	68 64 6C 72 type hdlr	00 v	00 00 00 flags	*00 00 00 00 predefined=0*	6D 64 74 61 handler type mdta	*00 00 00 00 Reserved=0*	*00 00 00 00 Reserved=0*	*00 00 00 00 Reserved=0*
									00 00 Name
Metadata Item Keys Atom	00 00 00 93 size	6B 65 79 73 type keys	00 v	00 00 00 flags	00 00 00 03 entry_count				
Key value 1	00 00 00 28 key_size	6D 64 74 61 key_namespace mdta	63 6F 6D 2E 61 70 70 6C 65 2E 71 75 69 63 6B 74 69 6D … key_name (Apple calls it key_value) com.apple.quicktime.creationdate						
Key value 2	00 00 00 21 key_size	64 61 74 61 key_namespace mdta	63 6F 6D 2E 61 70 70 6C 65 2E 71 75 69 63 6B 74 69 6D … com.apple.quicktime.model key_name (Apple calls it key_value)						
Key value 3	00 00 00 24 key_size	A9 6E 61 6D key_namespace mdta	63 6F 6D 2E 61 70 70 6C 65 2E 71 75 69 63 6B 74 69 6D … com.apple.quicktime.location.ISO6709 key_name (Apple calls it key_value)						
Metadata Item List Atom	00 00 00 xx size	69 6C 73 74 type ilst							
Metadata Item Atom	00 00 00 30 size	00 00 00 01 type =key 1							
Value atom	00 00 00 28 size	64 61 74 61 type data	00 00 00 01 type indicator (DF, wknown types)	46 52 1A 41 locale indicator (country, language)	32 30 31 34 2D 30 37 2D 30 35 54 … type=1: string 2014-07-05T13:02:04+0200				
Metadata Item Atom	00 00 00 21 size	00 00 00 02 type =key 2							
Value atom	00 00 00 19 size	64 61 74 61 type data	00 00 00 01 type indicator (DF, wknown types)	46 52 1A 41 locale indicator (country, language)	69 50 68 6F 6E 65 20 35 73 type=1: string iPhone 5s				
Metadata Item Atom	00 00 00 32 size	00 00 00 03 type =key 3							
Value atom	00 00 00 2A size	64 61 74 61 type data	00 00 00 01 type indicator (DF, wknown types)	46 52 1A 41 locale indicator (country, language)	2B 34 33 2E 36 35 32 31 2B 30 30 … type=1: string +43.6521+003.3638+148.202/				
Free Atom	00 00 04 00 size	66 72 65 65 type free	00 00 00 00 00 00 00 00						

3.2 Microsoft Xtra atom

When an MP4 or MOV file is edited by Windows Properties in the 'Details' tab of (right mouse), an 'Xtra' atom is added or changed as \\moov\udta\Xtra. Besides this, several values are also added or changed in the \\moov\udta\meta atom.

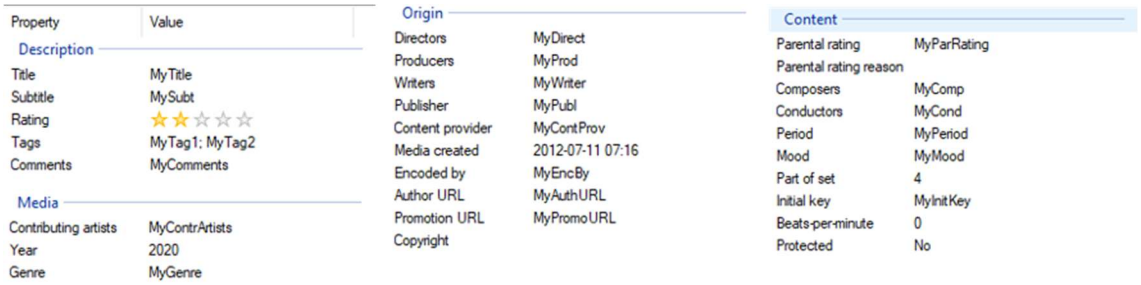


Figure 1: Properties displayed in the Windows property editor by Windows.

Table 3: Properties displayed in the Windows property editor and the atoms where they are stored.

Section	Property	Xtra key	moov/udta/meta key
Description			
	Title	-	©nam
	Subtitle	WM/SubTitle	-
	Rating	WM/SharedUserRating	-
	Tags	-	-
	Comments	-	©cmt
Media			
	Contributing artists	-	©ART
	Year	-	©day
	Genre	-	©gen
Origin			
	Directors	WM/Director	-
	Producers	WM/Producer	-
	Writers	WM/Writer	-
	Publisher	WM/Publisher	-
	Content provider	WM/ContentDistributor	-
	Media created	*cannot be set*	-
	Encoded by	WM/EncodedBy	-
	Author URL	WM/AuthorURL	-
	Promotion URL	WM/PromotionURL	-
	Copyright	*cannot be set*	-
Content			
	Parental rating	WM/ParentalRating	-
	Parental rating reason	*cannot be set*	-
	Composers	-	©wrt
	Conductors	WM/Conductor	-
	Period	WM/Period	-
	Mood	WM/Mood	-
	Part of set	-	disk
	Initial key	WM/InitialKey	-
	Beats-per-minute	-	tmpo
	Protected	*cannot be set*	-

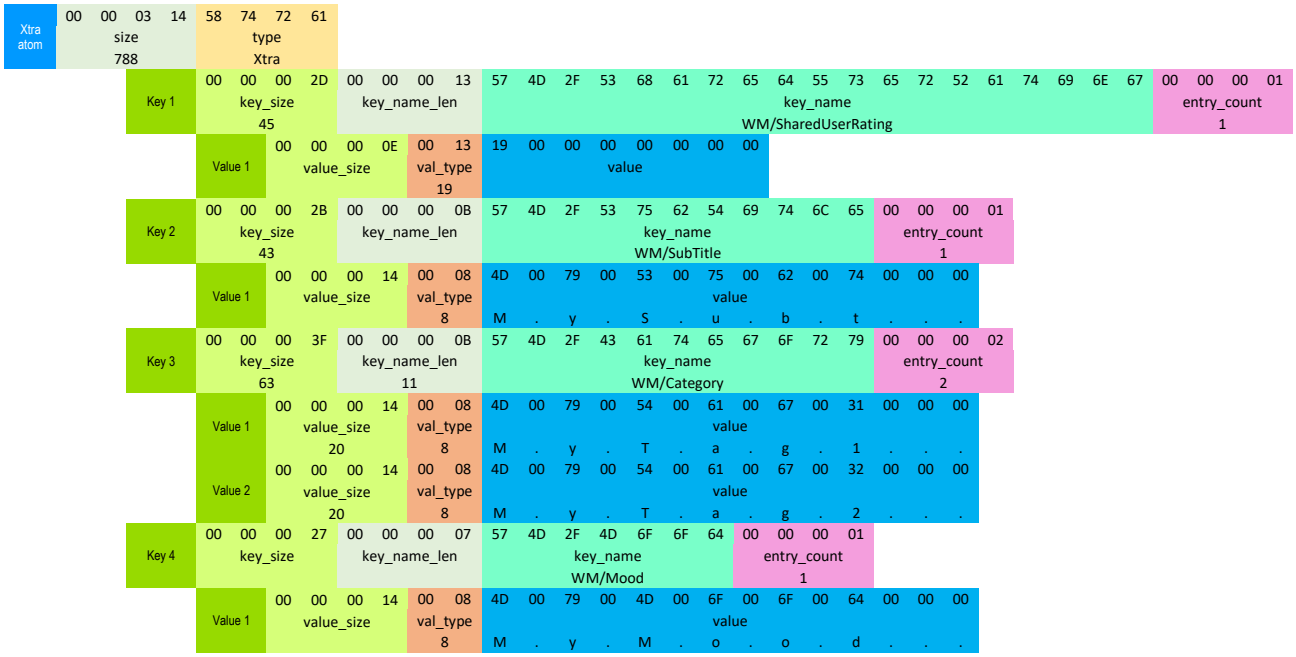
Information is not easy to find. The data can be stored in various types that are indicated by a type enumeration (like well-know types in the meta atom).

I cannot find this information as you would expect it on the Microsoft website. Although many 'keys' that are used in the Xtra atom (e.g. WM/Composer) are described in the WMF Attribute list (2) including a type enumeration (WMT_ATTR_DATATYPE enumeration); part of this enumeration is as follows: WMT_TYPE_DWORD = 0, WMT_TYPE_STRING = 1, WMT_TYPE_BINARY = 2 etc. However, this is not the enumeration used in the Xtra atom.

The actual enumeration used I found in Exiftool source code (3) and in an Xtrabox Java script (4), and is shown in Table 4. As noted in (3), an implementation has existed in a branch of mp4v2 but has been removed. This is discussed in (5).

Table 4: Type enumeration of Xtra values

Const Name	Decimal	Hexadecimal
MP4_XTRA_BT_UNICODE	8	$8
MP4_XTRA_BT_INT64	19	$13
MP4_XTRA_BT_FILETIME	21	$15
MP4_XTRA_BT_GUID	72	$48



1 https://en.wikipedia.org/wiki/MPEG-4_Part_14#
2 MOV_0234-windowscomments.mp4
3 Apple-Iphone5s.mov

1. **Wikipedia.** Wikipedia - QuickTime File Format. [Online] https://en.wikipedia.org/wiki/QuickTime_File_Format.

2. **Microsoft.** Windows Media Format 11 Attribute List. [Online] [Cited: 6 14, 2020.] https://docs.microsoft.com/en-us/windows/win32/wmformat/attribute-list.

3. **Harvey, Phil.** Perlscript "Microsoft.pm". [Online] [Cited: 6 14, 2020.] https://github.com/exiftool/exiftool/blob/master/lib/Image/ExifTool/Microsoft.pm.

4. **"XtraBox.java" script. [Online] [Cited: 6 14, 2020.] http://www.java2s.com/example/java-src/pkg/com/googlecode/mp4parser/boxes/microsoft/xtrabox-3706e.html.**

5. mp4v2 - issue #113. [Online] 8 5, 2011. [Cited: 6 14, 2020.] https://code.google.com/archive/p/mp4v2/issues/113.