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Flash Drive CHS Mapping

Modern flash drives are formatted with the same file systems as a modern hard drive would be. Two main examples being fat32 or NTFS. Modern hard drives are now equipped with an integrated Hard Drive Controller that allows the hard drive and CPU to communicate. This interface allows the mapping of the logical blocks to the physical CHS. Transistor-based semiconductor memories like a flash drive have a similar mapping process but use different tools. The flash drive will use a flash memory controller(FMC) to interact with the CPU. The flash drive’s FMC uses a flash translation layer (FTL) that contains the mapping procedure for mapping the LBA to physical addresses in the flash memory. This procedure happens below the file system.

CHS is no longer used as the primary scheme it has been replaced by Logical Block Addressing (LBA) yet it still leaves naming remnants. Even though the disk drive will report some CHS values as sectors per track (SPT) and heads per cylinder (HPC), they have little to do with the disk drive's true geometry. CHS values were replaced with LBA as CHS has a limit on the amount of addressable space. Using the standard Advanced Format (AF) CHS values, 1024 Cylinders \* 63 Sectors per Track \* 256 Heads \* 4096 Bytes per Sector totals to 64GBs of addressable storage. As CHS is still used on hard drives, LBA is used to translate those values into the actual blocks on the disk. With LBA, every sector is assigned a unique section number from 0 to N-1, with N being the total number of sectors on the disk.

To translate from CHS tuples to LBA section numbers, the following formula is used:

*A* = (*c* ⋅ *N*heads + *h*) ⋅ *N*sectors + (*s* − 1),

where *A* is the LBA address, *N*heads is the number of heads on the disk, *N*sectors is the maximum number of sectors per track, and (*c*, *h*, *s*) is the CHS address.

CHS values directly specify where a block is located on the disk, but even then, no hard disk is going to contain 256 heads, so if the hard drive needed more addressable space a value larger than the actual number of heads would be used, and the hard drive controller would translate that value to the actual location on the hard drive.

High Level Overview

1. Application layer creates a file
2. OS calls file system
3. File System specifies Logical Blocks for file allocation using LBA (Logical Block Addressing)
4. Volume Manager manages any hard drive abstraction or virtualization ex. RAID
5. Computer uses disk driver to interact with the storage unit
6. Integrated Hard Drive Controller maps
   1. to physical blocks using flash translation layer
   2. to physical blocks in CHS

References:

<https://www.forensicmag.com/article/2014/04/solid-state-drives-part-5>

<https://flashdba.com/2014/09/17/understanding-flash-the-flash-translation-layer/>

<http://files.iccmedia.com/magazines/basfeb15/basfeb15-p25.pdf>

<http://drona.csa.iisc.ernet.in/~gopi/west10/goodson.pdf>