About Solid State Drives (SSD)

Layout of the various disks

Solid State Drives (SSDs) can replace or complement traditional hard disks (HDDs). New Notebooks often dispose over SSDs, if not it is possible for users to upgrade by paying a surcharge. Unfortunately, the different structure of SSDs and hard disks is considered by only a few applications. This may lead to a massive loss of performance or a failure of memory cells due to the still limited number of write cycles on SSDs.
Note: deleting data is always a write cycle.

Hard disk layout

A hard disk consists of one or more circular plates coated with a thin magnetic layer. These plate (s) are attached concentrically on a rotating hub or shaft and always rotate with a constant speed around its own axis. With the help of magnetic heads (read / write heads), which glide on a stable air bubble of about 0.2 micron thickness of these plates, the data is read and written.

The circular plates are divided into tracks, which are distributed as concentric circles at equal distance above the surface of the magnetic disk inside a hard drive.

Each track contains a constant number of sectors, which divides each track into equal sections.
A sector contains at least 512 bytes, hard disks with large sectors contain a multiple of 512 bytes. This size is the smallest unit of disk access; as a result, at least an entire sector must be read or written.
The magnetic heads (read / write heads) are connected by an arm. This will result in a change of track on all plates simultaneously. Writing data will therefore be conducted from head to head and not from track to track, since no mechanical motion is carried out. The term cylinder was chosen to illustrate the concept. A cylinder depicts all tracks with the same number on all plates of a hard disk.

SSD layout

In contrast to the hard disk, a SSD consists of semiconductor memory building blocks, it contains no mechanical parts. The smallest unit of an SSD is a page, which is composed of several memory cells, and is usually 4 KB in size. Several pages on the SSD are summarized to a block. A block is the smallest unit of access on a SSD. Currently, 128 pages are mostly combined into one block; therefore, a block contains 512 KB.

Hard disk alignment

CHS (cylinder head sector) alignment

The alignment on cylinder head sector indicates an addressing method that introduces the geometry of the hard disk with the hard disk controller. This allows it to read data from a disk or write to one.

SSD alignment

Unlike hard disks, SSDs use a different algorithm to determine the first logical sector. The data are always read and written in blocks. Therefore, partitions / volumes need to always be aligned in blocks on SSDs.

From Microsoft Windows Vista on a non - CHS orientation is supported by Windows. In the registry under „HKEY_LOCAL_MACHINE\SYSTEM\CURRENTCONTROLSET\SERVICES\VDS\ALIGNMENT" are default values, which can be modified by the administrator. From a disk size of 4 GB on, the values stored are 1 MB. This value, 1 MB, is a multiple of the standard block size of 512 KB for SSDs and a multiple of 64KB at a CHS alignment. In this way, Windows ensures that both disks can work optimally.

Alignment support of O&O DiskImage

If drives (partition / volume) are not created using the proper alignment, it means a loss of performance at each read and write access. In contrast to the usual hard disks, the number of write accesses to a block in SSDs is limited. As a result, there is a risk whenever the alignment is mismatched that more pages have to be written or deleted, than actually available. This in turn can lead to an earlier failure of blocks.

The imaging program O&O DiskImage is compatible with conventional hard disks and SSDs. While cloning and restoring both types of alignment are considered. The program always prioritizes the alignment of the target disk. When restoring or duplicating to a Basic/GPT disk or empty area, the partitions are created according to this prioritization. If an image, from a source partition of a conventional hard disk is restored or cloned on a SSD, the partition on the SSD always will be aligned to the SSD. When restoring or cloning a drive, which is aligned to CHS, and the currently running operating system designates a 1 MB alignment, than for compatibility reasons, the CHS alignment is chosen.

References

The SSD Anthology: Understanding SSDs and New Drives from OCZ
http://www.anandtech.com/show/2738/5