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# Recommended usage of DSDIFF version 1.5

Version 1



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# 1 Introduction

## 1.1 PURPOSE AND SCOPE

This document describes the typical usage of the DSDIFF file format, a standard file format for storing DSD material [DSDIFF]. The specification is system independent, so applications across various computer platforms can use DSDIFF files.

In the specification of DSDIFF [DSDIFF] chunks are defined. Some of these chunks are optional. Within this document recommendations of how and when to use the various chunks are given.

Furthermore guidelines are given of how to use DSDIFF in the Super Audio CD production chain.

## 1.2 DEFINITIONS, ACRONYMS AND ABBREVIATIONS

CD	<b>C</b> ompact <b>D</b> isc
CRC	<b>C</b> yclic <b>R</b> edundancy <b>C</b> heck
DSD	<b>D</b> irect <b>S</b> tream <b>D</b> igital
DSDIFF	<b>D</b> irect <b>S</b> tream <b>D</b> igital <b>I</b> nterchange <b>F</b> ile <b>F</b> ormat
DSD File	DSDIFF file containing DSD audio
DST	<b>D</b> irect <b>S</b> tream <b>T</b> ransfer
	Format for lossless encoded DSD audio
DST File	DSDIFF file containing DST encoded audio
DST Frame	1/75 second of DST encoded audio
	The time corresponds to the Super Audio CD Frame time
	Actual length in bytes is variable
EDL	<b>E</b> dit <b>D</b> ecision <b>L</b> ist
Fs	Sampling frequency for CD, being 44100Hz
GMT	<b>G</b> reenwich <b>M</b> ean <b>T</b> ime
IFF	<b>I</b> nterchange <b>F</b> ile <b>F</b> ormat
PCM	<b>P</b> ulse <b>C</b> ode <b>M</b> odulation
Silence Pattern	A digitally generated DSD pattern with the following properties: <ul style="list-style-type: none"> <li>• all Channel Bytes have the same value</li> <li>• each Channel Byte contains 4 bits equal to zero and 4 bits equal to one</li> </ul>
Super Audio CD Frame	1/75 second of audio (is equal to CD frame length) At 64×fs a frame covers 37632 DSD samples per channel
Time File	DSDIFF file containing marker information, without sound data

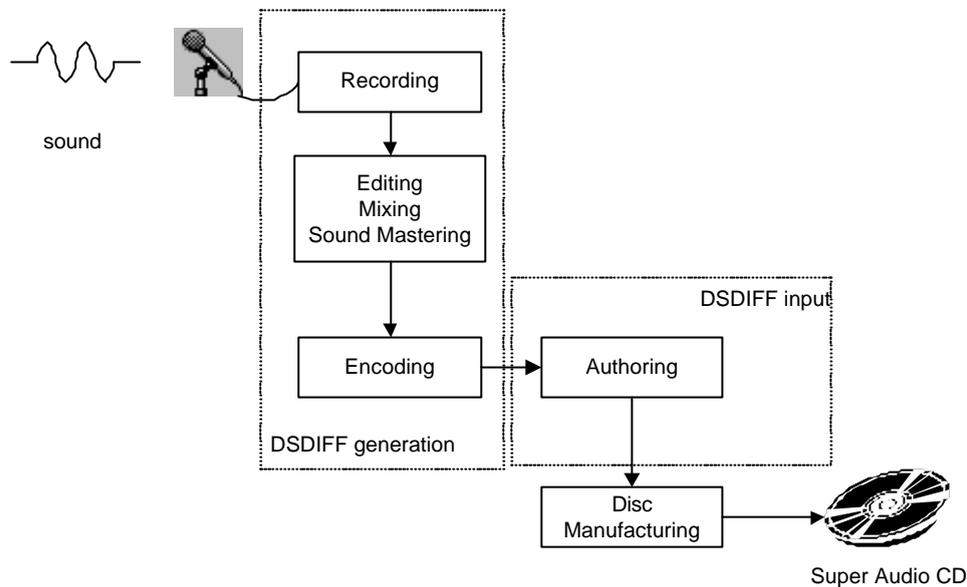
### 1.3 REFERENCES

[DSDIFF]	Direct Stream Digital Interchange File Format, Philips, Version 1.5 / April 2004
[ScarletBook]	Super Audio CD Standard (Part 2) Sony/Philips
[SONYText]	The Specification of the STT File Format Sony – Super Audio CD Business Centre

### 1.4 DOCUMENT HISTORY

Date	Version	Most important updates
2002-08-05	1.4/1	Initial document
2002-08-09	1.4/2	Added: <ul style="list-style-type: none"> <li>• Recommendation DST Sound Index Chunk (section 2.3)</li> </ul> Changed: <ul style="list-style-type: none"> <li>• Recommendation EMID (section 2.2)</li> </ul>
2002-12-03	1.4/3	Added: <ul style="list-style-type: none"> <li>• Explanation about marker offset field (section 2.2.2)</li> <li>• Time File Definition (chapter 4)</li> </ul> Changed: <ul style="list-style-type: none"> <li>• Authoring Recommendation (section 2.4)</li> <li>• File Revision information (section 5.2)</li> </ul>
2003-01-23	1.4/4	Changed: <ul style="list-style-type: none"> <li>• Size of a division file (section 3.1)</li> </ul>
2004-04-27	1.5/1	Added: <ul style="list-style-type: none"> <li>• Relation between Edited Masters and Time files (section 5.2.3)</li> <li>• Recommendations to use plain DSD in Edited Master (section 2.4)</li> </ul> Changed: <ul style="list-style-type: none"> <li>• Text changes in Naming Edited Masters and Time Files (section 5.2.1 and 5.2.2)</li> </ul> Removed: <ul style="list-style-type: none"> <li>• Versions numbers of reference documents (section 1.3)</li> </ul>

## 2 The content creation process



**Figure 1: Schematic view of the disc content creation process**

The content creation process consists of various stages.

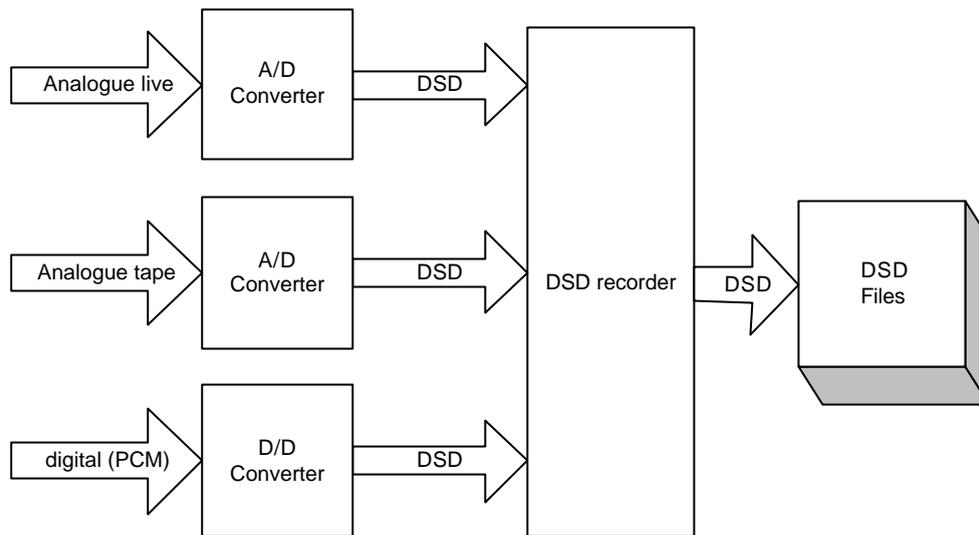
In this document the following process steps for creating a Super Audio CD disc [ScarletBook] are distinguished:

- 1) Recording
- 2) Editing – Mixing - Sound Mastering
- 3) Encoding
- 4) Authoring
- 5) Disc Manufacturing

According to [DSDIFF] not all chunks are required in a DSDIFF file. In this chapter additional information can be found on how to use the optional chunks within a particular stage of the content creation process.

The output of authoring and the input and output of the disc manufacturing are not described in this document, because the DSDIFF format is not used in those steps.

## 2.1 RECORDING



**Figure 2: Schematic overview of a recorder set up with different sound sources.**

There are different kind of sound sources for recording DSD signals (see Figure 2). To keep track of the used sound source the *File History Sound Source Comment* is defined. The following kinds of sound source types are defined within DSDIFF:

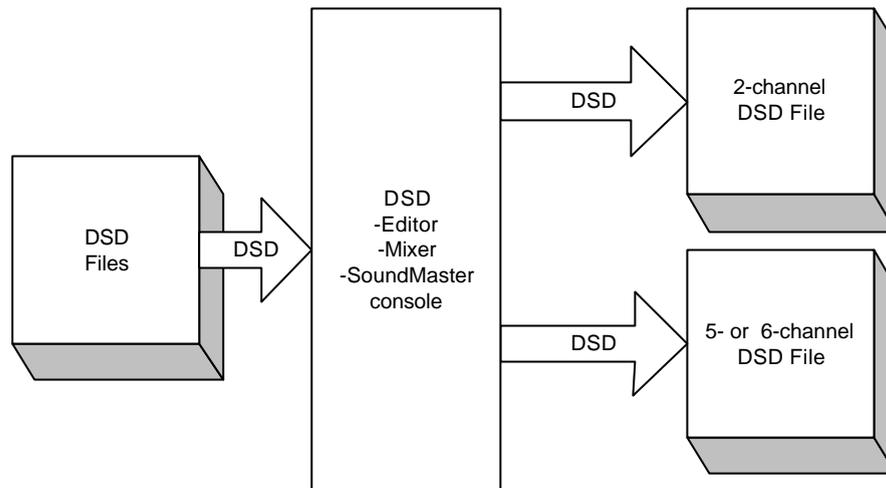
- *DSD*, sound data directly recorded in DSD during a live recording
- *Analogue*, sound data converted from an original recording on analogue tape
- *PCM*, sound data converted from an original recording in the PCM domain

### Recommended information in a DSD file after recording:

- Absolute Start time  
The start time of recording within the time line
- Channel ID's according to the loudspeaker set-up  
If the recording is not made in such a way that it corresponds with a loudspeaker configuration defined in [DSDIFF] then the *C001...C999* identifiers must be used; channel comments can be generated describing the channel contents (e.g. guitar, ...)
- Comment – General Remark  
Description of the recording
- Comment – Operator  
The name or User Identification of the recording engineer
- Comment - Sound Source [*DSD, Analogue, PCM*]
- Comment - Creating machine  
The name and version of the recorder application

## 2.2 EDITING – MIXING – SOUND MASTERING

The Editing, Mixing and Sound Mastering processes are closely related to each other. The different steps are not chronological, the order of these phases is an artistic decision. Furthermore the tools to perform these phases can be incorporated in one machine.



**Figure 3: Schematic view of the Editing – Mixing - Sound Mastering processes**

**Recommended information in a DSD file after Editing – Mixing – Sound Mastering:**

- Absolute Start time
- Channel ID's
- Loudspeaker Configuration
- Markers
- Track information, time and a description for the tracks on the disc
- Title
- Working title of the disc, for identification purposes
- Artist
- Name of the artist, for identification purposes
- Edited Master ID
- Identification for this production, for identification purposes.
- Comment – Operator
- User who created the Edited Master
- Comment - Sound Source
- Original sound sources, retrieved from the recording stage
- Comment - Creating machine
- Application or system which created the Edited Master.

For the specification of Edited Masters see [DSDIFF].

### 2.2.1 Channel configurations in Edited Masters

The Edited Master files are described in [DSDIFF]. The post production processes together will deliver at most 2 Edited Masters. An Edited Master contains the sound data and timing information to create one area on a disc.

For each of the following areas a Edited Master is generated (if the area exists):

- 2-channel area
- 5-channel area or 6-channel area

Within an Edited Master the following channel configurations per track are possible:

number of channels in file	number of used channels per track	channels in the file	used channels	TrackFlags
2	2	SLFT, MRGT	SLFT, MRGT	
5	3	MLFT, MRGT, C, LS, RS	MLFT, MRGT, C	TMF2_Mute
6	3	MLFT, MRGT, C, LFE, LS, RS	MLFT, MRGT, C	TMF2_Mute, TMF4_Mute
6	4	MLFT, MRGT, C, LFE, LS, RS	MLFT, MRGT, C, LFE	TMF2_Mute
5	4	MLFT, MRGT, C, LS, RS	MLFT, MRGT, LS, RS	TMF3_Mute
6	4	MLFT, MRGT, C, LFE, LS, RS	MLFT, MRGT, LS, RS	TMF3_Mute, TMF4_Mute
6	5	MLFT, MRGT, C, LFE, LS, RS	MLFT, MRGT, LFE, LS, RS	TMF3_Mute
5	5	MLFT, MRGT, C, LS, RS	MLFT, MRGT, C, LS, RS	
6	5	MLFT, MRGT, C, LFE, LS, RS	MLFT, MRGT, C, LS, RS	TMF4_Mute
6	6	MLFT, MRGT, C, LFE, LS, RS	MLFT, MRGT, C, LFE, LS, RS	

**Table 1: Possible channel configurations per track within an Edited Master.**

*Note 1: An Edited Master is restricted to 2,5 or 6 channels per file with a fixed channel identification. When a different amount of channels is wanted, the unused channels must still exist and must be filled with silence patterns. Denoting that a channel contains "digital silence" can be done with Track Mute flags.*

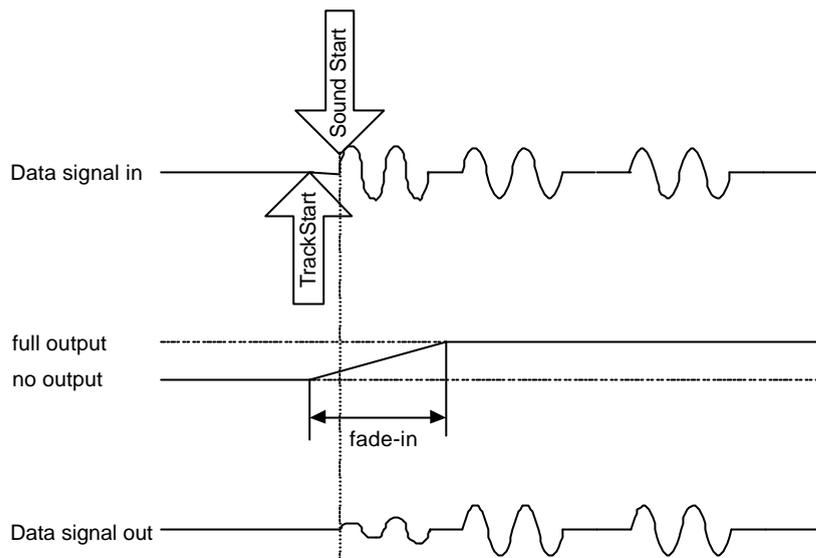
*Note 2: Other channel configurations are not allowed.*

It is recommended that each Edited Master has a unique EMID. The 2-channel Edited Master and the multi-channel Edited Master must have different EMID's even if they belong to the same title (or disc).

See also **Authoring, paragraph 2.4.**

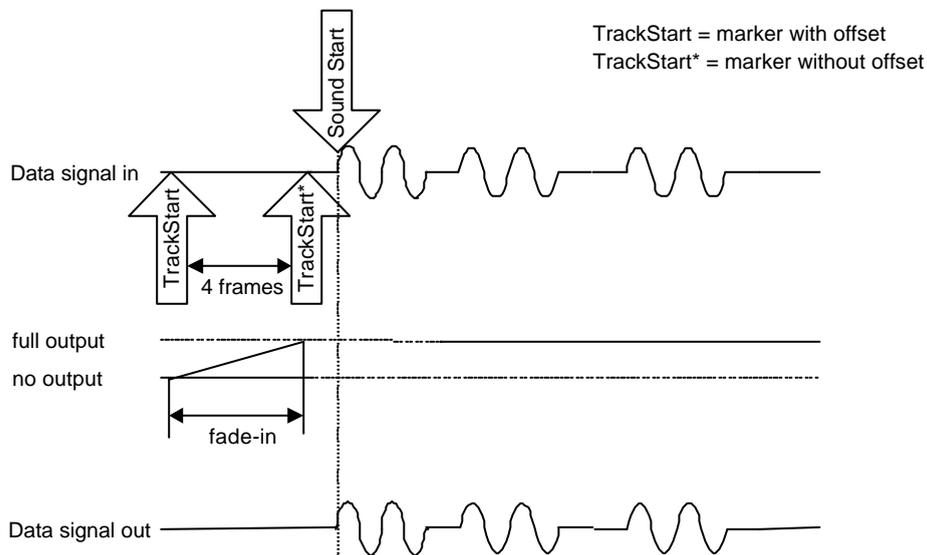
**2.2.2 The Marker offset field**

In the Super Audio CD specification [ScarletBook] it is stated :  
*It is recommended that both the fade-in and fade-out times of a SuperAudio CD player are less than 50ms.*  
 This means e.g. that the first notes of music may be masked by the fade-in of Super Audio CD players.



**Figure 4: Data masking by a fade-in of a Super Audio CD player when starting to play at a TrackStart Marker.**

The marker offset field can be used for compensating the difference between the intended starting point of the sound in a track and the marked position in a waveform on the timeline. A very likely position of the TrackStart Marker is the first DSD frame boundary in front of the first note of the music. To prevent masking of the first notes of the music the corrected position would be 4 DSD frames in front of this position.



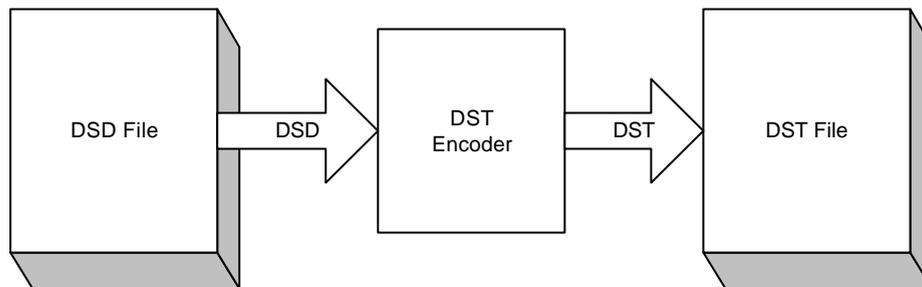
**Figure 5: No data masking by a fade-in of a Super Audio CD player due to the offset of the marker.**

It is recommended that editing systems have a default marker offset position of -150528 samples (corresponding to the number of samples in 4 frames) for TrackStart and Index markers.

Note: resulting marker positions (marker plus offset) must always designate a point within the sound file.

## 2.3 DST ENCODING

The encoding process compresses DSD data resulting in DST data. The compression algorithm is lossless: the process is reversible.



**Figure 6: The DST encoder will transform DSD sound data into DST sound data**

Compression is obligatory for 5 or 6-channel area, but can also be used for a 2-channel area. Therefore the sound data in a 2,5 or 6-channel DSD file can be compressed, resulting in a 2, 5 or 6-channel DST file. The DST frame rate is fixed to 75 Hz.

The DST encoding process can also be a part of Authoring.

It is recommended to encode a 2-channel area when a disc is created with a 2-channel area and a 5 or 6-channel area.

### Recommended information in a DST file after encoding:

The data to be transferred from a DSD to a DST file:

- Absolute Start time
- Channel ID's according to Edited Master
- Loudspeaker Configuration
- Markers
- Title
- Artist
- Edited Master ID
- All existing Comments

Additional data :

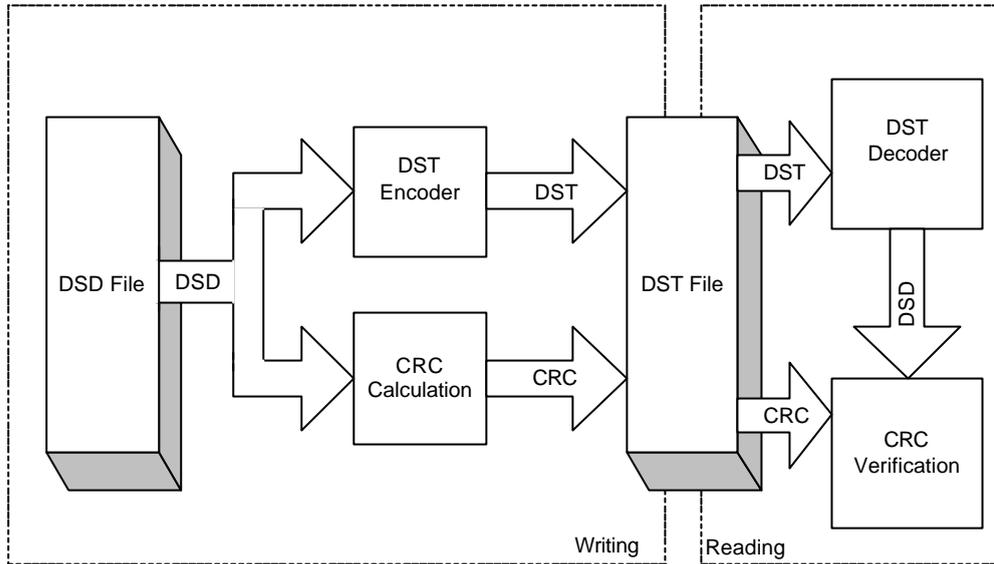
- Comment – Operator of the DST encoding process
- Comment - Creating Machine for the DST encoding process
- DST Sound Index Chunk
- CRC

### 2.3.1 Checking the DST encoding algorithm

The DST encoding algorithm can be verified by means of a CRC. The CRC is calculated over the DSD Frame data, which is the input for the corresponding DST frame. The CRC is stored together with the DST frame in a DST file.

After decoding the DST frame, the stored CRC can be used to verify the decoded DSD.

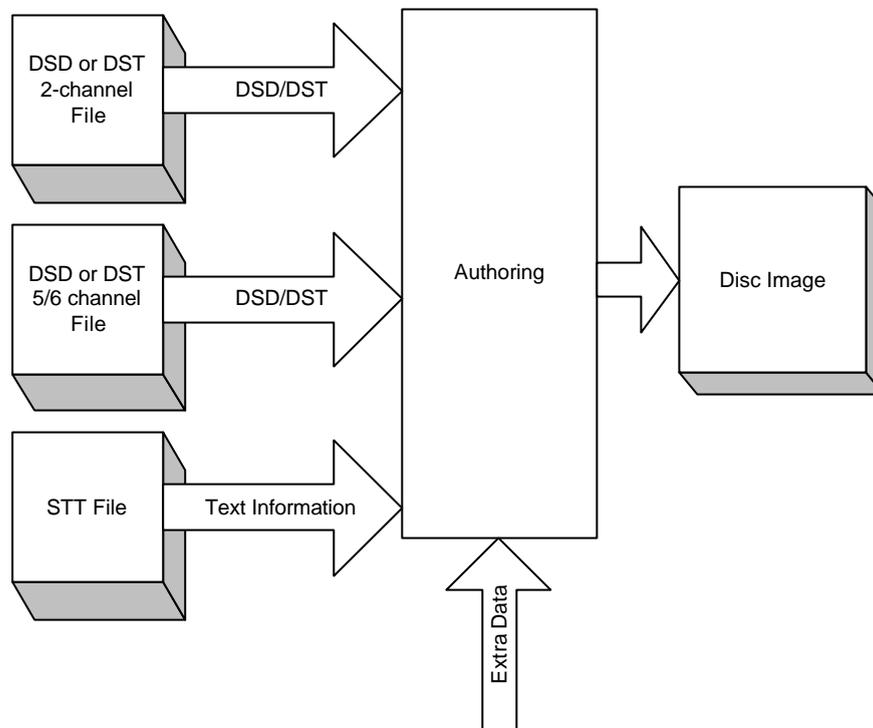
An implementation example of the CRC algorithm can be found in "Appendix A : The CRC algorithm".



**Figure 7: The DST encoder with CRC checking of the DST encoding algorithm.**

## 2.4 AUTHORIZING

Authoring will use DSDIFF files as input format for the sound data together with the time information. The input for Authoring will be a 2-channel Edited Master for the 2-channel area and a 5-channel or 6-channel Edited Master for the 5 or 6-channel area.



**Figure 8: Overview of the Authoring process.**

The input for the 5 or 6-channel area should be a DSD or DST file, if the input is a DSD file the DST encoder must be part of the authoring system.

The input for the 2-channel area can be either a DSD or DST file.

The input files must be Edited Masters [DSDIFF].

It is recommended to use plain DSD data in an Edited Master because not all authoring systems are capable of handling Edited Masters with DST encoded data.

DST encoded Edited Masters can be used for 2 channel and 5 or 6 channel areas, if it is checked that the authoring system to be used accepts DST encoded data.

Recommendations regarding DSDIFF:

- The recommended value for *Absolute start time* is zero.
- The recommended value for *ProgramStart* is the beginning of the sound data.
- The recommended length of sound data after the *ProgramEnd* is 2 second. This data is called *Post-roll* and must contain a muted signal.

When creating hybrid discs it is recommended that the marker information is identical if the same audio is placed on the CD-layer and the 2-channel area of the Super Audio CD.

The Text Information [SONYText] and the Extra Data are outside the scope of this document.

# 3 File system limitations

## 3.1 INTRODUCTION

The DSDIFF file format is defined independent of a specific operating system or file system. However, the size of a file can be limited by an operating system or file system (see Table 2). The maximum file size of a 5 or 6-channel uncompressed Edited Master will typically be over 4 Gigabyte. Therefore a number of file systems can not handle these large files.

Max Size	FAT16	FAT32	NTFS	HFS	HFS+
volume	2Gbytes	2Tbytes	2Tbytes	4Gbytes	2Tbytes
file	2Gbytes	4Gbytes	2Tbytes	4Gbytes	2Tbytes
name (+ extension)	8+3	255	255	31	255

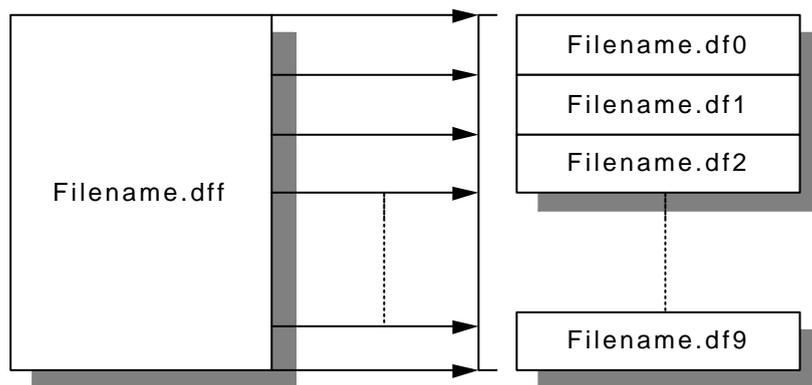
**Table 2: Maximum values of existing file systems**

Embedded systems are typically based on FAT16, FAT32.

PC based systems are typically based on NTFS, HFS and HFS+. To enable data exchange between these systems, a file larger than 4Gbytes, must be divided into a number of small files, each less than 4 Gigabyte.

## 3.2 THE DIVISION METHOD

A file is divided into a set of smaller (division) files. These division files are binary parts of the input file. One division file can not be interpreted as a single DSDIFF file. The binary concatenation of the division files will be the same as the original file.



**Figure 9: Division of a large DSDIFF file into "division" files.**

The extension of the filename will be used for tracking the order of concatenation. The filename will exist of <Filename>.dfN where:

- Filename is the original filename before division

- N denotes the order of the division files: the extensions of the divided files [df0 ...df9] represent the order of concatenation.

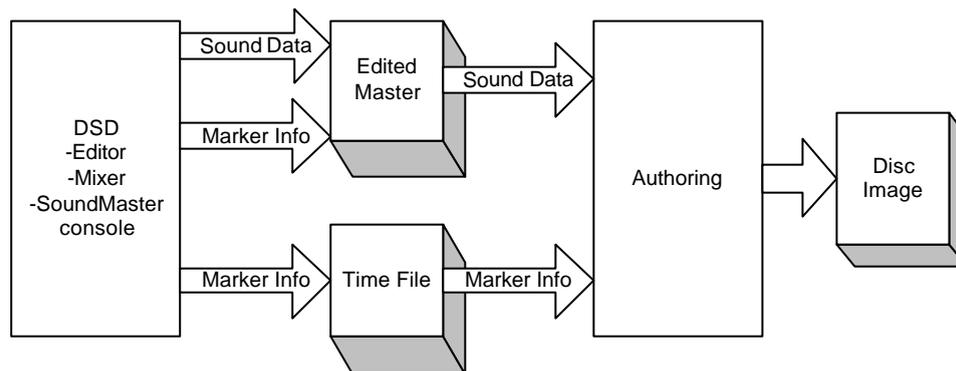
A DSDIFF file can be divided into a maximum of 10 division files.

# 4 Time File

## 4.1 INTRODUCTION

An Edited Master contains the DSD (or DST) sound data, marker and other information in one file. This has the advantage that all the data related to the sound and the sound data are kept together. However, this is also a disadvantage : the sound has to be exported again if the marker information has to be updated, resulting in a large file with respect to the marker information (the only part of information that has changed) itself.

Therefore it will be useful to export only the marker information in a DSDIFF file, which will be used to overrule the marker information of the original Edited Master file. The file without the sound data will be called a "*Time File*". The Time File will not contain the sound data and will be quite small in respect of the complete file with the sound data.



**Figure 10: Overview of using a Time File to overrule the markers in an Edited Master.**

## 4.2 EXTENSION OF A TIME FILE

The extension of the time file is ".dft".

### 4.3 REQUIRED CHUNKS IN A TIME FILE

In a Time File the following chunks must be available:

- Form DSD Chunk
  - Format Version Chunk
  - Property Chunk
    - Sample Rate Chunk
    - Channels Chunk
    - Compression Type Chunk
    - Absolute Start Time Chunk
    - Loudspeaker Configuration Chunk
- DSD Sound Data Chunk
- Comments Chunk
- Edited Master Information Chunk
  - Edited Master ID Chunk
  - Marker Chunks

### 4.4 RESTRICTIONS ON A TIME FILE

The following restrictions apply to a Time File :

- The sound data type is DSD
- The Compression Type is 'DSD '
- The DSD sound Data must have size 0.

The following chunks must be the same as in the related Edited Master:

- Format Version Chunk
- Channels Chunk
- Sample Rate Chunk
- Absolute Start Time Chunk
- Loudspeaker Configuration Chunk
- Edited Master ID Chunk

The Marker chunks must exist and contain a valid *Program*.

The Comments chunk must have a *File History / Revision* comment. It is recommended to have only one *File History / Revision* comment per Time File.

### 4.5 IDENTIFICATION OF A TIME FILE

Data used for identification of the Time is :

- The EMID in the Edited Master ID Chunk, *emid[]*. For relating to an Edited Master.
- The *File History / Revision* Comment, to distinguish different versions of the Time File. Furthermore it is recommended to use for further identification:
  - Artist chunk
  - Title chunk
  - The *File History / General Remark* Comment, to explain the different versions of the Time File.

# 5 File History

## 5.1 INTRODUCTION

The Comments Chunks in DSDIFF can store different kinds of comments. One of the Comment types is the *File History*.

The *File History* type has subsets, called references. By looking at all the comments designated by a File History reference a change history of the file can be made up.

Specified references are :

- General Remark  
A remark why and how a specific operation has been performed.
- Operator  
The name or User Identification of the operator.
- Creating Machine  
The name and version of the machine or application responsible for creating the file.
- Place or Zone  
The information about the time zone (or location) with respect to GMT.
- Revision  
The revision number of the Time File.

### General Recommendation:

*When the sound data of a DSDIFF file is copied to another file it is good practice to copy all comments (in the same order) to keep the history of the file.*

The time stamp is leading for the order of the comments. But there will be applications writing DSDIFF files without a real time clock. These applications should specify a year less than 2000, indicating that there is no real-time clock available. Linking comments by means of using the same time stamp will also apply here. So the first set of comments generated should use the year 0, the second set year 1, etc. When time stamps less than 2000 exist then order of the comments in the DSDIFF file will be leading over the time stamp.

## 5.2 FILE REVISION INFORMATION

When an error in the Edited Master is noticed a new Edited Master has to be generated incorporating the fix. By generating another Edited Master or a Time File one should distinguish the different file versions.

### 5.2.1 Edited Masters

To distinguish the different versions of an Edited Master one should:

- Create a new EMID when the audio data is changed.
- Add or increase the *File History / Revision number* when metadata is changed, but the audio data remain unchanged.

The textual description of the reason of the remake should be added as a *File History / General Remark*. It is recommended to use the *File History / Revision* in an Edited Master when metadata is changed, while the audio data remained unchanged.

An EMID can exist of:

<company><project><date><time>

Example of an EMID:  
 "Philips\_SuperAudioCDProject\_2004-03-22\_17:00"

### 5.2.2 Time Files

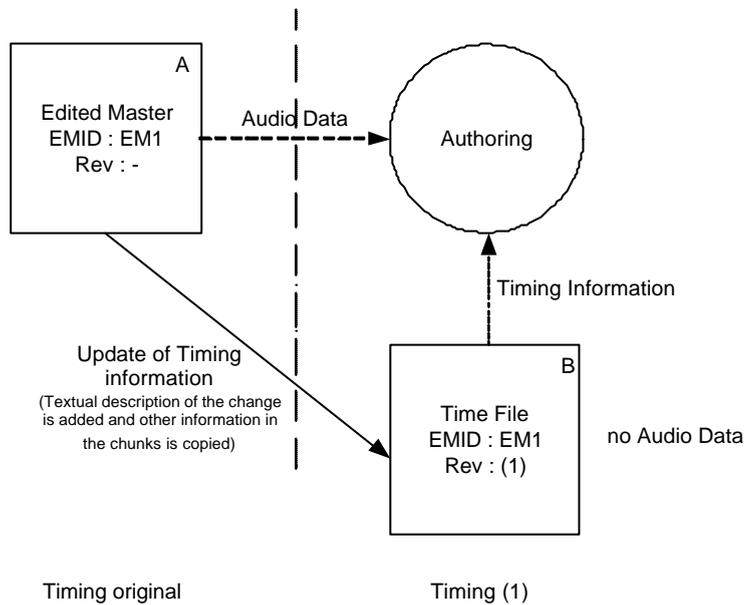
To distinguish the different versions of a Time File one can:

- Add or increase the File History / Revision number

The textual description of the change/remake should be added as a *File History / General Remark*.

The relation between a Time File and an Edited Master is maintained by the EMID.

### 5.2.3 Relation between Edited Master and Time Files



**Figure 11: Relationship between Edited Master and Time Files**

Edited Master A is the original file, it has no revision information. The timing data (marker information) of file A will be updated by means of Time File B. This means that at the Authoring stage the files A and B will exist, and that the sound data of file A and the timing information of file B are used for authoring.

The authoring stage must allow the users to verify EMID of the Edited Master and the *File History / Revision* of the Time File.

When merging the Edited Master A with EMID 'EM1' and Time File B with EMID 'EM1' and Revision '(1)', the EMID of this new created Edited Master will be 'EM1' with Revision '(1)'.

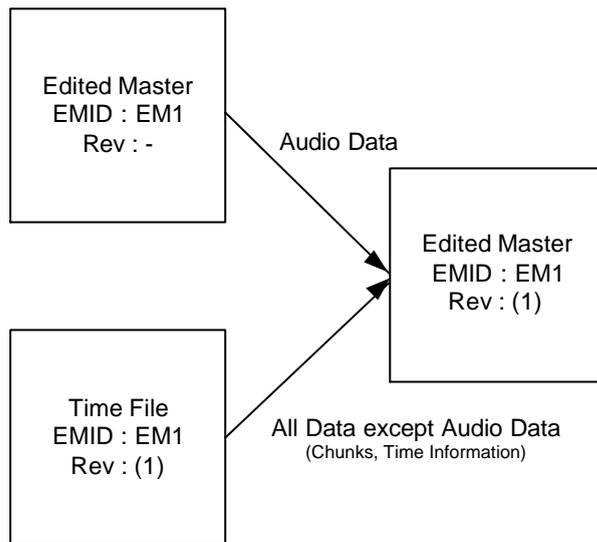


Figure 12: Merging of Edited Master and Time File

### 5.3 EXAMPLES OF USAGE OF COMMENTS

Comment order in file	Time Stamp yyyy-mm-dd hh:mm:ss	<i>cmtType</i> / <i>cmtRef</i>	Description
1	2001-12-19 12:30:10	0/0	"My First Comment"
2	2001-12-19 12:30:10	3/2	"Program X Version"
3	2001-12-19 12:30:10	3/1	"User Identification"

Table 3: One set of comments linked by means of the time stamp.

Comment order in file	Time Stamp yyyy-mm-dd hh:mm:ss	<i>cmtType</i> / <i>cmtRef</i>	Description
1	2001-12-19 12:30:10	0/0	"My First Comment"
2	2001-12-19 12:30:10	3/2	"Program X Version"
3	2001-12-19 12:30:10	3/1	"User Identification"
4	2001-12-19 12:40:10	3/4	"(1)"
5	2001-12-19 12:40:10	3/0	"Update Timing"

Table 4: Comments in a Time File belonging to the previous Example.

Comment order in file	Time Stamp yyyy-mm-dd hh:mm:ss	<i>cmtType</i> / <i>cmtRef</i>	Description
1	2001-12-19 12:30:10	0/0	"My First Comment"
2	2001-12-19 12:30:10	3/2	"Program X Version"
3	2001-12-19 12:30:10	3/1	"User Identification"
4	2001-12-19 12:40:10	3/0	"Update Timing"
5	2001-12-19 12:50:10	3/4	"(2)"
6	2001-12-19 12:50:10	3/0	"Update Timing again"

Table 5: Second Time File (see section 4.4)

Comment order in file	Time Stamp yyyy-mm-dd hh:mm:ss	<i>cmtType</i> / <i>cmtRef</i>	Description
1	2001-12-19 12:30:10	0/0	"My First Comment"
2	2001-12-19 12:30:10	3/2	"Program X version"
3	2001-12-19 12:30:10	3/1	"User Identification 1"
4	2001-12-19 14:30:10	3/2	"Program Y version"
5	2001-12-19 14:30:10	0/0	"My Second Comment"
6	2001-12-19 14:30:10	3/1	"User Identification 2"
7	2001-12-19 14:30:10	3/3	"(GMT -01:00)"

**Table 6: Two sets of linked comments [1..3] and [4..7].**

Comment order in file	Time Stamp yyyy-mm-dd hh:mm:ss	<i>cmtType</i> / <i>cmtRef</i>	Description
1	0000-00-00 00:00:00	0/0	"My First Comment"
2	0000-00-00 00:00:00	3/2	"Recorder X version"
3	0000-00-00 00:00:00	3/1	"User Identification 1"
4	2001-12-19 12:30:10	0/0	"My Second Comment"
5	2001-12-19 12:30:10	3/2	"Program Y version"
6	2001-12-19 12:30:10	3/1	"User Identification 2"
7	0001-00-00 00:00:00	0/0	"My Third Comment"
8	0001-00-00 00:00:00	3/2	"Emb. System Z version"
9	0001-00-00 00:00:00	3/1	"User Identification 3"

**Table 7: Three sets of linked comments, two of them generated by a machine without a real time clock [1..3] [7..9].**

## APPENDIX A : THE CRC ALGORITHM

Source code for calculating the CRC over the DSD data of size of 1 DST frame.

```

#define CRC_CRCSize (4)                // Size of the CRC in bytes
#define CRC_FRAMESEONECHANNEL (4704)   // FrameSize in bytes of one channel

ULONG CRC_CalcOverDSD(int numChannels, BYTE* Message, bool Check)
{
    // numChannels : the amount of input channels [2,5,6], this determines the length of the input message.
    // Message : the actual DSD stream with length of 1 Frame.
    // Check : TRUE, checking the CRC, message is appended with the CRC to be checked
    //         FALSE : calculating the CRC, returned in a ULONG.
    ULONG Poly = 0x40000008;           // polynomial, shifted 1 bit to the right
    const unsigned long Long_msb = 0x80000000; // used to check value of bit 31 of shift register
    const unsigned long Short_msb = 0x80; // used to check value of bit 7 of messagebyte
    int MessageByte;                  // used to store 1 messagebyte
    int i,j;                           // counters
    long unsigned Rem;                 // used to store contents of shift register (remainder)
    int numBytes = CRC_FRAMESEONECHANNEL*numChannels;
    // amount of bytes in the message
    if (Check) numBytes +=CRC_CRCSize; // increase with the size of the polynomial
    //
    // Data is put through a 32 bits shift register. After all data has been processed, the
    // shiftregister contains the CRC value (this is called the remainder, variable REM).
    // When the Check option is on, the 4 CRC bytes are also put through the shift register.
    // If that CRC is correct, the remainder should be zero at the end.
    // Data is put through, MSB first.
    // Shifting is easy:
    // if bit 31 of the shift register (=Rem) is not equal to the next databit then the value
    // of the shift register is XOR'ed with the shift polynomial (that polynomial equals
    // the XOR gates of the shift register, excluding the first and the last gate). The register
    // is shifted 1 position to the left (a 1 is inserted at bitposition 0). Otherwise
    // the register is shifted 1 position to the left (a 0 is inserted at bitposition 0).
    Rem = 0L;                          // initialize shift register

    for (i=0;i<(numBytes);i++)          // process all bytes
    {
        MessageByte = Message[i];
        for (j=0;j<8;j++) // process bits of 1 byte
        {
            if ( ((MessageByte & Short_msb) == Short_msb) != ((Rem & Long_msb) == Long_msb))
            {
                Rem ^= Poly;           // XOR and shift with value 1
                Rem = (Rem << 1) + 1;
            }
            else
            {
                Rem = (Rem << 1);      // no XOR, shift with value 0
            }
            MessageByte <<= 1;         // shift byte so next bit of data will be processed
        };
    };
    return (Rem);
}

```