HTAP FILE FORMAT SPECIFICATIONS

File extension: **.HTAP**

0.0 DOCUMENT VERSION SPECIFICATIONS

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It is allowed to:

- Use these specifications to add support to extract, transform and use the information contained in the HTAP files to any application
- Use this file format specifications to create files as the result of any hardware/software combination designed/built/distributed by a third party aimed to convert the information contained into a Magnetic tape in accordance with the content of the “INTENDED USAGE” chapter.
- Distribute publicly the present document but strictly at no charge

Changes, suggestions, corrections, requests for further information about the present specifications can be requested/communicated to info-eng@manosoft.it.

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2.0 INTENDED USAGE

HTAP file format was born to provide Retro Computers support community with a well-documented standard file format aimed to preserve the content of the old digital magnetic tapes. The format has been designed to store the information with great accuracy to allow further post-processing in statistical data analysis software and to allow its usage in Retro-computing Emulation platforms.

HTAP acronym stands for "**H"**igh resolution "**TAP"**e.

Special attention has been paid to make sure the HTAP format is able to correctly represent the real information read from tape surpassing the old TAP standard in terms of precision and consistency with the real data stored on tape for all the possible user cases.

HTAP was born primarily to store the data of the old Commodore 8-bits line of computers, anyway the format is "platform agnostic", as such it can consistently store the data of any magnetic digital tape. HTAP format contains an identifier that specifies the Computer the stored magnetic data pertains to but this information is relevant only if HTAP is converted to a non-platform-agnostic file format or for informational reasons in the post processing. The information about the computer that created the digital information is not relevant during the playback of the content of an HTAP file. A list of the valid Platform ID specifiers is provided by these specifications.

HTAP file format contains a unique signature named AuthentiTape. This signature is saved in the file by CUTE32 and any other device approved by us (see chapter "AUTHORIZATION PROCESS") when the file is created by reading a magnetic tape. This signature depends on the data stored in the HTAP file so it's always possible to make a check and understand if the file is genuine or it has been altered after it was created by an authorized hardware (see chapter "AUTHORIZATION PROCESS").

A file having a broken (or null) AuthentiTape signature can for sure be played back and loaded in an emulator or in the real CBM computers but its origin is uncertain and/or it can have been modified manually or with a specialized tool so it cannot be considered as trusted material since a GENUINE HTAP has to be intended as a "native" file resulting in a one-shot reading of the magnetic tape content or a section of it generated by an hardware combination that meets the minimum requirements indicated in the chapter "MINIMUM REQUIREMENTS".

It is allowed to anyone to create software manipulating/converting HTAP files provided that, if this software creates new HTAP files, the software sets the AuthentiTape field of the created HTAP files to $00000000. These HTAP files will be automatically recognized as NON GENUINE.

It is allowed to anyone to create a hardware that reads the content of a tape and generates an HTAP file. This Hardware will have anyway to set the AuthentiTape field of the created HTAP files to $00000000. In case Hardware vendor thinks his hardware can meet the requirements indicated in the chapter "MINIMUM REQUIREMENTS" he is allowed contact us to go through the Authorization Process so that his hardware will be authorized to produce GENUINE HTAP files.

3.0 AUTHORIZATION PROCESS

In case a vendor would like to generate GENUINE HTAP files with his own hardware/firmware combination he will have to contact Manosoft. Manosoft will ask some high-level questions to understand if the device and its firmware are meeting the minimum prerequisites indicated in “MINIMUM REQUIREMENTS” chapter and, if this is the case, will provide the necessary code to “sign” the generated HTAP files with the correct AuthentiTape signature that will certify them as being GENUINE.

We, Manosoft, retain the full right to deny to anyone to generate GENUINE HTAP files according to our unquestionable judgment.

4.0 MINIMUM REQUIREMENTS

This section describes what are the requirements a Hardware/Software combination must meet to be allowed to create HTAP files:

1. Digital tape signal edges must be detected using a micro-processor that allows to detect signal changes and to determine the duration of the pulses directly in the hardware. It is NOT allowed to use “interrupts” as a mechanism to process and measure pulses duration unless the pulse being measured lasts for more than 10ms.
2. The hardware mentioned in the point (1) above must have a minimum absolute precision of 100ns including edge detection and time counter triggering start/stop.
3. Timer internal update should take place with a precision of at least 100ns even if the timer will provide information with a resolution of 0.5us
4. The signal fed to the device indicated in the point (1) above must be directly the digital output of the tape deck used with the Computer that is aimed to process the information. The only transformations allowed on the signal are:
    a. Voltage level shifting to adapt signal voltage (typically 5V) to the voltage level used by the micro-processor. The device used in this case must introduce a symmetrical propagation delay of no more than 50ns
    b. Digital filtering in the time domain aimed to eliminate pulses with a width of no more than 10us
5. In no case it is allowed to “artificially” inject halfwaves in the HTAP that are not actually existing as content of the tape being captured (for example for polarity synchronization).
6. The minimum halfwave duration that the hardware can correctly measure must be of at least 5us. The maximum duration of a halfwave that the hardware can correctly measure must be at least 2^32 us.
7. Hardware must start to capture information form tape in the moment the user starts to replay tape content.

5.0 THE FORMAT

HTAP file format consists of one header immediately followed by tape digital data encoded with a specific standard.

THE HEADER

Header of the HATP file is stored in the first 20 bytes of the file and is structured as follows:

Offset	Length (in bytes)	Field usage
0x00	0x05	Hardware identifier. A string ID of five characters identifying the hardware that created the HTAP. e.g “CUTE32” the only one registered ID at the moment.
0x06	0x06	The string “-HIRES”. The presence of this string identifies officially the HTAP to be a valid HTAP file
0x0C	0x01	A byte indicating HTAP format version. For the moment only 0x00
0x0D	0x01	Machine that created the data stored in the HTAP. The list of compatible machine IDs is currently: 0x00 = Commodore 64/Commodore 128 0x01 = Commodore VIC20 – Commodore PET 0x02 = C16-C116-Plus/4 This list is likely to be extended.
0x0E	0x01	The Television standard of the machine that created the data stored in HTAP 0x00 = PAL – Phase Alternating Line 0x01 = NTSC - National Television Standards Committee
0x0F	0x05	Reserved – Internal Usage.
0x14	Any – Max 2GB	Magnetic Tape Data

THE MAGNETIC TAPE DATA

The data representing the digital signal stored in the magnetic tape starts at file offset 0x14.

HTAP file format is “halfwave oriented”. An halfwave is a timeframe in which the signal stays at a specific level HIGH (5V) or LOW (0) for a specific amount of time. HTAP file host the duration of the halfwaves along with other information.

The halfwaves are stored with a different format depending on their duration. We distinguish short-duration halfwaves (also called “pulses”) from long-duration halfwaves (also called “pauses”).

An halfwave is classified as short-duration (pulse) if its duration is 10ms or less. If the duration of an halfwave is more than 10ms then it is classified as long-duration (pause).

Short-duration (pulse) halfwaves are stored in units of 0.5us ticks.

Long-duration (pause) halfwaves are stored in units of 1us.

HTAP uses 16-bit integers two-bytes combinations in LSBF format to encode the information.

SHORT DURATION HALFWAVES (PULSES)

Pulses halfwaves are encoded with a single signed 16bit integer value. The sign is represented by bit 15 (value & 0x8000) and is “1” to indicate HIGH signal (5V) or 0 to indicate LOW signal (0V). The absolute value of the integer (value & 0x7FFF) represents the duration of the halfwave in 0.5us “ticks”. The duration of a pulse cannot be

greater than 10ms as we indicated previously therefore an integer representing a short-duration halfwave cannot contain a value greater than 20000 (20000 = 10000/0.5us).

For example, a pulse encoded as

0x3075

Would be illegal.

As an example of an encoded sequence of pulses let's consider the following 16-bits integers sequence:

D781 8F01 6D81

The sequence represents a signal composed of three short-duration halfwaves (pulses) as follows:

Integer on file	Absolute value (in MSB format)	Sign	Meaning
D781	01D7	High	A 5V halfwave with a duration of 471 ticks each one having 0.5us duration, therefore 235.5us
8F01	018F	Low	A 0V halfwave with a duration of 399 ticks each one having 0.5us duration, therefore 199.5us
6D81	016D	High	A 5V halfwave with a duration of 365 ticks each one having 0.5us duration, therefore 182.5us

It is NOT allowed to have sequence of pulses where the polarity is not alternating. A sequence like.

D781 8F81 6D81

Is NOT allowed since the first two pulses both have the MSb (bit 15) set so there would be two consecutive HIGH halfwaves. The same applies to two consecutive LOW pulses.

It is also forbidden to have pulses with 0 ticks duration, whatever is their specified polarity so, pulses like 0x8000 or 0x0000 are forbidden.

LONG DURATION HALFWAVES (PAUSES)

Long Duration Halfwaves (Pauses) are encoded using 4 consecutive 16-bits values. The first two 16 bits values are set to 0x0000 as flags indicating a pause.

A sequence of values such as:

0000 0000 7900 611C

Represents a pause since the first two integers are both set to 0x0000. Differently from pulses, the duration of the pauses is indicated in microseconds.

In the previous example the pause would last:

0079 1C61 = 7937121 microseconds = about 7.94 seconds

The polarity of the pauses is not stored an must therefore be derived indirectly from the polarity of the pulses in the vicinity (for example immediately before or after) the pause itself.

For example, a sequence like:

0000 0000 7900 611C D781

Indicates a long-duration (pause) LOW halfwave because it's immediately followed by a HIGH short-duration pulse (D781 = 235.5us)

In case of consecutive halfwaves the polarity is alternating from one pause to the next so in a sequence like:

0000 0000 0400 23ED 0000 0000 7900 611C D781

The first pause (0000 0000 0400 23ED) would be a HIGH pause lasting 322,8ms followed by a LOW signal pause (0000 0000 7900 611C) lasting 7.94 seconds then followed by a HIGH pulse (D781) lasting 235.5us

The initial playback level of an HTAP file can be therefore identified by searching the first pulse and then counting the pauses from the beginning of the HTAP file data and the pulse. If the number of pauses is even, then the polarity to be used when starting to playback the HTAP file is the same as the one of the first pulse just found, if the number of pauses is odd, then the polarity to use when starting to playback the HTAP is the opposite respect to the one of the first pulse found.

For example, let's suppose that the sequence used for the previous example is found at the beginning of data of an HTAP file:

0000 0000 0400 23ED 0000 0000 7900 611C D781…

The first pulse that can be found reading the stream sequentially is 0xD781 that has HIGH polarity. To get to D781 we've to skip two pauses (an even number of pauses) therefore the first pause at the beginning of the file has to be played back with the same polarity (HIGH) of the first pulse found (D781)

Element	Polarity
0000 0000 0400 23ED	HIGH – 5V long-duration halfwave (pause) 322,8ms
0000 0000 7900 611C	LOW – 0V long-duration halfwave (pause) 7.94s
D781	HIGH – 5V short-duration halfwave (pulse) 235.5us

Due to the way the pause is encoded the maximum value is:

0000 0000 FFFF FFFF

That represents a long-duration halfwave of 4294967295 microseconds that corresponds roughly to 1 Hour, 11 minutes and 34 seconds.

Important Notes:

- It is NOT allowed to concatenate pauses to extend the pause duration beyond the above specified limit
- Halfwaves of duration of 10ms or less CANNOT be encoded as Pauses, they must be encoded as pulses
- Pauses with 0 duration (0000 0000 0000 0000) are NOT allowed

- The initial pause, if present, must be calculated from the moment the user starts the replay of the tape. In no case it is allowed to omit the initial pause in case from the moment the user starts the playback of the magnetic tape to the time the first digital tape signal changes for the first time an interval of time has passed.

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