

Data Compass - Recovering Data from Failed Hard Drives

A Hard Drive can be compared to a small computer. It employs microprocessors to control both the physical behaviour of the various electro-mechanical components, and the logical operations that store and retrieve data as an arrangement of the magnetic particles on the disk surface. This operation is completely independent of the operation of the host PC. Like any computer, the hard drive needs its own software to control the operation of the microprocessors, but unlike a PC this software is limited to the drive's operational functionality, and is not (and under normal circumstances cannot be) changed by the user. This hard drive 'software' is, as a result, more usually referred to as 'Firmware'. The firmware carries out a range of functions, from what might be termed 'Analogue' functions such as controlling the spinning of the disc and positioning of the read/write heads, as well as the 'Digital' functions used to pass data files to and from the PC, keeping track of the location and parameters of the data files stored, and many, many more. Without firmware the drive is simply a collection of electronic components.

Just as the software on a PC can have problems, so the firmware can also cause a hard drive to fail if it becomes lost or corrupted. Statistical analysis shows that up to 60% of hard drive problems are due to firmware failure. Firmware problems can arise from a range of causes:

- Instability or failure of electronic components
- Accidental or inadvertent removal of power to the drive
- Deterioration of the magnetic response of the data recording surfaces

The latter cause is virtually inevitable over time, and the deterioration will accelerate the longer or more intensively the drive is used. Additionally the disk manufacturing process is not 100% perfect and as a result disks will commonly leave the factory already having problems with certain areas of the disk. These areas where the drive has problems correctly reading data from the disk are known as 'Bad Sectors'. Sectors that fail simply because the data stored on them has become corrupted are known as 'Logical' bad sectors and these can be 'repaired' by re-recording the data correctly or in the correct format, however areas with problems arising from the magnetic response of the disk surface failing are known as 'Physical' bad sectors, and these cannot be repaired. Bad sectors of either kind can occur both in the data storage area of drive, but also in a 'reserved' area dedicated to storage of part of the drive firmware called the 'Service Area'. User data area bad sectors can cause the loss or corruption of data files or reduced performance of the drive, bad sectors in the firmware area can lead to the drive failing completely. As the firmware area needs to be accessed every time the computer is switched on and every time drive is accessed, the chance of bad sectors becoming a problem in this area is consequently higher.

Part of the data stored in the firmware Service Area is the so-called 'P-List'. This is a list of known bad sectors detected as part of the post-manufacture testing process. Any sectors recorded in the P or 'Production' List will not be used for the storage of data, the firmware will automatically arrange the data around them. Additionally where the drive firmware detects further bad sectors arising from the normal day-to-day use of the drive, these sectors will be progressively added to a 'G-List' or 'Grown' list (again stored within the service area) and again these sectors will be avoided, with the firmware arranging data around them. This

process takes place automatically, with the user largely if not completely unaware that it is being carried out.

Where firmware has suffered logical defects, the HD Doctor range of drive restoration tools can be used to diagnose and repair such problems. However where problems arise that are mainly due to physical defects then recovery of user data will be difficult if not impossible without the use of Data Compass.

As previously stated, bad sector problems only worsen every time the disk is accessed, and the intensive read actions required to attempt to recover usable files from a disk are likely to be particularly detrimental, with a vicious cycle of ever increasing risk of data loss. On common approach used to overcome this problem is that of 'cloning'. This involves taking an exact image of the disk contents, and then recovering the data from this cloned image rather than the original disk. Data Compass is particularly effective in producing such disk 'images' even from disks with serious bad sector problems.

Where the firmware, or the individual portions of 'microcode' or 'Modules' that make up the firmware become corrupted, this will often be indicated by either the drive not being detected correctly by the host PC (possibly shown as incorrect drive model, or with incorrect capacity displayed), or by being not detected by the PC at all. The HD Doctor tools can be used to correctly diagnose and repair such problems. The tool will allow the firmware modules to be tested or their content examined visually for defects, and where they are found to have problems they can be reloaded using 'good' modules obtained either from copies taken from matched 'donor' drives, or from libraries of firmware available for registered customers to download. However the subject of firmware is a complex one and firmware 'architecture' varies widely between different drive manufacturers and

even between different drive ranges from the same manufacturer. Thus it can be difficult for a technician to become proficient in firmware repair without considerable experience or training.

Instances will also arise where firmware modules have been checked and found to be faulty and where, on uploading known 'good' copies back to the drive and re-checking the modules, they are still shown to be faulty. After repeated unsuccessful attempts to repair such modules, it may become rapidly evident that the faulty modules are arising due to physical defects in the firmware Service Area. Such defects cannot be repaired, and would, until the arrival of Data Compass have meant that drives suffering such problems would have been thought irrecoverable.

Data Compass has the ability for the complete range of Hitachi drives, to do away with the need to repair drive firmware and access the data directly to recover files. This is possible because the Data Compass has stored internally the complete range of Hitachi 'Analog' firmware necessary to take over the critical functions and directly control the operation of drive so that data can be accessed and recovered without the need to repair the firmware at all.