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Accessing Audio Files on a CD-I Disc

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CD-I has inherited some addressing conventions from CD audio which are discussed in this note. A two-second offset exists between the "Absolute Time" time base and the "Logical Block Numbers" used in accessing files.

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Accessing Audio Files on a CD-I Disc

1) Introduction

Some of the addressing conventions that exist for the family of compact discs are not intuitive. Because their definition is spread over the Red, Yellow and Green Books, it is not easy to access the information in its original form. This technical note is an attempt to clarify the things a programmer should know to be able to access Red tracks on a Green disc. It also explains how to interpret the disc access data achieved by monitoring the RS lines that carry the commands that go from the MMC to the player. AIM provides a Macintosh program, called "SPY" for the latter purpose.

2) Addressing conventions

The complications that surround addressing in the CD media are part of the heritage of Compact Disc as an audio medium. It was decided that for audio purposes a tolerance of plus or minus one (1) second would be acceptable. Thus, the Red Book specifies this amount of slack between the actual music tracks and the subcode that contains the address information. Also, the Red Book specifies two second's worth of silence between tracks; as a result, no matter where the exact start of the play begins no audible disturbance is created. Later, when compact disc expanded to include the CD-ROM definitions, the authors of the Yellow book had to guarantee that all addressable information on the disc could indeed be accessed by the drives. They achieved this objective by having the sector at the absolute time code of 2 seconds be the "Logical Block 0." Thus, by creating a logical addressing space that was offset by two seconds from the absolute time base, they could guarantee access to every block, despite the tolerance between main channel and subchannel.

Since the Green Book is a further refinement of the Red and Yellow books, this addressing convention was inherited (but not explicitly mentioned) in the Green Book. The only reference to this effect in the Green Book is indirect. In Chapter II (page II-5), it says that the label starts at 00:02:16, while in Chapter III (Page III-15) it says that the label starts in block 16. This is the same two-second offset between Absolute Time and Logical Block Number.

The same is true for the one-second tolerance that is still reflected in the Green Book in regard to access to Red Tracks under the SS_CDDA function call.

3) Consequences for reading Audio Tracks on a CD-I disc.

The functions ISSeek, SS_Seek and SS_CDDA operate on the basis of the file position pointer, which is in the Logical Block Number domain. The information found in the TOC is in the Absolute Time Code domain. Thus, when a Red Track is

played on a hybrid CD-I/CDDA disc, the following operations need to be performed:

- Read the TOC to get the time code address of the track to be played.
- Transform the time code into a file position pointer. This can be done by subtracting two seconds from the time code, converting the Minute:Second:Frame format into Frames, and multiplying the resulting "Logical Time Code," expressed in frames, by 2048.
- Seek to this file position pointer by either `I$Seek` or the C-equivalent `lseek()` for the case in which the head does not need to be pre-positioned, or by `SS_Sseek` if the optical head needs to be pre-positioned.
- Start the actual play with `SS_CDDA`.

The most frequent mistake in this area is to not subtract the two-second offset between Q channel TOC and file position pointer.

Alternatively, the Red Tracks can be built into the CD-I disc image; in which case, you always remain in the "Logical Block Number" domain, and you do not have to worry about the offset, etc. You can simply open the file and play it. This is one of the reasons that delivering a complete disc image that includes the Red Tracks for mastering is recommended.

4) Consequences for using "SPY".

When using "SPY" or any other means to monitor the accesses to the disc, keep in mind that the RS commands given by the MMC to the disc drive are in terms of ATime. Thus, the reading of the disc label in block 16 shows as a GOTO 00:02:16, and equally you find the same two-second offset for all file accesses. When doing these measurements, keep in mind that the MMC adds one more variable to this. It has a built-in calibration routine that compensates for the plus or minus one-second tolerance between subchannel address and main channel address. It does this by maintaining an offset internally which it measures on the first access and continuously corrects on the basis of further accesses. This is a unique feature of the Philips MMC that considerably reduces the overall access time. On the other hand, this could be quite confusing for someone who is trying to correlate commands on the RS line to file accesses on the disc, so you have to be aware of this. The offset is fixed for each disc (although potentially different for different discs). Also, in modern pressing plants, the proximity of subchannel and main channel addresses is under much tighter control than the plus or minus one-second worst case figures that are allowed by the standard. Thus, in actual measurements, it turns out that offsets of a couple of frames are typical. In summary, when trying to interpret results from monitoring the access lines to the player and trying to correlate that with file addresses on the disc, keep in mind that there is a fixed offset of two seconds between the two, and a variable offset that is typically on the order of a few frames. Once the relationship is established, it is constant for the whole disc.

5) Conclusion.

This note describes the notion of the Absolute Time Codes and the Logical Block Numbers for access to locations on the Compact disc. Once the distinction is clear, it is a simple matter of taking a two-second offset into account when going from one domain to the other.