

PerfectDisk's SMARTPlacement™

This paper explores the various aspects of Perfectdisk's SMARTPlacement technology.

The word random has a negative connotation; it implies disorder and a lack of discipline. This is why something that is well thought out and executed is generally preferred over something that is random. When you shop for groceries, you make a list; you don't randomly grab things off the shelf. You pray the bank doesn't randomly debit your account; and you probably would not file important papers randomly in a file cabinet. These are just some things in life where you want order instead of chaos, and this is certainly true on your disk drive.

NTFS and the Windows Disk Defragmenter (WDD)

The Windows file system is somewhat random. When it creates or extends a file it looks for available space on the drive and places the file wherever it finds space. If it can create the file in one piece, that's great. If it creates the same file in 100 pieces, that's OK too. As a result, the location of any given file on the disk is random.

The same kind of random behavior applies to the Windows Disk Defragmenter (WDD). Its goal is to try and defragment as many of your data files as it can, paying very little attention to anything else. When it finishes, most of your file may be defragmented, but they are randomly scattered all over the disk. Data files are in among system files, metadata files and directories. Files that change frequently are intermixed with files that rarely change. Worst of all, from a system performance standpoint, the remaining free space is splattered all over the disk in a very random fashion. This kind of random file placement causes unneeded disk accesses, wastes disk space, and uses excess resources with each successive defragmentation.

PerfectDisk and SMARTPlacement

PerfectDisk's SMARTPlacement™ technology is a patented file placement strategy that intelligently places files on the disk for performance, or drive health purposes. SMARTPlacement uses several criteria to determine where it should place a file and where to put the free space. The net benefit of SMARTPlacement is that it creates a disk that minimizes unnecessary disk accesses, makes the best use of disk space and reduces the time and resources needed on subsequent defragmentation passes. To explain how SMARTPlacement works, we need to look at the different kinds of files on the disk and how PerfectDisk treats them.

- **Boot Files-** are files the operating system uses in the boot, or startup process. PerfectDisk defragments these files and SMARTPlacement usually locates them at the front of the disk near the Master Boot Record (MBR). This results in faster boot times. WDD attempts to keep boot files together on the drive; but over time will fail due to its inability to consolidate free space in the area where it wants to place the files. In addition, the WDD has no ability to place these files near the MBR.
- **Master File Table (MFT) /Reserved Zone -** is the index to the disk volume and the Reserved Zone is an area immediately adjacent to the MFT that allows the MFT to grow without fragmenting. Only PerfectDisk ensures that the MFT and the Reserved Zone is located 3GB of the way into the volume - which according to Microsoft delivers an additional 5-10% performance improvement with NTFS. This makes sense when you consider the MFT is accessed for every file request. If the index is located amid the data files, the seek distance is roughly half of what it would be were the MFT on the outer perimeter of the disk. The WDD defrags the MFT and places it wherever it can find room. In other words, its location is random.
- **System Files-**are special system files that cannot be moved online, notably the page file (on all systems) and the hibernate file (on workstations). The page file is part of the operating system's virtual memory system and it is usually 2-3 times the physical memory in size. The hibernate file is created when you opt to shut down a workstation in hibernate mode. The size of the hibernate file is equal to the size of physical memory. With today's systems, these two files can be very large and they fragment. PerfectDisk's offline defragmentation defrags these files and SMARTPlacement positions them roughly in the center of the disk. As with the MFT, these files can be very active and this is an ideal locality to minimize their disk I/O. The WDD does nothing with the system files; it leaves their unmovable fragments randomly scattered all over the disk
- **Metadata Files-** are special files related to the Windows file system and are placed 1/2 way into the drive on drive format. Several of these files cannot be moved online, but they can be moved with a PerfectDisk offline defragmentation. SMARTPlacement maintains

these files in the middle of the disk for NTFS performance and reliability. The WDD does nothing with the metadata files; it leaves their unmovable fragments randomly scattered all over the disk.

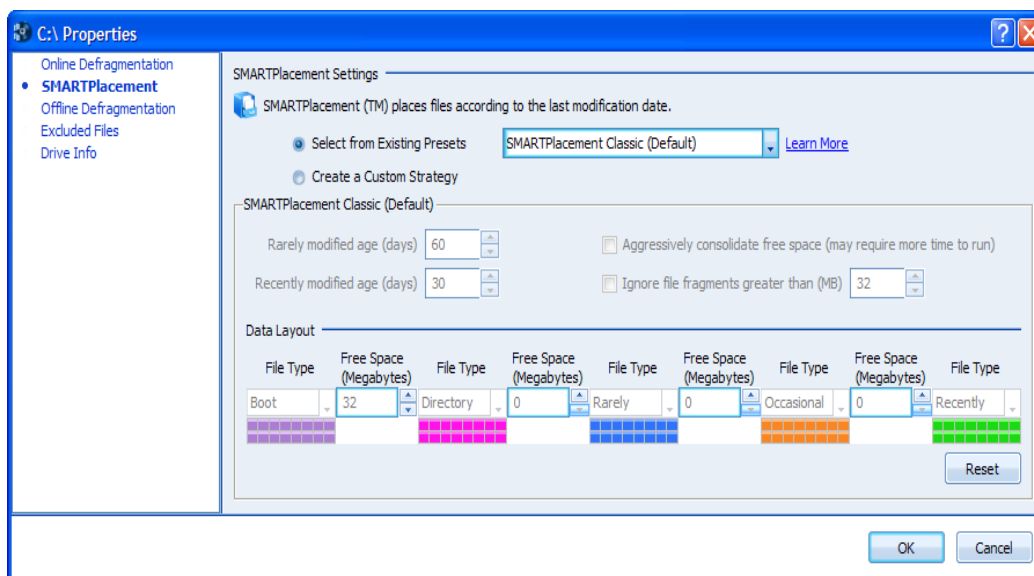
- **Data Files-** are user files and represent the largest portion of the total files on a disk (at least after some use) and SMARTPlacement divides these files into three categories based on their frequency of change. The categories are:
 - **Rarely Modified** files are files that have not changed in 60 days (default). These files are defragmented and SMARTPlacement groups them together. If these files remain unchanged, the next time PerfectDisk runs these files are already defragmented, and they are right where PerfectDisk wants them to be. As a result, the Rarely Modified files do not need to be moved. This means subsequent defrags take less time and use fewer resources because there is less work to do.
 - **Frequently Modified** files are files created or changed in the last 30 days (default). These files are generally placed adjacent to contiguous free space to minimize re-fragmentation. The next time PerfectDisk runs it is easy to marry any file extents with the original piece of the file, since it is nearby. This also minimizes file movement in the defrag process. If files have been deleted, the resulting free space “hole” can easily be merged with the contiguous free space, maintaining its integrity and allowing better “packing” of files on the disk.
 - **Occasionally Modified** files are files that don’t meet the requirements to be categorized as Rarely Modified or Frequently Modified. PerfectDisk waits to see if these files migrate to one of the other categories, or if they are deleted and become free space. The WDD does not categorize files and has no intelligent file placement of any sort.
- **Directories-** are the folder files that contain data files. PerfectDisk defragments NTFS directories and SMARTPlacement groups them together.

In addition to defragmenting all the Windows file types, PerfectDisk consolidates the free space on the disk into the largest possible chunks with its Space Restoration Technology™. There are three benefits to free space consolidation. First, it reduces the number of unnecessary physical accesses to the disk. When the file system can find adequate free space, it can write to the disk in fewer accesses. Contiguous free space improves file write speed in the same way file defragmentation improves file read speed. Secondly, it slows refragmentation. Fragmented free space exacerbates file fragmentation. Fragmentation is the problem we are trying to fix, not foster. Thirdly, free space consolidation maximizes the usable space on the disk.

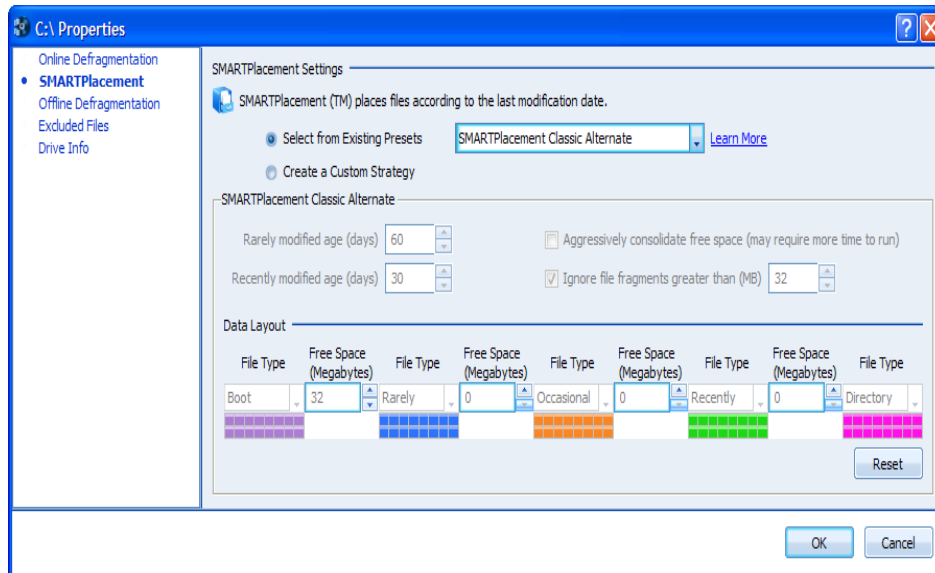
SMARTPlacement Options

PerfectDisk offers its users several SMARTPlacement options that can be used on a disk-by-disk basis to tailor your storage needs. The options available are:

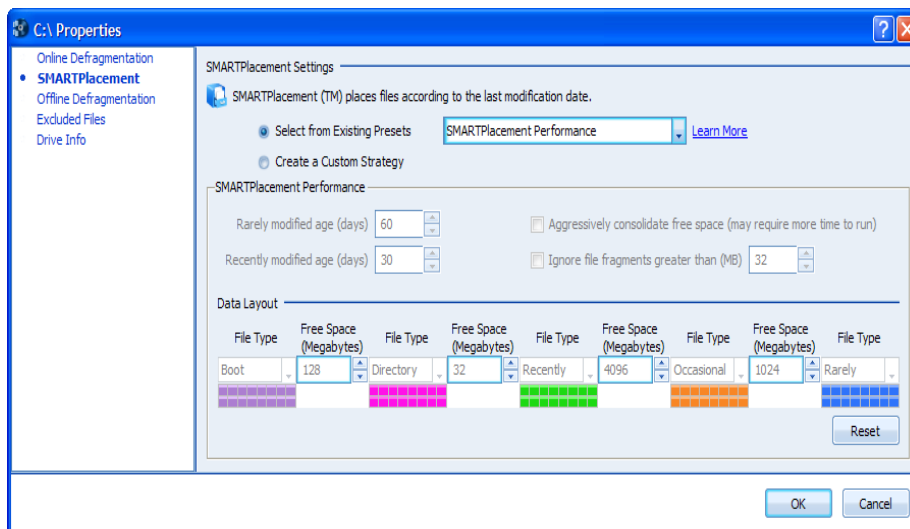
- SMARTPlacement Classic (Default) - This setting is designed to provide the best balance between file performance, improved boot times, and preventing re-fragmentation. The boot files are placed at the front of the disk followed by Directories, Rarely Modified, Occasionally Modified and Recently Modified files. The remaining free space is consolidated at the end of the disk.



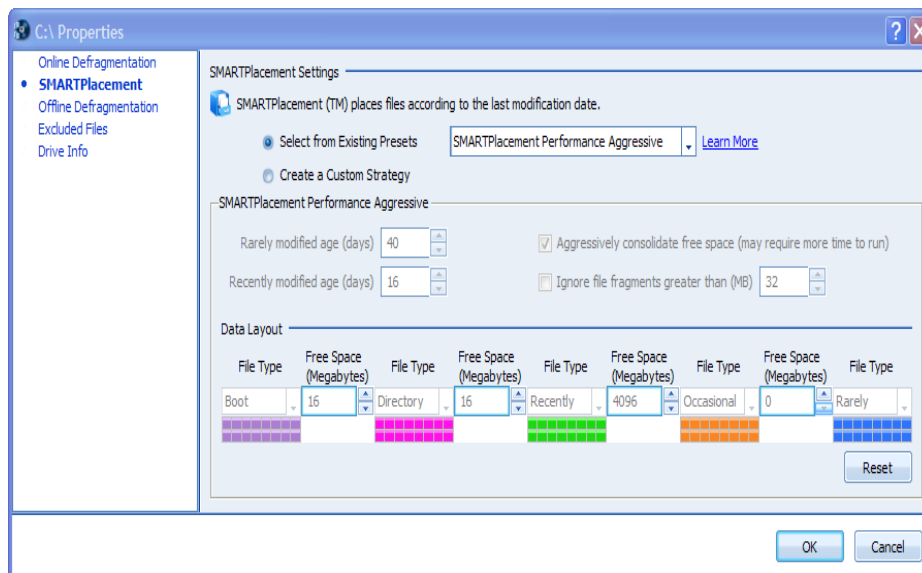
- SMARTPlacement Classic (Alternate)- This setting differs from the default Classic in that the Directories are placed at the end of the files, between the Recently Modified files and the consolidated free space. Classic Alternate also ignores file fragments over 32MB, which improves large file defragmentation performance.



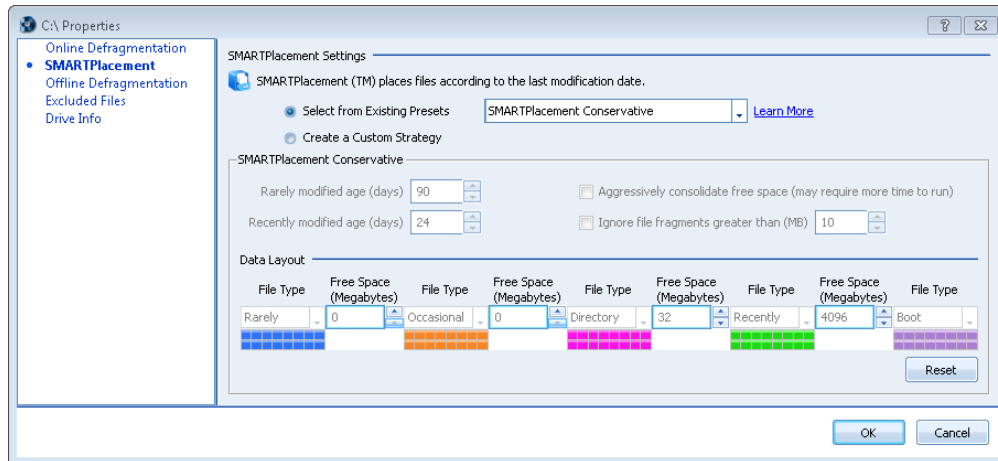
- SMARTPlacement Performance- This setting places a greater emphasis on improving the performance of frequently used files and the boot files, and less on fragmentation prevention. At the end of the Occasionally and Recently Modified files there are free space gaps of 4GB and 1GB respectively. Rarely Modified Files are positioned between the Boot and Occasionally Modified files. Directories are placed at the end. This setting also ignores fragments greater than 32Mb to improve large file defragmentation performance.



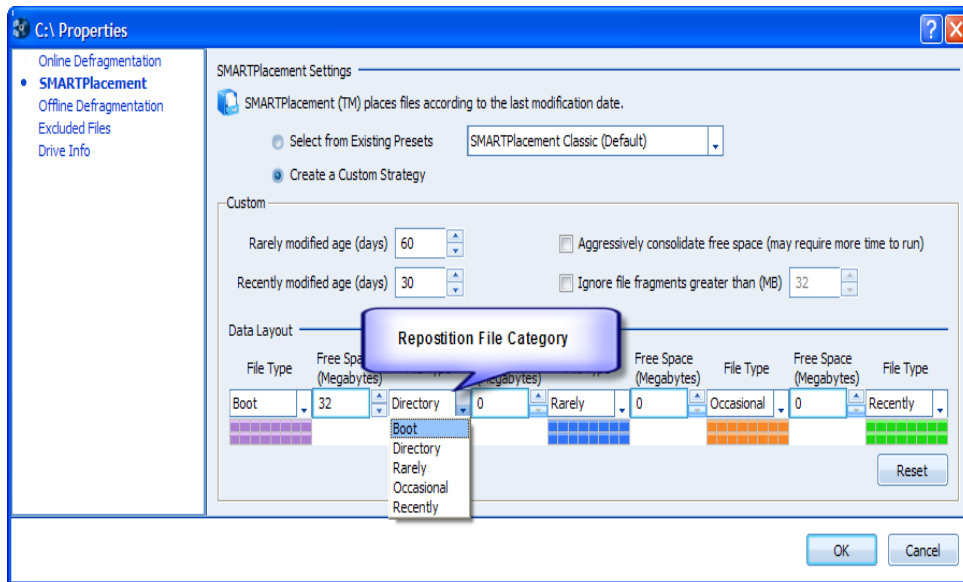
- SMARTPlacement Performance Aggressive- This setting takes even more aggressive steps to improve performance of frequently used files. The file aging dates for classifying Rarely and Recently Modified files changes to 40 and 16 days respectively. This means PerfectDisk will move files to their appropriate category faster. The Occasionally Modified files are followed by a 4GB gap so they can grow organically, and file fragments greater than 32MB are ignored to improve large file defragmentation performance.



- **SMARTPlacement Conservative**- This setting places more emphasis on drive health and less on performance. The aim of the Conservative option is to minimize re-fragmentation and reduce the workload on physical devices. The file aging dates for classifying Rarely and Recently Modified file changes to 90 and 24 days respectively. This means PerfectDisk will take longer to move files to their appropriate category. This setting ignores file fragments greater than 10MB.



- **Custom Strategy**- This setting lets the user define their own file placement strategy. Users can specify the file aging criteria for Rarely and Recently Modified files, reposition the five file categories, specify the buffer zones adjacent to each category and define the minimum size of fragments you want PerfectDisk to ignore.



Summary

There is an old adage that says, “Failure to plan is a plan for failure.” The default SMARTPlacement Classic setting still delivers an excellent balance of performance and fragmentation prevention. Over the years PerfectDisk has been lauded for its incredible flexibility. The ability to customize SMARTPlacement is in keeping with this approach and providing the user with options. The variety of customer applications and workloads dictate that there might be “better fit” file placement options in certain circumstances.

Whether you stick with the default setting or opt for one of the other SMARTPlacement options, the ultimate goal of these strategies is to provide good overall system performance, make the best use of disk space, prevent most fragmentation before it happens, reduce excessive I/O and minimize the time it takes to defragment the disk.

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About Raxco Software

Raxco Software has been helping large enterprises, small businesses, and consumers with their computer resource management needs for over 30 years. Its PerfectDisk is Windows® Certified by Microsoft®, and optimized for Windows 7. The PerfectDisk line has a long award-winning history, most notably its perfect 5-star review from CNET Download, winner of the *Windows IT Pro* Readers' Choice Awards for Defragmentation Utility and Storage Management Tool, and Redmond Magazine's Best of the Best Award, and having won PC Magazine's Editors Choice award multiple times. In addition to its PerfectDisk line, Raxco also produces PC optimization software for Windows operating systems and HP's OpenVMS operating system. Raxco Software can be found on the Web at www.raxco.com.

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